Heavy Metals Program
Situation Report
January 1967

GOLD PLACERS
OF THE
NOME COASTAL PLAIN

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Introduction

The gravels that underlie the coastal plain at Nome (figs. 1-2) probably constitute the largest gold placer deposit in Alaska. Gold is unevenly disseminated more or less throughout the coastal plain gravels. Average grade apparently is greatest in the Nome River-Snake River area. Reworking of the disseminated deposits during periods when the sea level was both higher and lower than at present formed placer concentrations in stream channels at stream mouths, on beaches, and on offshore bars. Only such concentrations have been considered minable, but in some areas, gold from the overlying gravels added appreciably to the recovery.

The United States Smelting Refining and Mining Co. and predecessor companies operated bucketline gold dredges on the coastal plain for over 50 years. Mining ceased during the past 10 years because the continuing rise in operating costs made other investments more attractive. Operations included extensive sampling. Results are confidential, but responsible managing officials of the USSR&M Co. state that known reserves are adequate for many years of operation on about the same scale as in the past. Publicly available information is inadequate to make even a rough estimate of the average grade or the total amount of gold remaining. Recently, the Geological Survey announced a cooperative project with the USSR&M Co. which presumably includes re-evaluation of sampling results and computation of reserve data.

Location

Nome, Alaska (figs. 1-2) is centrally located on a crescent-shaped coastal plain that extends about 30 miles along the Bering Sea coast and about 4 miles inland. Gold can be panned on the present beach from one end of the crescent to the other, but most of the productive gold placer deposits of the coastal plain have been found within 5 miles of Nome.

Geology[1/]

> "The coastal plain at Nome, Alaska, is underlain by the most complete sequence of Pleistocene marine and glacial sediments known in the American Arctic. Three marine stratigraphic units (Submarine Beach, Third Beach-Intermediate Beach, and Second Beach) record at least three distinct intervals during which sea level stood as high or higher than at present and during which sea temperatures were warmer than at present. A fourth interval of high sea level may be represented by 'Fourth Beach' at the inner edge of the coastal plain. Glacial drift of the Iron Creek (Nebraskan or Kansan) glaciation and of the Nome River (Illinoian) glaciation separates the three marine units, and outwash, alluvium, colluvium, wind-blown silt, and peat that accumulated during Wisconsin and Recent time cover the glacial drift and the youngest of the marine sediments.

1/ See bibliography.

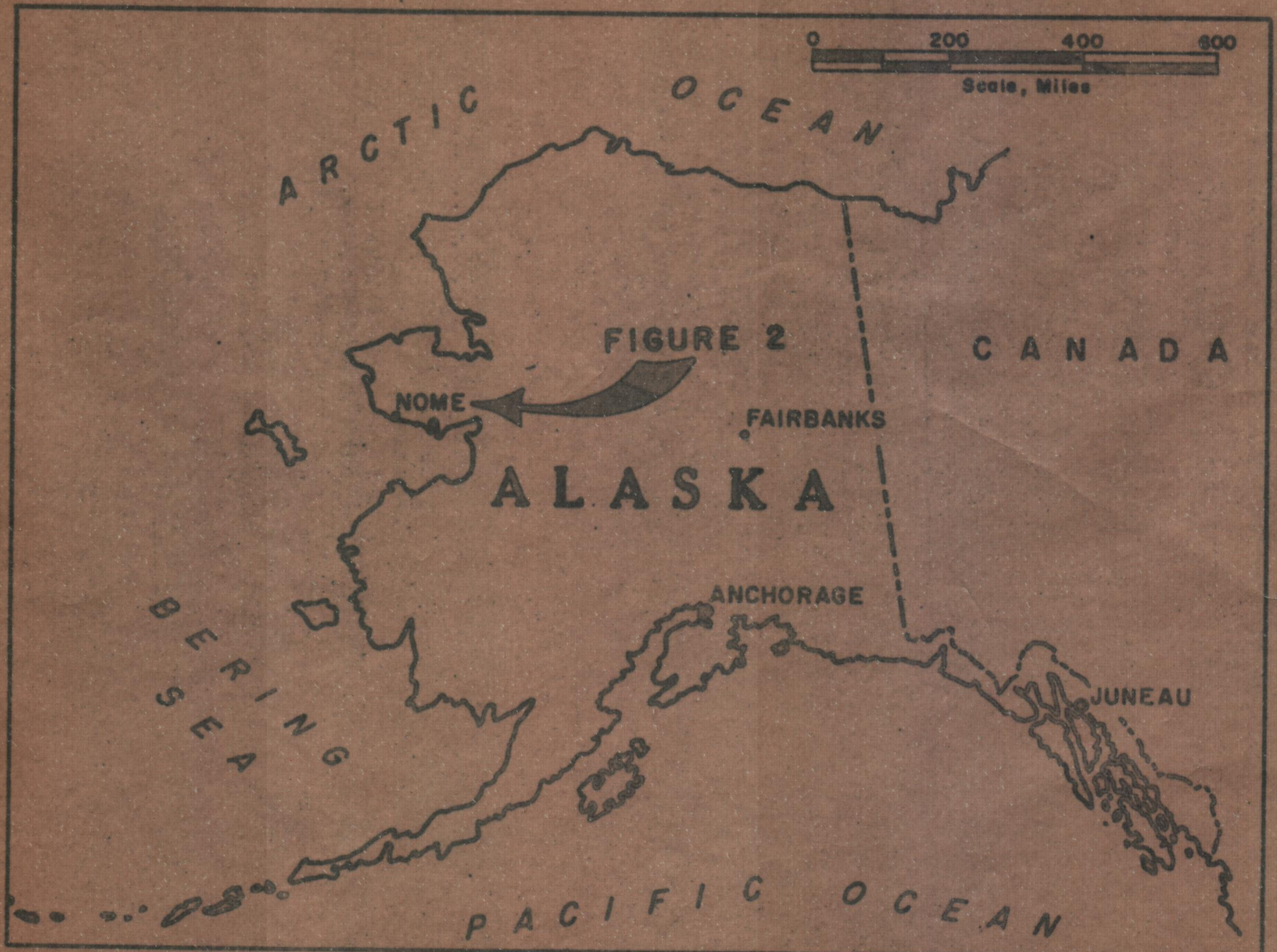

FIGURE 1.- Index Map of Alaska.

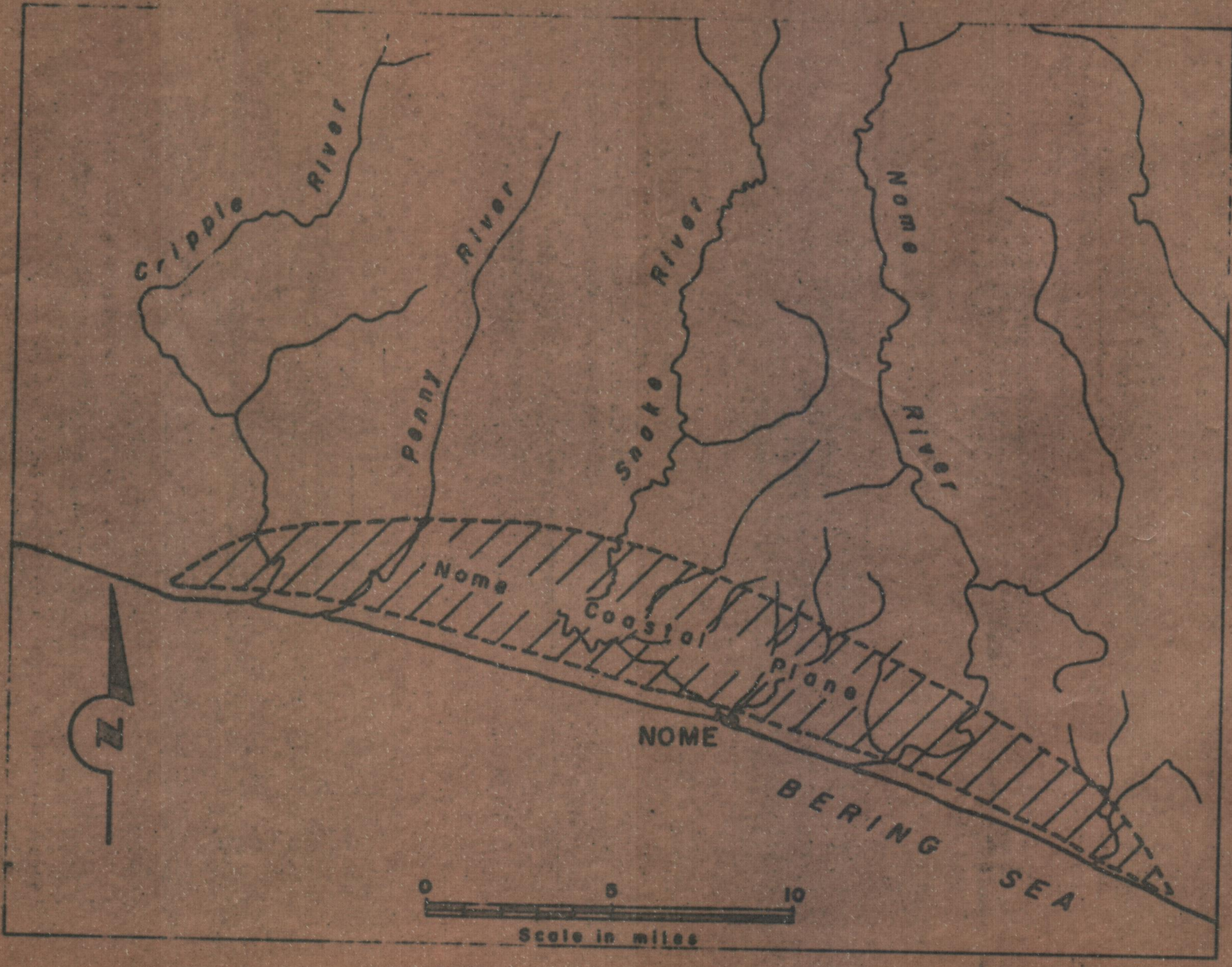

FIGURE 2. - Nome Coastal Plain.

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"The shallow continental shelf beneath the Bering Sea probably was a land area until crustal warping created the present marine basin in Late Tertiary time. The earliest late Cenozoic marine encroachment in the Nome area is recorded by the sediments of Submarine Beach, probably of late Pliocene age; sea level than lay at an altitude that exceeded -20 feet by an unknown amount.

"Later, sea level rose to form Fourth Beach, possibly during the Aftonian (First) Interglacial; Fourth Beach now lies at an altitude of 120 feet. Sea level fell, and the coastal plain was invaded by ice during the Iron Creek glaciation which may be of either Nebraskan (First) or Kansan (Second) glacial age. After the ice withdrew, sea level rose again during the Yarmouth (Second) Interglacial to form Third Beach and the associated offshore deposits known locally as Monroeville and Intermediate Beach; sea level probably lay somewhat higher than 75 feet during Third Beach time. During the Illinoian (Third) glacial, the coastal plain was again invaded by ice of the Nome River glaciation. The ice once more withdrew, and sea level rose 35-40 feet above its present position to form Second Beach of Sangamon (Third) Interglacial age.

"Sea level fell well below its present position during the Wisconsin (Fourth) glacial age. Ice did not reach the coastal plain at Nome, but a thin mantle of loess was deposited everywhere, and intense frost action resulted in the movement of colluvium that now masks the original glacial microrelief on the drift of the Nome River glaciation (Illinoian).

"At the end of the Wisconsin glaciation, 9,000 to 10,000 years ago, the summer climate warmed greatly at Nome, and ice wedges that had formed during the preceding glacial interval were removed by thawing. The climate grew cooler again as rising sea level approached its present position and no subsequent large climatic changes can be recognized in the pollen and stratigraphic record at Nome."

Placer Mining

Gold was discovered on Anvil Creek and adjacent streams (fig. 3) in 1898. For many years, these streams were the principal producers in the region. Mining of the coastal plain deposits started when gold was discovered on the present Nome beach in 1899; a great crowd of hand miners practically exhausted the richer concentrations in less than two years. The Second Beach was discovered at about this time; the Third Beach was discovered in 1904, and all of the presently known ancient beaches were discovered and roughly outlined within the next few years.

FIGURE 3. - Ancient Beach Lines, Nome Coastal Plain.

The first dredge was built in 1905 and by 1911 nine dredges were operating in the Nome area. At first, dredging was limited to thawed ground along stream channels. A series of experiments culminated in the patenting of a cold water thawing technique by J. H. Miles in 1920. This development made large-scale dredging feasible in the deep gravels of the Nome coastal plain. Thawing equipment and methods developed at this time continued in use practically unchanged until the close of operations in 1962. Meanwhile, a steady refinement in the construction of dredges and recovery plants culminated in the building of a jig-type bucketline dredge that was placed in operation on the Submarine Beach in 1957. Unexpectedly high thawing and digging costs apparently made the operation of this dredge unprofitable despite a highly efficient recovery plant. The dredge on the Submarine Beach was shut down in 1961, and all dredging on the Nome plain ceased in 1962.

The gold production of the Nome district from the beginning of mining until the present is listed in table 1. Production of both the adjacent creek placers and the gravel plain placers are included. Since the 1930's most of the gold has been produced by bucketline dredges on the coastal plain. Normally, three dredges with 9-cubic-foot buckets were operated .

Comparison with thawing costs in the Klondike and other areas indicates that thawing costs in the Nome area may have been 20 cents or even more per cubic yard; at least half of the value of recovered gold, and probably more than half. Other costs apparently were only slightly higher than dredging costs in warmer climates.

Table 2 shows the number of days per year that the dredges worked from 1936 to 1940, a period of high and profitable productivity. The dredging season is determined by the availability of water and by the buildup of ice in the dredge ponds. Only the top few feet of thawed ground freezes. The digging and recovery plant on a dredge can be protected from cold, but the dredge hull swinging back and forth breaks the ice on the pond and pushes it into piles that refreeze on the side of the dredge pond until the dredge no longer has room to swing. Note that dredges can work about 170 days per year, but that the season when weather is warm enough for efficient cold water thawing will not exceed 90 to 100 days. Therefore, the amount of ground thawed per day must be almost double the dredging rate.

TABLE 1. - Total gold production, Nome district, Seward Peninsula, Alaska

	Gold	
	Ounces	Value
1898-1930	3,275,626	$ 67,707,200
1931-32, @ $20.67	99,826	2,063,403
1933, @ $25.56	41,670	1,065,085
1934, @ $34.95	63,031	2,202,933
1935-60, @ $35.00	909,007	31,815,245
1960-65, @ $35.00	91,567	3,204,845
Total, Nome district	4,480,727	$108,058,711

TABLE 2. - Dredging season, Nome district, Seward Peninsula, Alaska, 1936 to 1940

Year	Starting Dates	Number of Dredges	Total Dredge Days	Average Days Per Dredge
1936	May 17	3	515	172
1937	May 28	3	510	170
1938	May 23	3	468	156
1939	Missing	3	483	161
1940	May 12	3	567	189
Average length of dredging season				5)848 170

Recommendations

The Bureau of Mines has started a program of research designed to lower the costs of mining the permanently frozen placer deposits of the Nome coastal plain. The large, modern bucketline dredges are such efficient mechanisms that there seems to be little chance of significantly lowering digging and recovery costs. The only other item of expense large enough to be significant is ground preparation. The use of giant rippers, huge mechanical breakers, or other modern techniques may have promise, but seem inherently too costly for use on these deeply buried, relatively large, low-grade gold deposits. In any case, the best chance to make an immediate gain in minable reserves is to lower the costs of proven ground preparation methods.

The greatest single cost item in ground preparation is thawing. The cost of thawing deep ground is directly related to the difficulty of placing thaw pipes vertically downward to bedrock. Water at about 45° to 55° F is pumped to bedrock. As it makes its way upward, it warms and thaws the ground and emerges at about 37° to 40° F. In the Nome beach deposits, the points cannot be driven but must be set in holes drilled to bedrock. The high cost of drilling makes it necessary to use maximum spacings. Current practice is to space holes 32 feet apart in all directions; the maximum spacing that will thaw the ground in a single summer. Under average conditions, points on 16-foot centers will thaw ground in about 2 weeks while 10 to 12 weeks are required to thaw ground with points on 32-foot centers.

The current practice is to drill the holes for thaw pipes with churn drills during the winter. Hooking up the pipes and keeping circulation going is a tremendous job that requires a large crew of unskilled laborers throughout the thawing season; ordinarily the summer season is well advanced before the thaw fields are working efficiently. Since 10 to 12 weeks is practically an entire thawing season, the amount of plumbing equipment necessary to thaw gravel for a dredge digging 5,000 to 10,000 cubic yards per day for 170 days per year represents a very considerable investment.

Thawing labor costs could be lowered if a mechanical device could be developed that would efficiently place thaw pipes in the gravels. The gravels of the Nome coastal plain are derived in part from glacial outwash and contain a high proportion of rounded hard cobbles and boulders, that so far, have defied all drilling devices except the old reliable keystone-type churn drills. Thaw pipe spacing of 16 to about 20 feet from center to center instead of the 32-foot spacing now used would require about 2 to 3 times as many holes as are used in current practice, but with this spacing the ground could be thawed in one quarter of the time or less with consequent additional savings in labor, thawing equipment, and interest on money invested.

The cost of drilling thaw pipe holes on less than 32-foot centers with churn drills is considered to be prohibitive. The churn drill has not been essentially modified or improved in over 50 years, but has remained in favor in the placer mining industry because it is a reliable and efficient sampling device. It seems probable that a better drill can be developed for use when it is only necessary to make a 2-inch vertical hole and insert 1-inch thaw pipe.

It is intended that the Bureau of Mines cooperate with the United States Smelting Refining and Mining Company to develop a modern thaw field drill and to improve thawing practices and ground preparation equipment in general. Tests would be conducted on the so-called "Submarine Beach deposits" at Nome, Alaska. Bureau of Mines and company engineers would cooperate in designing the tests and evaluating the results. The Bureau would publish the results as an information circular. The company has agreed to cooperate in the proposed project.

The ultimate objectives of the cooperative project would be to lower direct thawing costs and to develop methods that would make gold recovery possible within one year after starting to drill thaw pipe holes, thus lowering investment costs. If deep dredging ground can be thawed without the necessity of winter drilling, this alone will reduce costs considerably. Other phases of the work besides drilling the holes obviously will have to be speeded up, but a cheap high-speed method of drilling or otherwise placing thaw points is the essential key to all other improvements.

The Submarine Beach deposits are believed to be ideal for testing purposes for four reasons. The first reason is that two large beach deposits of placer gold are overlain by a gold-bearing overburden. The grade of these deposits is thought to be ample for mining at a profit under present conditions if the engineering problems can be solved. The second reason is that the mixture of muck, clay, gravel, cobbles, boulders, and beach sands in this area presents problems so difficult that any technique that works here probably will work in any permafrost area. The third reason is that the Submarine Beach area is adjacent to the city of Nome, the Nome airfield, and the Alaska Steamship Co. docks. Probably, it is more conveniently located with respect to transportation and communication than any other valuable permanently frozen placer gold deposit. The fourth reason is that abundant water is available for thawing. A pump station near the mouth of Snake River was used for many years; a station could be re-established in this area that would furnish an ample supply of water. The sea also is close, if it is desired to experiment with the use of salt water. The high-level ditches that supplied water for mining the Third and Fourth Beach line also are available since no mining is being done at present.

The principal drill manufacturers were contacted during the past two months. The drilling problems involved were outlined and suggestions were requested. The diversity of equipment recommended and the obvious impracticality of most of the recommendations indicates that commercially available drilling equipment developed for other uses is too specialized to be suitable for thaw pipe drilling. The Bureau of Mines will have to modify or improve existing equipment or perhaps develop entirely new equipment for the purpose.

Currently the Bureau of Mines engineers and the engineers of the USSR&M Co. are evaluating data from previous drilling and thawing tests. This data will be used as a basis for detailed recommendations for additional tests.

Although the lowering of ground preparation costs is the most urgent need at the moment, research also is needed to improve methods of locating and evaluating both permanently frozen and thawed placer deposits. Particularly needed are practical geophysical or other methods to delineate the deposits so that they can be sampled economically. The problem is being studied and specific recommendations will be submitted shortly.

Methods for preventing the formation of ice on dredge ponds during the winter also should be considered. Channels in some northern harbors are kept ice-free by placing a compressed air line on the harbor bottom and allowing air to escape. The ascending bubbles form an air lift that continually brings warm water to the surface. This or a similar technique might be used in dredge ponds. The problem should be studied and any technique that seems economically feasible should be tested in the field.

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