521228
92J/15

December 18, 1984

MEMO TO: D.E. Cross

FROM: D.J.T. Carson

SUBJECT: GOLD OCCURRENCE AT GEM PROPERTY

Three polished thin sections (previously examined by Vancouver Petrographics) and five large polished sections of your two samples, A and B, were examined under the microscope. An XRD analysis of each specimen, and several electron microprobe analyses of specific minerals, were also made. Details of the mineralogy and analyses are given below and with the accompanying photomicrographs. Bondar-Clegg analyses of the two samples were as follows:

SAMPLE	Au	Ag	Co	As	U
GEM-A	17.21	2.7	1.33	13.18	.004
GEM-B	21.67	1.0	5.98	31.71	.065

Mineralogy

The eleven sections studied contain an average of about 35% cobaltian arsenopyrite (Co,Fe)AsS containing 8-9% Co, and skutterudite $(Co,Ni,Fe)As_{3-x}$ with about 20% Co. The identifications and mineral compositions were made by electron microprobe operated by E. Clemson. Very minor molybdenite (MoS_2) is also present. Minor cobaltite (CoAsS) and gersdorffite, which is (Co,Fe,Ni)AsS, were reported by VPL but were not identified in this study.

The main non-opaque minerals in the samples are chlorite, quartz, pyroxene, and amphibole. Subordinate carbonate, biotite, apatite, rutile, and chloritoid were also identified optically and/or by XRD.

Occurrence of Gold

The main gold-bearing mineral in the samples is native gold. Associated with the gold, and of similar abundance, is maldonite (Au_2Bi), which contains about 65% Au and 35% Bi. Also associated with gold and maldonite are rare grains of a coppery-coloured telluride(?) which could not be identified.

A total of 71 grains of gold were observed and measured. Seventy of these grains, ranging in size from .5u to 16u in diameter (average diameter=4.6u) and comprising 99.97% by weight of the gold observed, occur as inclusions in arsenopyrite-skutterudite. All the maldonite grains have an occurrence similar to that of gold. One 2u grain of gold occurs on a grain boundary between the outer edge of an arsenopyrite crystal and quartz.

Predictive Metallurgy

The gold-bearing minerals are completely tied up in arsenopyrite-skutterudite, and are very fine-grained. Direct cyanidation of the ground ore would not be successful, even at a costly fine grind (Hemlo is 90%-200 mesh with coarser gold; Horne C-Zone pyrite with similar-sized gold and tellurides was ground to 95%-325 mesh). Also, dissolved arsenic from finely ground arsenopyrite-skutterudite would probably foul the cyanide solutions. Coarse grinding followed by gravity concentration of the arsenopyrite-skutterudite fraction would result in a gold concentration of about 2x, to approximately one ounce per ton. Gold, cobalt, and arsenic recoveries in the gravity concentrate should be +90%. The arsenic content would be about 60% and the cobalt content 10-15%. There could be serious environmental problems caused by smelting or roasting of such a high-arsenic concentrate. Horne smelter could possibly blend in minor arsenic; the Asarco smelter in Tecoma may have accepted such a concentrate but is now shut down. As you mentioned, however, this concentrate might be smelted in Germany, where the gold, arsenic, and (?) cobalt could be recovered.

DJTC/hmc

PHOTOMICROGRAPHS

Abbreviations

au = gold = Au

aspy = arsenopyrite = (Co,Fe)AsS(50%As,25-26%Fe,17-18%S,8-9%Co)

sk = skutterudite = (Co,Fe,Ni)As_{3-x}(79%As,2%Fe,0-0.3%Ni,19-20%Co)

md = maldonite = Au_2Bi (65%Au,35%Bi)

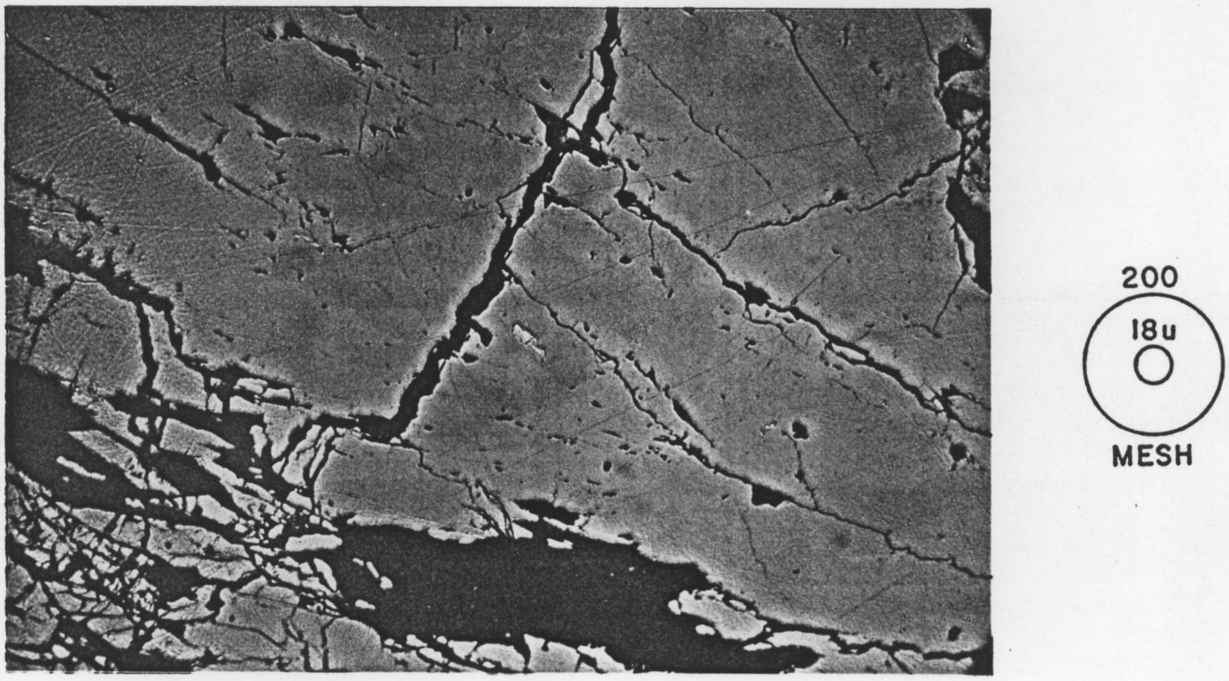
gn = gangue = silicates, carbonate, apatite

Example

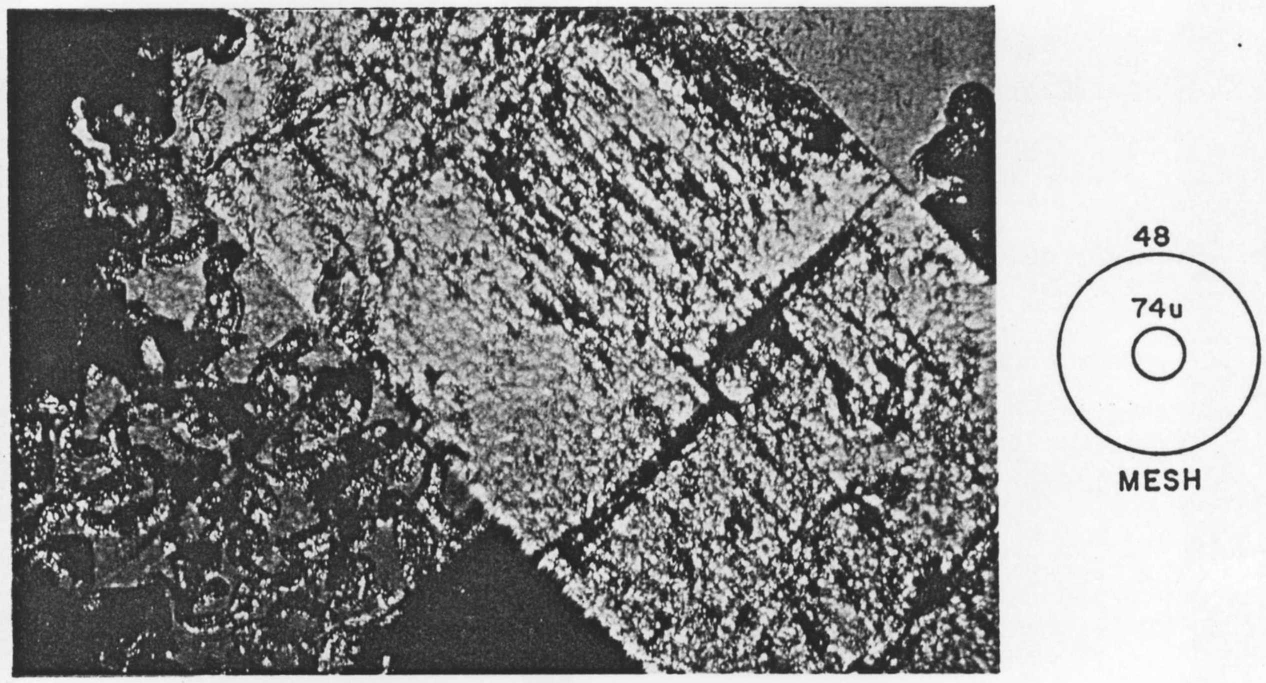
2au/aspy-sk = 4x24u, 3u

two gold grains enclosed in arsenopyrite* and/or skutterudite*, having dimensions of 4x24 microns and 3 microns.

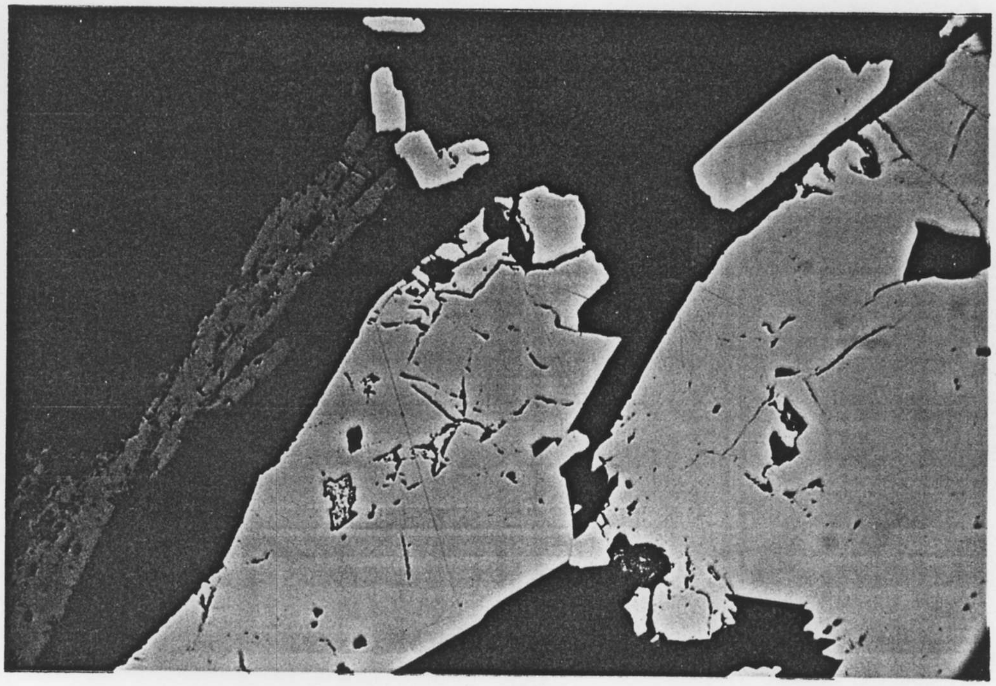
* Note that although several arsenopyrite and skutterudite grains were identified and analysed by the electron microprobe, the two minerals are not distinguished from one another in the photomicrographs and are simply referred to as aspy-sk.



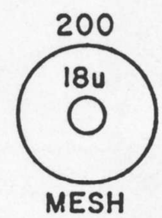
(1) GEM-B Several au/aspy-sk; largest au = 4x24u. Note the different shades of pink and white of arsenopyrite and skutterudite. Black = gn and cracks.

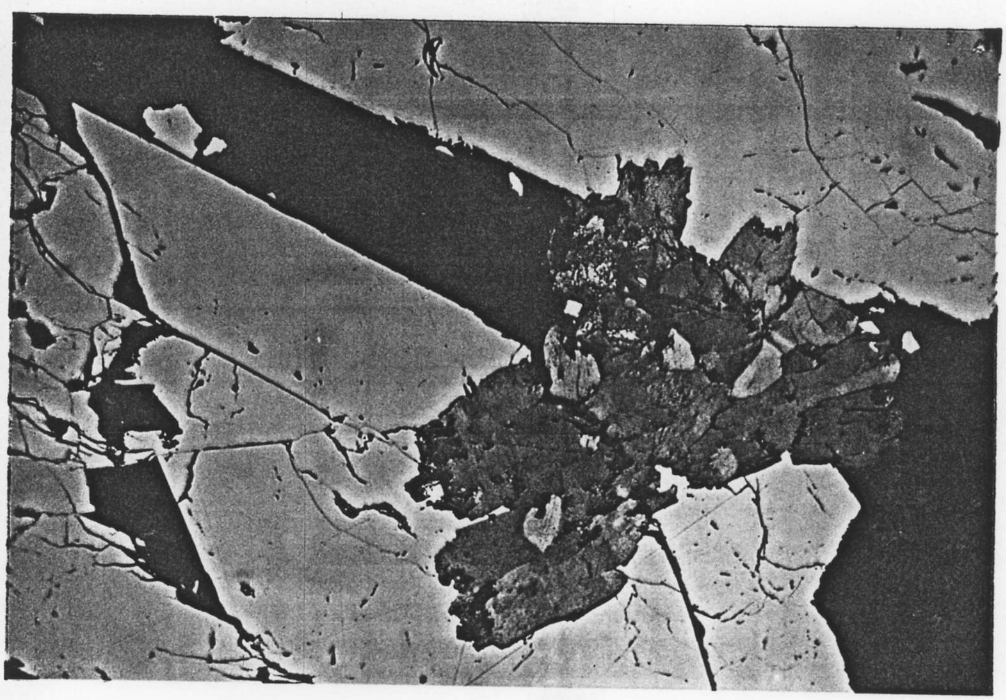


(2) GEM-B Large apatite crystal and smaller crystals of choloritoid, in quartz (green, blue). Polarized transmitted light.

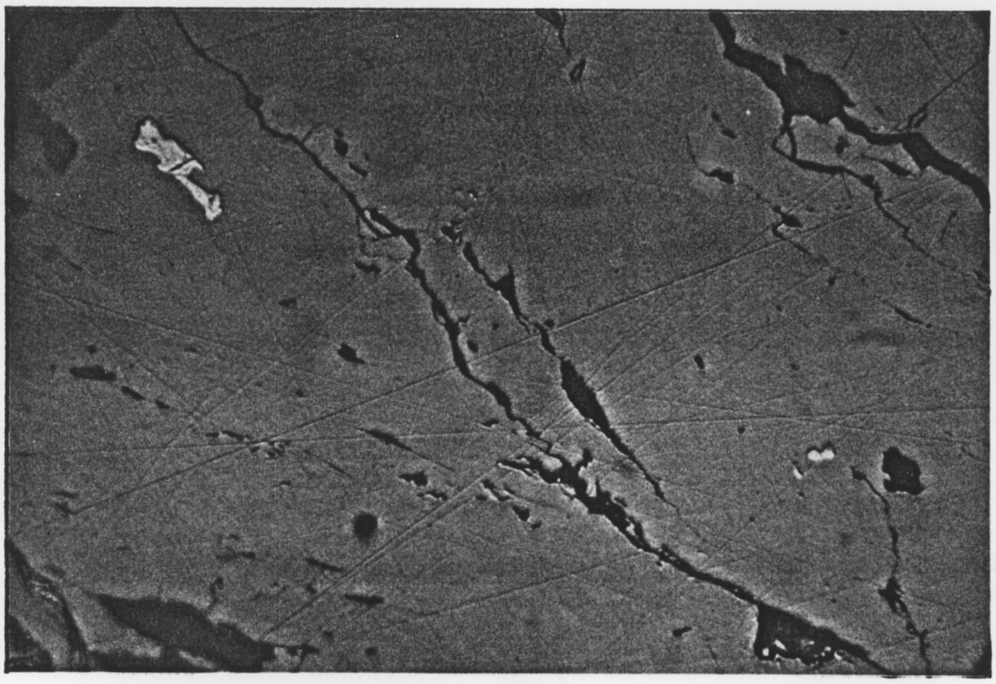


(3) GEM-A White aspy and sk crystals in black gn; grey-blue rutile crystals in gn; maldonite grain (Au_2Bi) in aspy-sk.

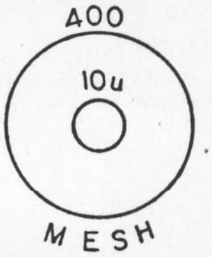


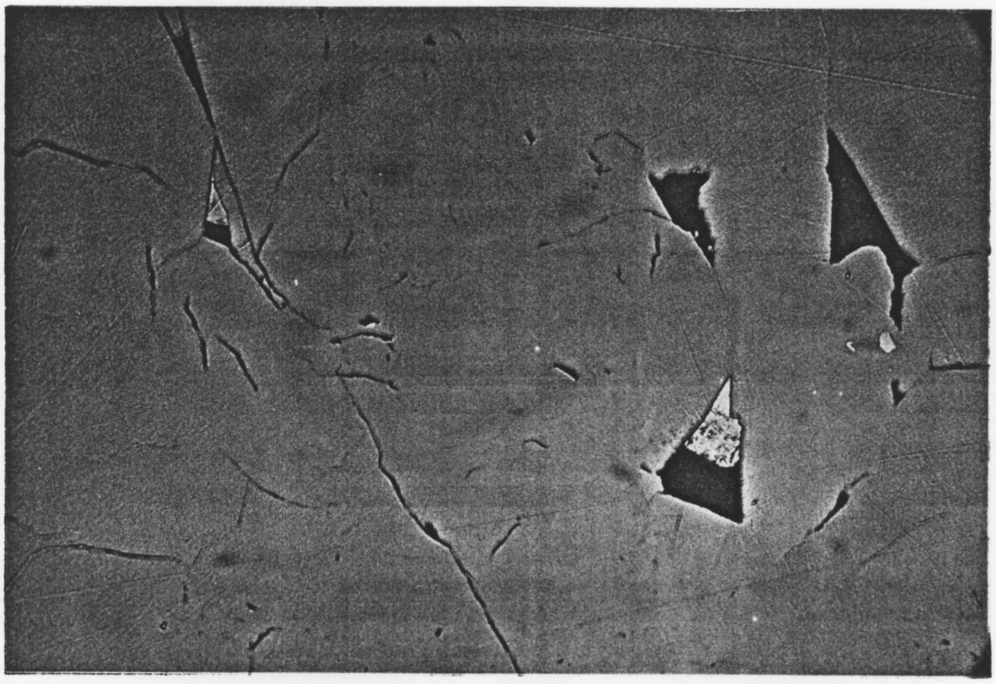


(4) GEM-B Molybdenite crystals intergrown with aspy-sk and gn (black).

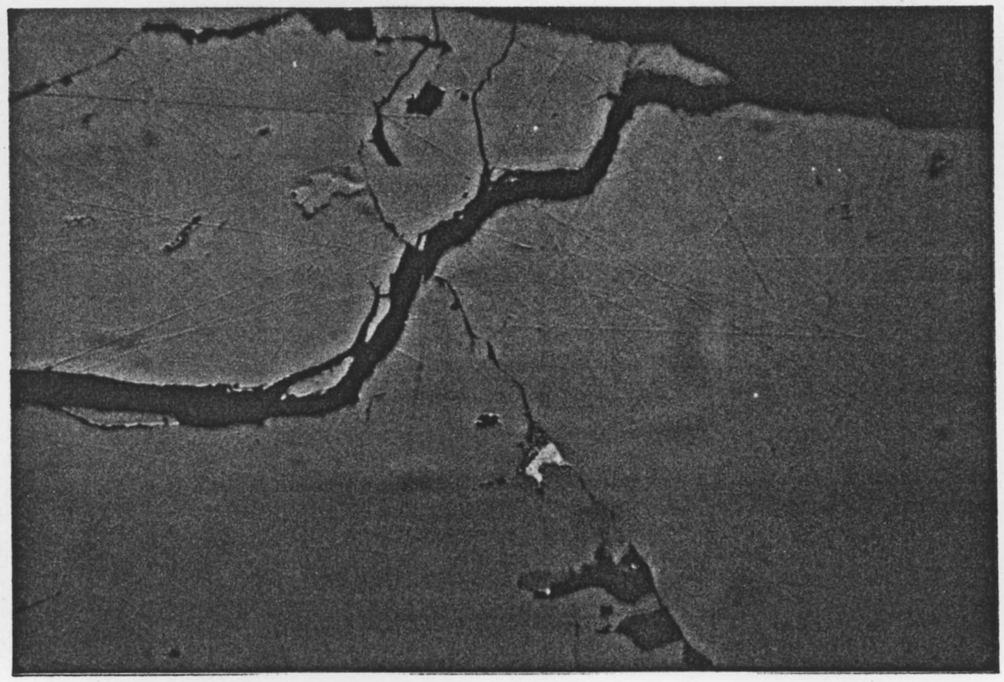


(5) <u>GEM-B</u> 3au/aspy-sk = 4x24u,1u,3u. The same grains are seen in photomicrograph (1).

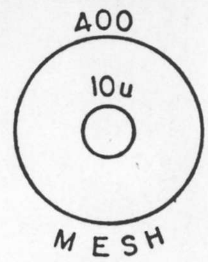


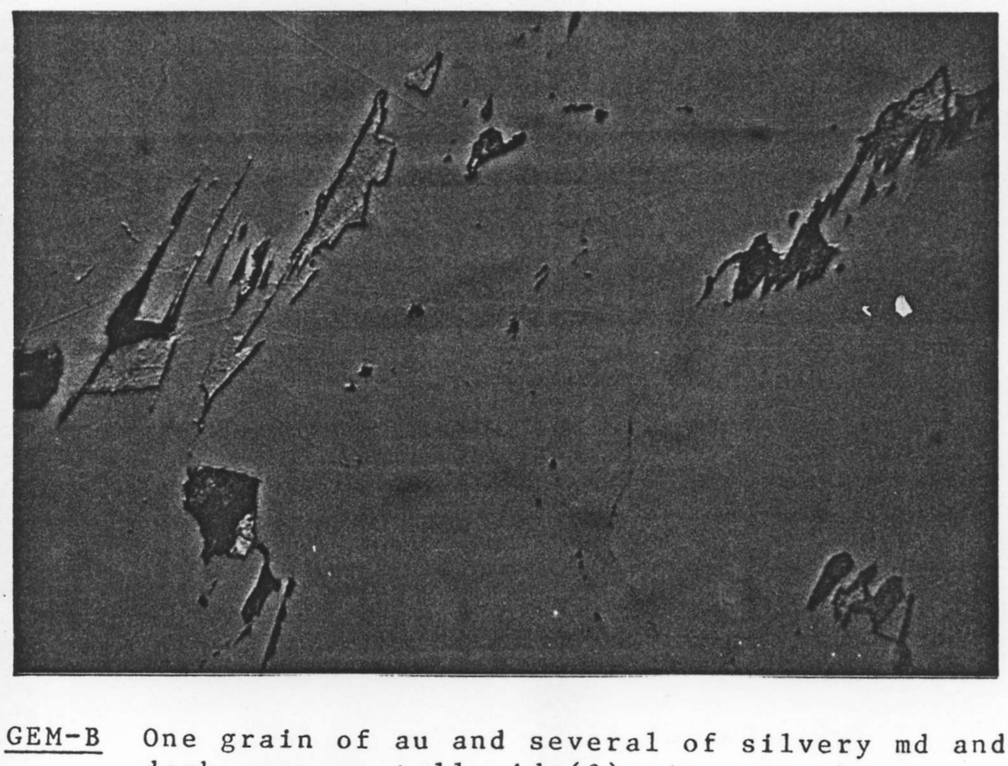


(6) <u>GEM-A</u> 1au(+md)/aspy-sk = 3x5u; the md is silvery and a second grain of md occurs in the upper-left.

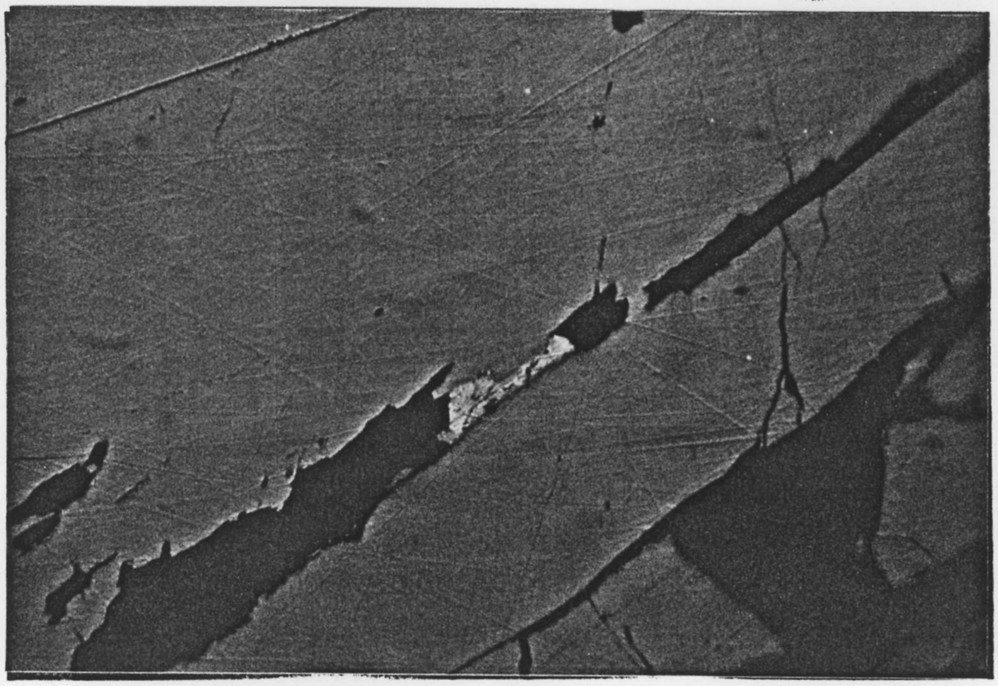


(7) <u>GEM-B</u> 1 au/aspy-sk = 4u; the au is intergrown with a coppery-coloured telluride(?). Grain of silvery md in upper left.

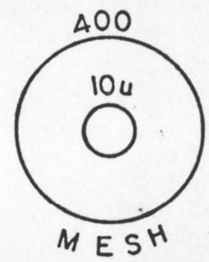


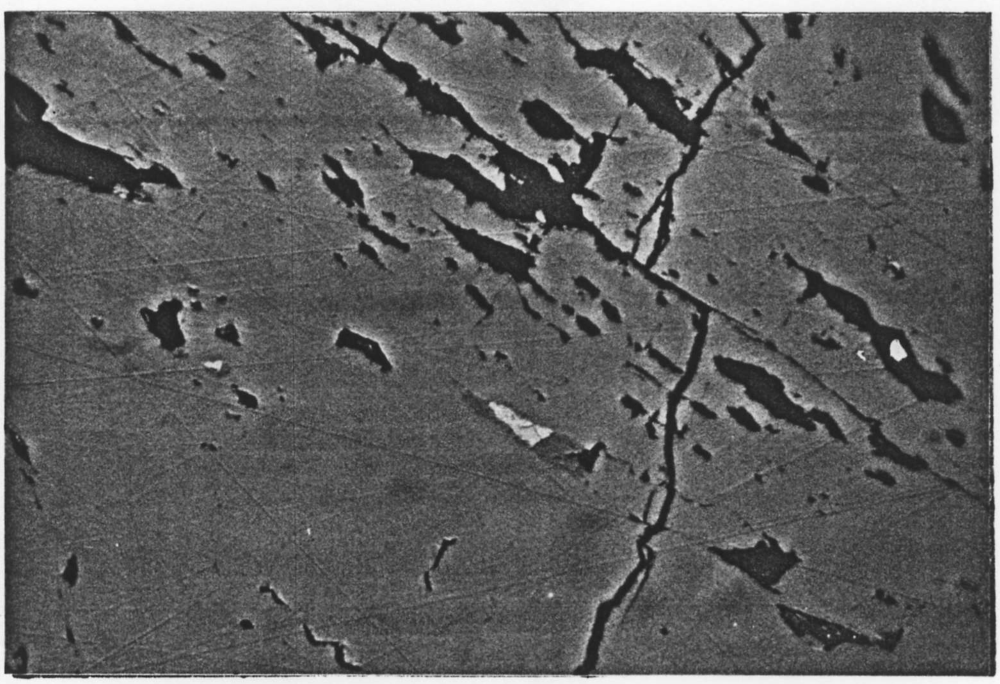


(8) <u>GEM-B</u> One grain of au and several of silvery md and dark coppery telluride(?), in aspy-sk.

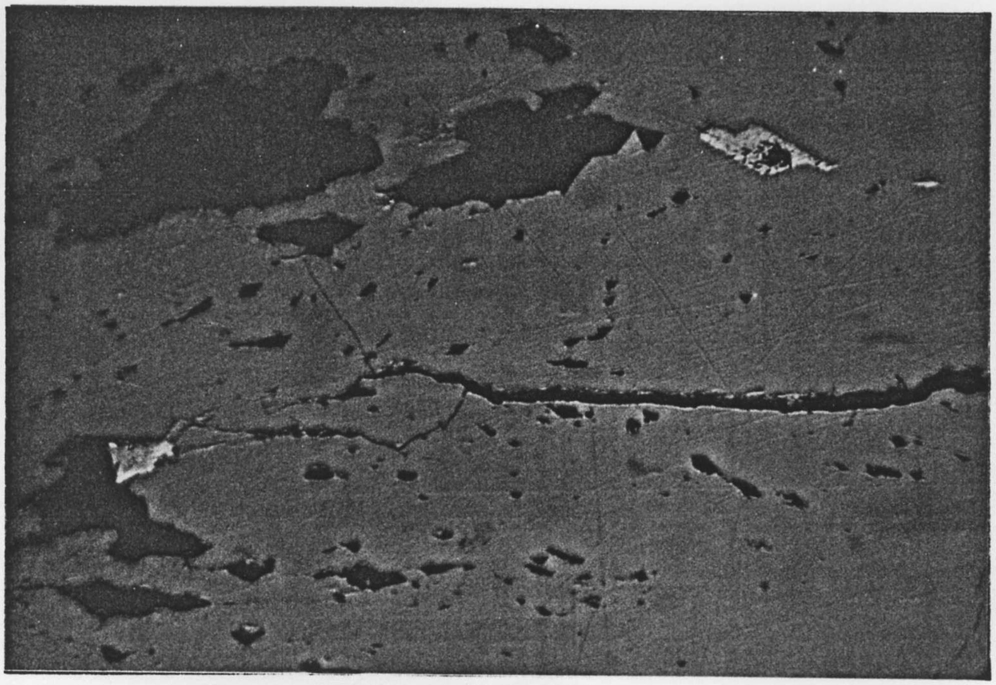


(9) GEM-A lau(+gn)/aspy-sk = 4x28u. This is the largest grain of gold observed.

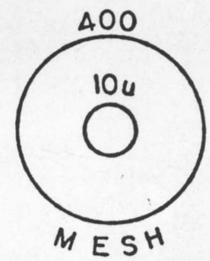


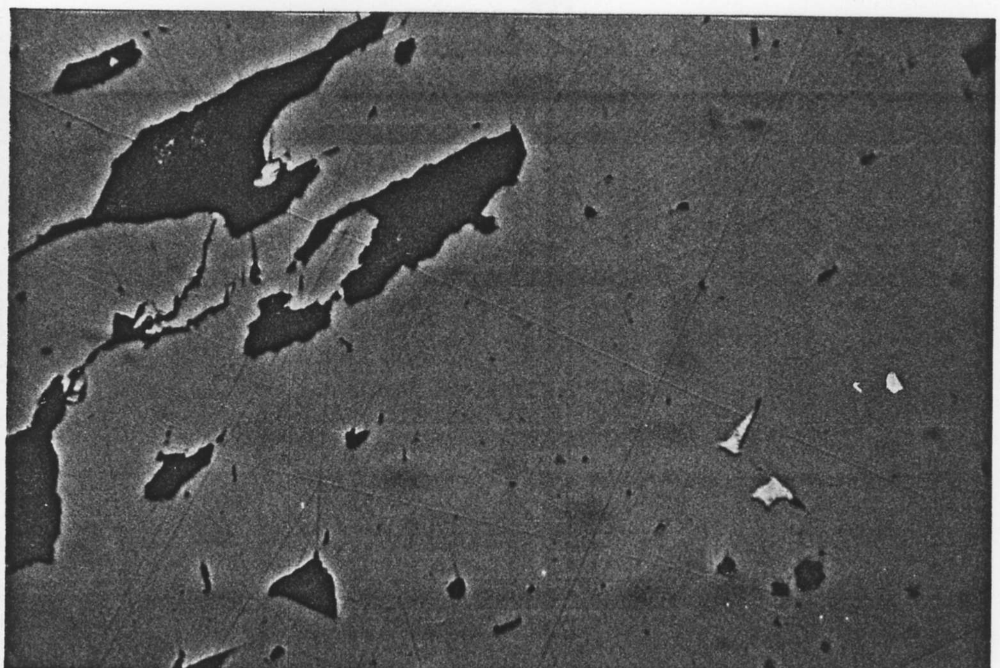


(10) GEM-B 2au/aspy-sk = 3x12u, 2u; both grains are intergrown with silvery-gray md.



(11) GEM-B 3au/aspy-sk = 7u, 8x12u, 2u.





(12) GEM-B 2au/aspy-sk = 5u, 2u. Black = gn.