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Progress Report: Reduction of Zinc Sulfide

Merritt E. Langston

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To date the work which has been completed has been concerned with an attempt to duplicate the results reported by Liu in his thesis. In short, little can be said in comparing the two separate investigations because there does not seem to be any apparent similarity, even though the operating conditions were kept as nearly the same as possible. Figure 1 shows the lack of agreement for the amount of total zinc distilled, expressed as weight percent.

A point worth considering is the effect of compaction on the amount of zinc distilled. One run was made at 900 °C for 6 hours using a loosely packed charge of ZnS + 2Fe. The analysis showed 80.9% total zinc and 3.0% total sulfur were distilled. In a similar run using the same amount of charge only under a 1000 psi compacting load, the recovery was 63.7% zinc and 5.5% sulfur. This brings to mind the question of whether it is better to compact the charge to bring about intimate particle contact or to leave the charge loose in order that the zinc vapor might have a free path of escape.

Figures 2, 3, 4, and 5 are self-explanatory. They represent a summary of the work which has been completed up to the present time. From them the following conclusions are drawn:

(1) The reaction temperature has a greater effect on the amount of zinc and sulfur distilled than does the reaction time.

(2) The addition of graphite greatly increases the amount of total zinc distilled. It is doubtful that carbon enters into the reaction because of the instability of carbon bisulfide at the temperatures used. One possibility is that carbon acts as a catalyst; another is that its presence lowers the amount of compaction of the charge and that the charge behaves in a manner similar to that of the uncompacted charge discussed previously.

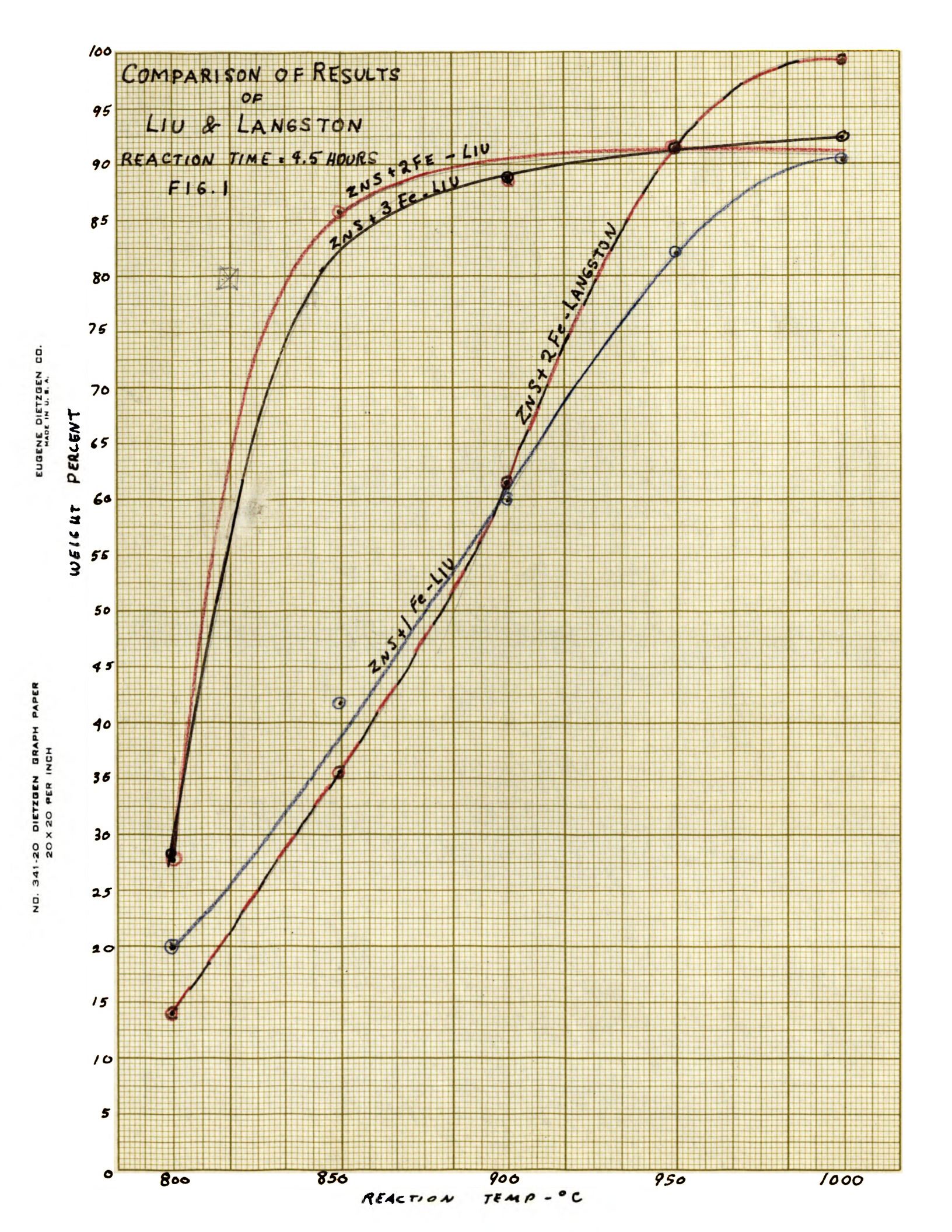
(3) Carbon in the form of lamp or oil black also increases the recovery of zinc, but to a lesser extent than the relatively pure graphite. The presence of a large amount of volatile combustable matter may interfere with the reaction. At least its presence lowers the amount of actual free carbon in a given amount.

(4) Silica, in the form of minus 150-mesh sand, has no effect when added to the charge.

(5) The shape of the crucible (cylindrical versus truncated cone) had no effect upon the rate of reaction.

Going back to Fig. 1, it is seen that Langston's results for the ZnS + 2Fe reduction more closely resemble the data of Liu's ZnS + 1Fe reduction. For the sake of comparison it would seem adviseable to make two more series of runs: one using a charge of ZnS + 1Fe and the other of ZnS + 3Fe. The reaction time could be kept constant for all runs, using the usual five reaction temperatures. This would mean ten more runs altogether, but it is believed that the time spent would be well worth the effort.

No further comments seem to be necessary.


COMPARISON OF RESULTS
OF
LIU & LANGSTON
REACTION TIME = 4.5 HOURS
FIG. 1
ZNS + 2FE - LIU
ZNS + 3 Fe - LIU
ZNS + 2 Fe - LANGSTON
ZNS + 1 Fe - LIU
WEIGHT PERCENT
REACTION TEMP - °C
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
800
850
900
950
1000
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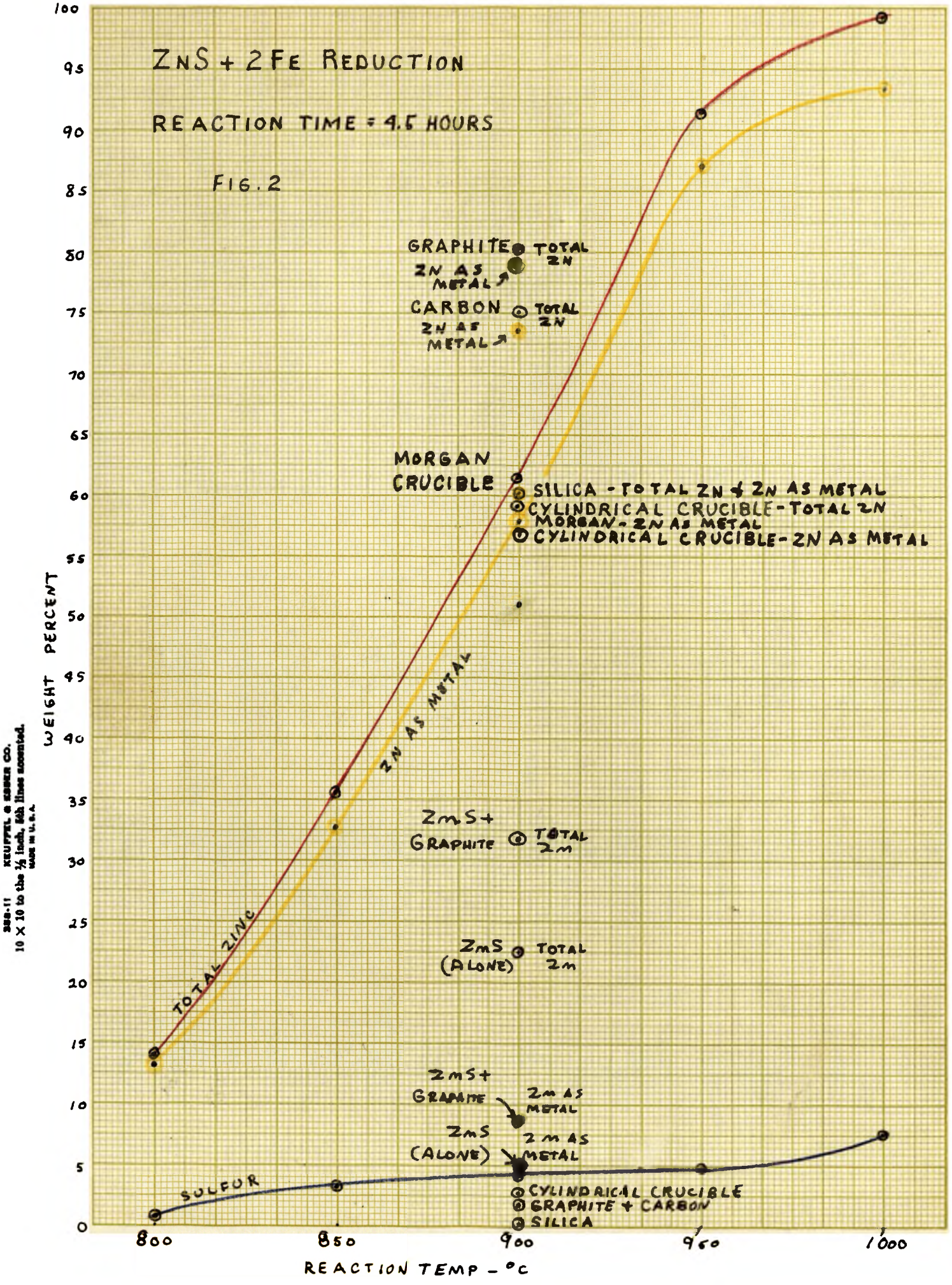
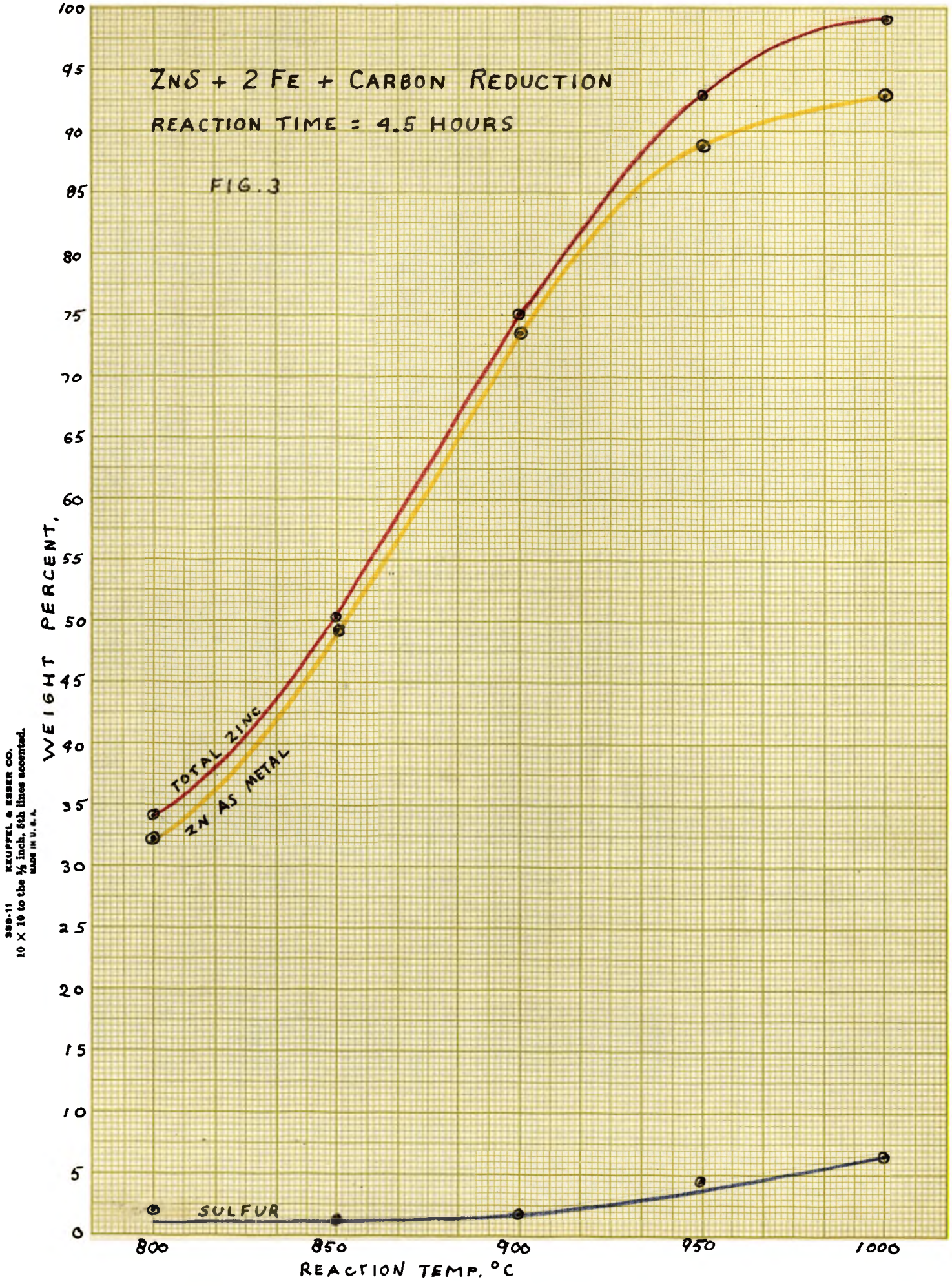
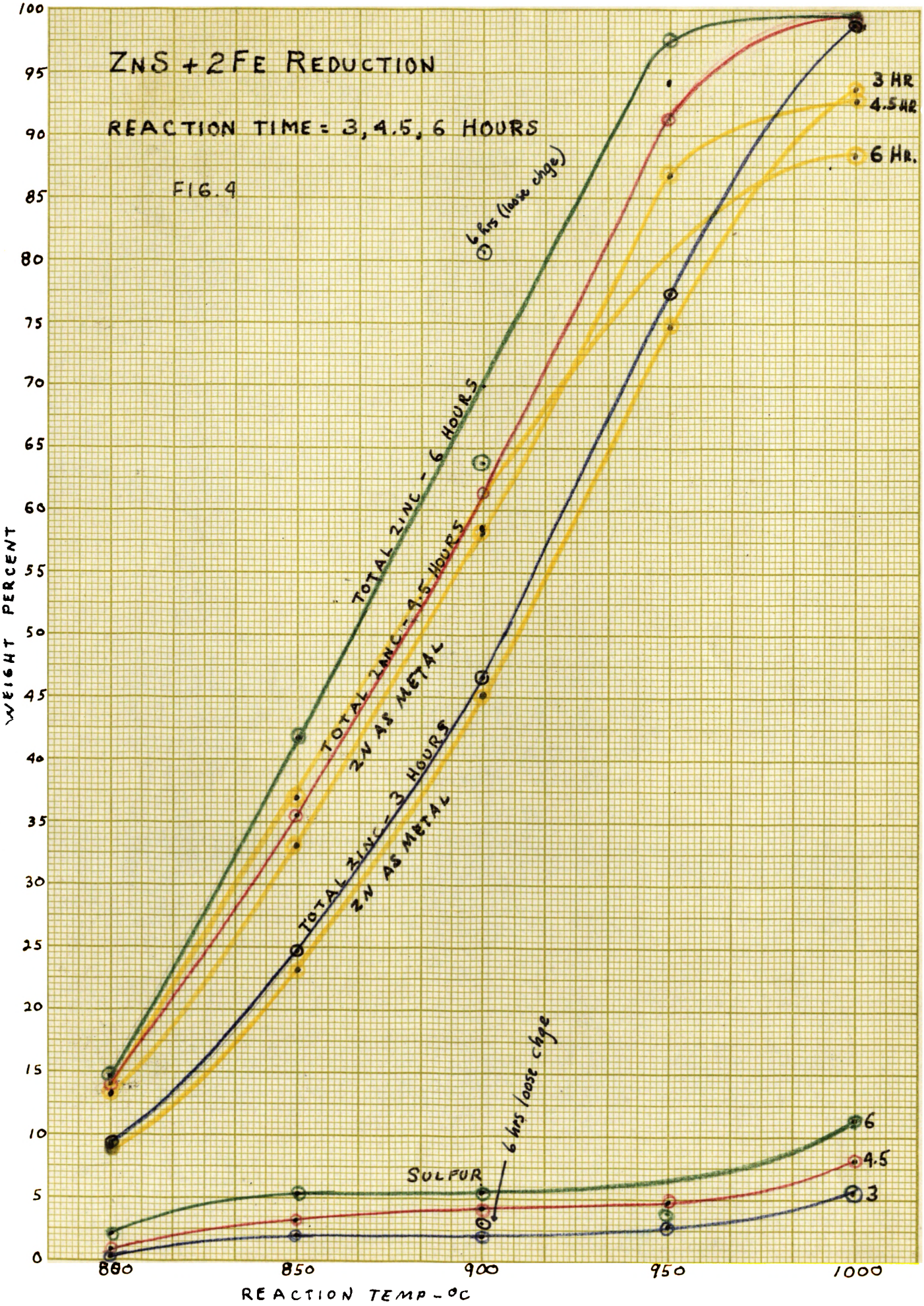
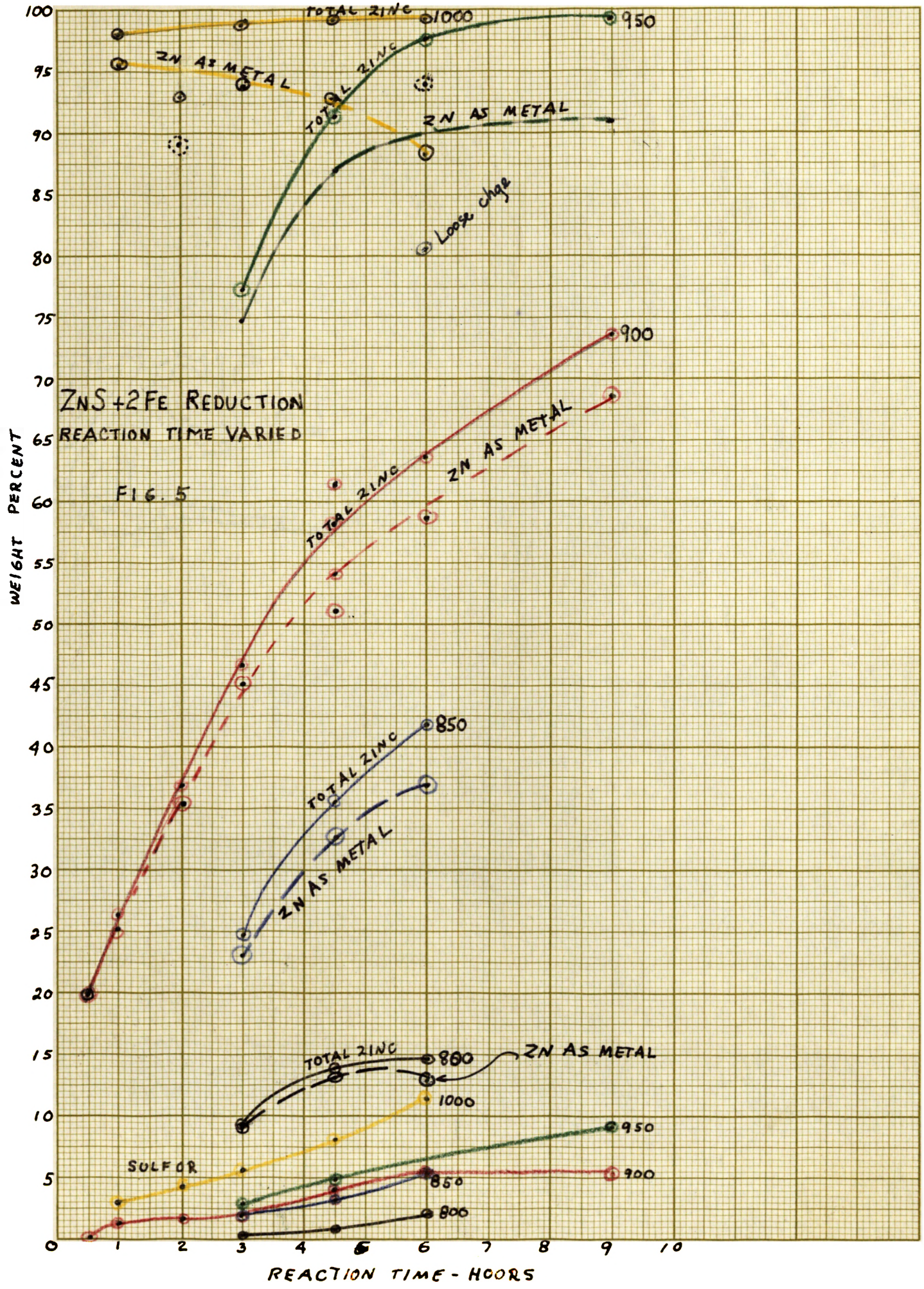

ZnS + 2Fe REDUCTION
REACTION TIME = 4.5 HOURS
FIG. 2
GRAPHITE TOTAL ZN
ZN AS METAL
CARBON TOTAL ZN
ZN AS METAL
MORGAN CRUCIBLE
SILICA - TOTAL ZN & ZN AS METAL
CYLINDRICAL CRUCIBLE - TOTAL ZN
MORGAN - ZN AS METAL
CYLINDRICAL CRUCIBLE - ZN AS METAL
TOTAL ZINC
ZN AS METAL
ZnS + GRAPHITE TOTAL Zn
ZnS (ALONE) TOTAL Zn
ZnS + GRAPHITE Zn AS METAL
ZnS (ALONE) Zn AS METAL
SULFUR
CYLINDRICAL CRUCIBLE
GRAPHITE + CARBON
SILICA
WEIGHT PERCENT
REACTION TEMP - °C
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
800
850
900
950
1000







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