BOOK105R

Notes:

"10152" on bottom edge

Blank pages: page opposite page 1, 2, 4, 150, 151, back cover sheets

-page 11 has half sheet of graph

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
September 14, 1999

SECRET

14-2-2

COMPUTATION BOOK

NAME	Number
K-1095 INTERACTION EXPERIMENTS —	27

Course .....

Used from 1/4/49 19..., to 2/26/49 19...

HARVARD COOPERATIVE SOCIETY
Cambridge, Massachusetts

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1946.

SECRET

10152

INV. 52

CLASSIFICATION CANCELLED
DATE 6/3/60
For the Atomic Energy Commission
for the
Chief, Declassification Branch

RESTRICTED DATA
This document contains restricted data as defined in the Atomic Energy Act of 1946.

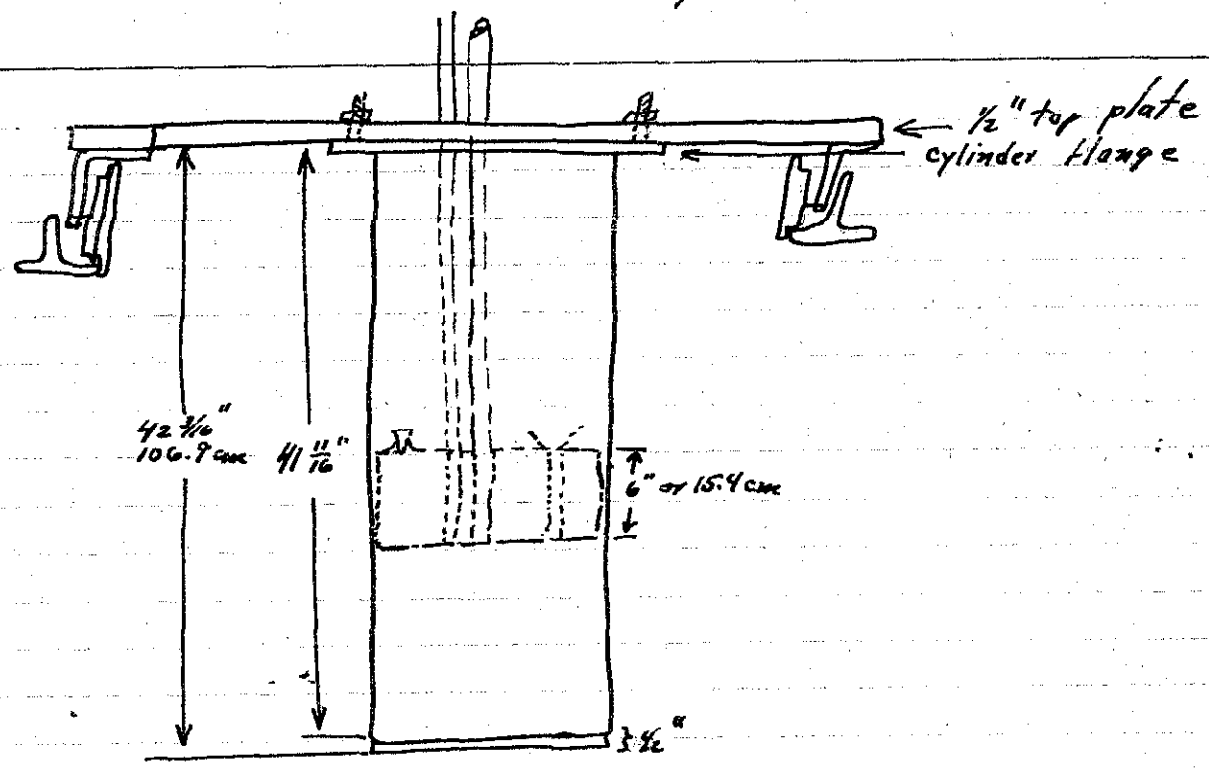
"This document consists of 152 pages,
No. 1 of 1 copies, Series A"

"This document consists of _____ pages,
No. _____ of _____ copies, Series _____"

SECRET

				PAGE
227	2-15" Al Cylinders	Untamped	H/x ≈ 175	128
228	#1 15" Al	Untamped	H/x ≈ 175	131
229	2 - 15" Al Cylinders	Tamped	H/x ≈ 175	132
230	2 15" Al Cylinders	Tamped	H/x ~ 350	138
231	#1 15" Al Cylinder	Untamped	H/x ≈ 350	140
232	2 15" Al Cylinders	Untamped	H/x ≈ 350	141
233	#1 20" SS Cylinder	Untamped	H/x ≈ 350	145
234	2 20" SS Cylinders	Untamped	H/x ≈ 350	146

Dimensions of Movable Cylinder Assembly



Some Values for large coil used for instrument checks.
Total Flux = 1.93×10^7 N/cm
at 40" = 150 c/cm/cm^2 = Tolerance

CALLIHAN
MOONEYHAM
CRONIN
PRESSEY

1-4-49

Exp. # ○

Exp. # ○ Al. 8" cylinders TAMPED $H/X = \infty$

SOURCES ON bottom of both cyl.

TRIP POINTS. #3 85 X100
#4 5.5 X100

SCALES. #3 X100 #5 X2
#4 X10 #6 X25

BACK GROUND COUNTS.

#1	6.0	5.0
#2	8½	7.5

soln level	COUNT #1	#2
Soln level 5.9 cm	4	6½
6.5	3½	6.0
8.3 settled to 7.2	2½	6.0

TROUBLE WAS ENCOUNTERED IN establishing CONTACT with top tamper and soln level in the ~~fixed~~ movable cylinder.

The valve between the cylinders (reactors) was closed and 4 cm added to the fixed cyl. Soln. Level 11.3 cm

(#3 somewhat sensitive to movable top tamper switch and quite sensitive to turning counters OFF & ON.)

The valve between reactors opened. It took about 2 min for level to drop from 11.3 to 9.6.
Contact was finally established with soln. level in mov. cyl.
Final Height 9.3

There is water in all three cylinders on aux. manifold.

ZER

SEPARATION

4.5

55.8

105

INSIDE DI

$1/x = \infty$

ZERO CONDITIONS - MOVABLE SOURCE & CONTROL ROD -

SEPARATION IND. POSITION	ΔS	SOURCE IND. POS.	SOURCE COMP.	ROD IND. POS.	ROD COMP.
4.5	0 (CONTACT)	0	66.0	12.0	86.6
55.8	51.3	0	40.3	12.4	61.9
105	100.5	100	66.5	12.0	33.2

INSIDE DIM. MOVABLE CYLINDER = 105.9 cm. (From bottom of top plate to cyl. bottom.)

with top tamper

. closed and
11.3 cm

ch.)

ok about

in more cyl.

ux. manifold.

8

1-5-48

CALLINAN
CRONIN
McLENDON
MOONEY HAM
PRESSEY

Exp. 194

8" Al Cylinders. (FIXED cylinder ONLY) UNTAMPED H/X Sep 49. N ~~25~~

TRIP POINTS #3 8.5 x 100 H/X 29.9
#4 5.3 x 100

Fix Source ~~X~~ 10.0 cm from bottom (10.8 onscale)
INST. SCALES #3 - x100 #5 - x2
#4 - x10 #6 - x25

Dolly position 115 cm. ON INDICATOR ZEROS 4.5
adjustment on mov. source 20 cm.
scale on mov. " 7 cm
Mov. control rod at Zero
adj. on C.R. 33.2 cm
scale on C.R. 12 cm
Fixed C.R.

Soln. in cylinders 1, 3, 4, & 9.

		Soln. Ht.	Counts.				
12:48 pm.	Filling from #1						
12:55 pm	#1 Empty						
1:05 p	Filling from #3		#1	2	C_0/C_1	C_0/C_2	
1:18 p		-0.5 cm.	49, 48	58, 59.5			
1:30 p	(zero in cylinder)	1.3 cm					
1:40 p		6.3	49-51	60-61			
1:45 p.	#3 MT at 7.5 cm. filling from #4						
2:03 p		17.0 (19.8)	39, 39	100.5, 98		.595	
		16.1	53-51	116.5 117.5	.94	.50	
			51	53 116.5			
2:40	#Mov. source RAISED 1 meter						
	" " Removed		89.0 49-65.5	114.0 113.5-113			
2:50	Filling from #9	19.3	74-163	131-130.5		.45	
3:10		21.9		143		.41	
3:20		24.4		151		.39	
3:35		30.5		166		.355	

94.5 cm from top of boiler plate to top of soln in ~~fixed~~ movable cyl. when sight glass indicates 17.4 cm. This gives a measured depth of 12.4 cm in movable cyl.

The valve between reactors was closed & the level in the fixed reactor dropped from 17.4 to 12.4 (via sight glass into cyl. #9) and valve between reactors opened. The level in the sight glass read 12.35+ after waiting 10 min. Another 5 cm was drained from the fixed reactor (into #9) and the cross valve opened. The sight glass level rose from 7.45 cm to 8.85 cm in 15 min. There is now a difference of 2.4 cm between levels in cyl.

21 - 8" cm in #3
D.V - 1 cm in cyl. #1
10 - 8" cm in #9

Conclusion of 8" Al cylinders ~~for~~ #1, #3, #4, #9, #1 & #9 = 29.8, for fixed cylinder with all movable cylinder - 30.5 cm of

Samples: Two sam
1/14/49 - R

Replaced into wat
tubing
solution

Closed
about it

&
Filled d
#1 Em
Filled
#3 -
Height =

Clamp
floor a
cylinder
line i
kink in

Draine

Remove
No sign
Tygon
slipped
here
twist,
cylinde
tubing

29.9

Replaced stainless steel line between 3" ell and flange into water tank (a line external to the tank) with tygon tubing in an effort to remove source of delay in solution level equilibration-

Closed this tygon tubing with a "C" clamp at about its midpoint.

Filled dead volume from #1-
#1 Empty.
Filled to 9.9 cm on sight glass (after one blow back) from #3 -
Height = 9.7 cm after second blow back-

Clamp removed - liquid surged in tygon tube to flange, then flow slowed almost to a stop. Observation into movable cylinder showed no flow into it. Trouble, therefore, in line in tank. This shows that the trouble is a kinking of that line -

Drained back as before, i.e. dead volume in #1 -
balance in #3 -

Removed rubber (2") & B-T armor from line in tank -
No sign of leakage -
Tygon however had been badly twisted where it was slipped over the metal tube at flange end. Appeared to have been caused by combination of twist & bend - mostly twist, also some bend at attachment of to metal at cylinder end. There is obvious need for stepper-walled tubing.

FP - DC -

Samples: Two samples of solution, #194A & 194B (Requisitions 710055-6) taken & sent to Work. Lab 1/6/49
1/14/49 - Results reported by phone by Dunnell - 194A - 0.427 gm U / gm sol.
194 - 0.419 " "

ders

Co/C1

Co/C2

.595
.94 .50

.45
.41
.39
.355

movable
as measured

vel in the fixed
#9) and value
read 12.35+
n the fixed
ht glass level
is now a differen

in #9

1-6-49

Interrun Checks

using *

Tube connecting movable & fixed cylinders was installed 1/2" ID 5/16" Oblock rubber pressure tubing. no fabric. 2" OD rubber hose also installed. Clamp was installed in outside flexible fuel line.

Soln. was added to a depth of 10.3 cm in the stationary cylinder. Line connecting cylinders was then opened and drop in level per unit time observed.

Time	Level With outer 2" tube in place	Level with no outer tube
0	10.3	10.3
10 sec	8.8	
20 sec	8.2	
30 sec		8.2
45 sec	7.9	
1 min	7.6	7.0
1 1/2 min	7.3	6.1
2 min	6.9	5.6
2 1/2 "	6.7	
3 min	6.5	5.4
4 "	6.2	5.35
5	6.0	5.35
6	5.9	5.35
7	5.75	
8	5.6	
9	5.6	
10	5.525	
11	5.5	
12	5.4	
13	5.3	
15	5.2	5.35
17	5.15	
19	5.10	

Note- outer tube was cut off not disturbing inner tube connection

11:10 Height of solution in movable cylinder measured directly by use of a rod.

height = 4.9 cm } at same time
from sight glass = 5.35 }

1. Valve closed between two cylinders
2. Drained out 8 mm from fixed cyl.
3. Then opened valve and after 5 min - sight glass increased 3.5 mm -

* This is really 5/8" I.D. making for a loose fit on connection - DV 1/16/49

1.

Height cm

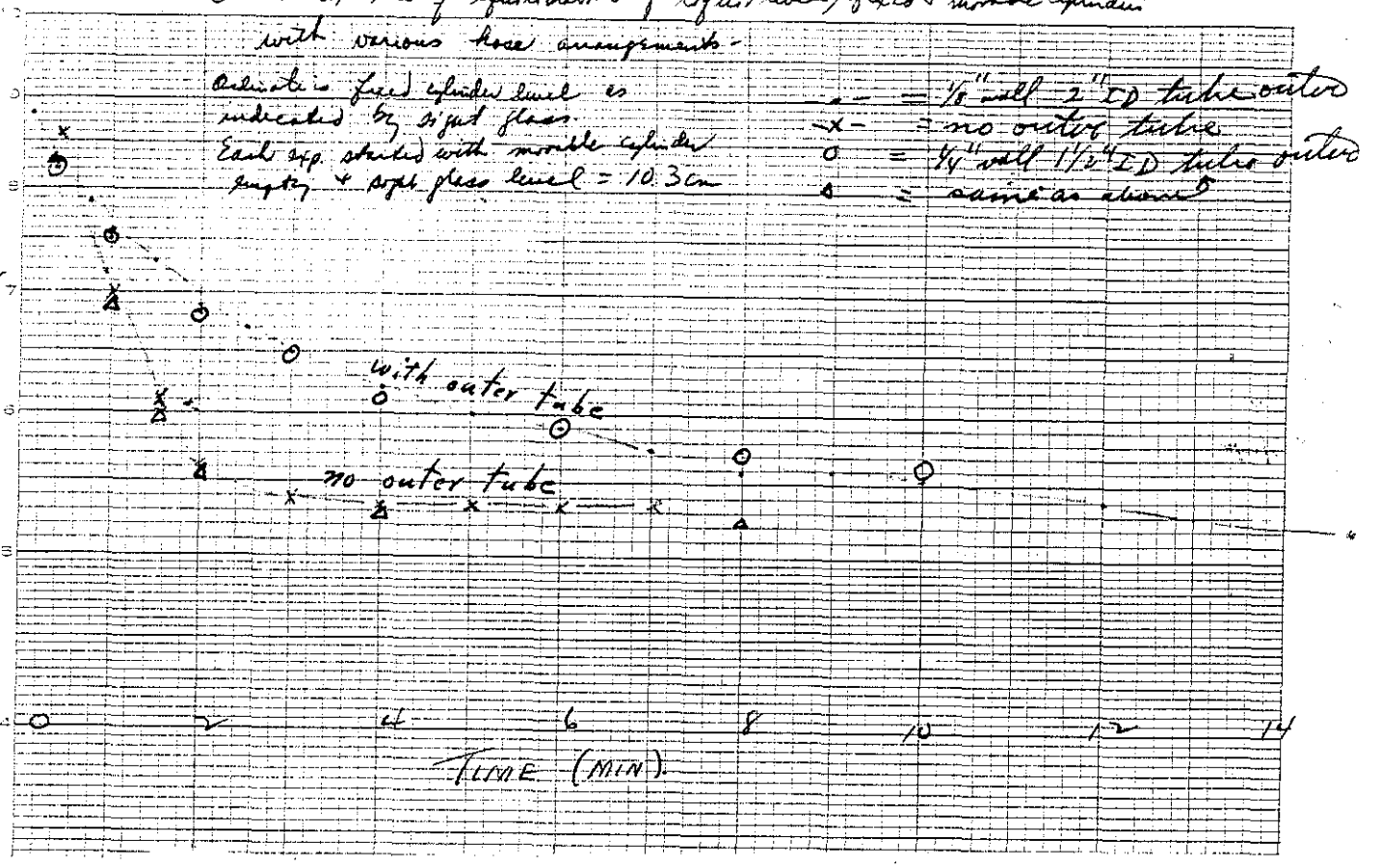
Time
4:02
4:025
4:03
4:035
4:04
4:05
4:06
4:08
4:10
4:12

Drain b
clamp

DATA on time of equilibration of liquid levels, fixed & movable cylinders with various hose arrangements -

Ordinate is fixed cylinder level as indicated by sight glass.
Each exp. started with movable cylinder empty & sight glass level = 10.3 cm

- = ½" wall 2" ID tube outer
-x- = no outer tube
o = ¼" wall 1½" ID tube outer
Δ = same as above o



EUGENE DIETZGEN CO.
MADE IN U.S.A.

...e installed
...labic.
... installed

...m in
...hes was
...ened.

Note-
outer tube
was cut off
not disturbing
inner tube
connection

4. Solution seemed to be in equilibrium.

11.19 Drain back to zero in # 3 pit cyl

Dead Volume in # 1 cyl. pit.

Samples taken from cyl # 3

Sp. Gr. = 1.940
approx 4 ml samples
#194 = 7.5983 gms sample Reg # 710056 } see page 13 in
#194A = 7.6341 gms. " " # 710055 } Analytical Weighing Book.

3:50 She outer hose (of flexible connection) has been replaced with a smaller diameter but thicker wall tubing
1/4" wall 1 1/2" ID rubber tube.

Present
Morfitt
Callihan
Cronise
Moonyean
Pressey
Bastron
Carmichael

To check drain time -

Time	Level
4:02	10.3
4:025	8.2
4:03	7.5
4:035	7.1
4:04	6.8
4:05	6.5
4:06	6.1
4:08	5.9
4:10	5.7
4:12	5.65

Drain back to 4.7 cm (drain back 8 mm with movable cyl closed off)
Clamp loosened

...der measured
...e time

...ight glass

Callahan
Morfitt
Cronin

4:25 Solution Ht = 3.9cm movable cyl clamped off.

Time	Level
0	0
30 sec	7 mm
60 sec	1.05 cm
1½ min	1.7
2 min	1.8
2½ min	1.9
3 min	1.95
3½ "	1.975
4 min	1.99

4:32 Drain back to zero in each cyl

Filling to 10.2 cm

Time	Level
30 sec	8.3
1 min	6.9
1½	6.0
2	5.6
2½	5.35
3	5.30
~~3½~~	
4	5.30
8	5.25

5:31 Cylinders moved closed together and movable cylinder clamped off.

Sol'n Ht = 10.3 cm (in fixed cyl. only)

Background

Drain

Now

Fixed
So co
bottom o

S

Time	Soln Ht
6:15 PM	5.3
6:20	7.8
6:28	9.9
6:42	12.8
6:52	14.3

Conclusion -
Solute
with
same

H/X = 29.9

Callihan
Norfitt
Cronin

1-6-49

Experiment # 195

2 cyl. untamped 8" Al H/X = 29.9

Background #1 100 75 #2 76

#3 on X100
#4 on X10
#5 on X2
#6 Red on X50
PM – OK

} all instrument checked

Trip points
#3 = 75 } on 100 scale
#4 = 6 }

Drain to equalize to closed point of 2 cyl.

Time	Level
0	10.3
30 sec	8.3
1 min	6.9
2 min	5.5
3 min	5.20
4 "	5.25
12½ "	5.28

Now starting untamped ~~#1~~ experiment from here.

Fixed cyl. control rod is 10 cm of bottom with reading of 8 cm
So scale reading + 2 cm is height of Control Rod from bottom of cylinder.

With soln @ 5.25 count #1 83 #2 60

Source moved to 7.8 on scale (7.0 cm of bottom)

Time	Soln Hgt (cm)	#1	#2	1/M1	1/M2	Comments
6:15 PM	5.35	~~90~~	~~76~~	~~1.00~~	~~1.00~~	Feeding from #3
6:20	7.8 (Source under)	88, 91	78, 78	~~1.00~~	~~1.00~~	3 mm drops 1/2 min after Soln shut off.
6:28	9.9	162	100	.80	.78	#3 empty
6:42	12.8	145	126	.62	.62	
6:52	14.3	162	138	.55	.56	#2 empty Soln all gone.

Conclusion – Two 8" Al cylinders untamped in contact, far from critical with all available solution (H/X = 29.8). The maximum height = 14.3 cm in each cylinder. This system, with additional solution, may be more reactive than the single cylinder at same height. and probably would not become critical – Dc.

H/X = 29.9

14 Callihan Cronin Morfitt

Experiment # 196

H/X = 29.9

1-6-49

Single Stationary 8" Aluminum Cylinder Water Tamped H/X ≈ 30

Instrument Check #1 - 9, 9 #2 - 5, 5 Source 6.8 cm (actual 6.0 cm)

#3 on 100, #4 - on 10, #5 - #5 faulty, unsteady, #6 25 scale

Time	Soln Hgt.	#1	#2	Co/Co	So/Co	Remarks
9 07 PM	0.0	—	—	—	—	Filling from #9
9 11	8.3	11.0 / 10.5, 11.5	6.0 / 6.5, 6.0	1.0	1.0	#9 empty
9 23	12.1	17.0, 16.5	10.5, 10.0	.65, .67	.57, 0.60	filling from #3
9 38	17.2	47.0	36	.23	.167	Est. crit 19.8
9 48	18.5	113	90	.097	.067	Est. crit 19.5
10 02 PM	19.5	CRITICAL WITH BOTTOM OF CONTROL ROD 1½ cm above top of soln.				
		Drainback 2 cm.				
10 21	19.2+	Not Critical but almost.				

Conclusion. Cylinder critical at height of 19.3 ± .05 cm.

JNM

Drainback. Inventory after Drainback.

#1 Dead Volume
#3 18.5 cm.
#9 10 cm.
} in terms of 8" cylinder

3/4/49 JC

H/X = 29.9
8" al cylinder tamped.
H_c = 19.3 + 1.4 = 20.7 cm corrected.
Sp. gr. = 1.926
Concentration = 0.394 gm U/gm sol = 0.759 gm U/cc sol.
V_c = 6.71 ℓ
M_c = 5.09 kg.

Callihan Macklin Morfitt Pressy.

Macklin replaced by Cronin @ 12:00 M

Time	Soln Hgt. change
10:50 A.	—
11:00 A	0.2
11:45	5.0
12:08	7.3
12:12	

Expt.

TRIP. POINTS

#3 - 10

On = actual

During O

now sol

the experi

the #3 ch

was caref

the starting

on both

was repea

was severe

each dri

in effecting

Drain

#1,

Cylind

#2

#5

in

JNM

1-6-49

Callihan
Macklin
Morfitt
Pressy.

H/x = 29.9

1-7-49

Macklin replaced by Crouse @ 17:00 M

Expt. 197

Two 8" Id Contact Tamper —

TRIP. POINTS #3 - 75 x 100 #4 - 5.8 x 100 Source 5.8 cm. scale (actually 6.0)

#3 - 10 #4 - 10 #5 - 5 #6 - 25

~~On movable stationary control rod. Scale reading +2 cm = actual reading~~ Scale reading of 8 cm is Zero on stationary Control Rod.

Time	Soln Hgt. cm.	#1	#2	C_0/C_1	C_0/C_2	Remarks
10:50 A.	—	—	—	—	—	Filling from #1
11:00 A	0.2	—	—	—	—	#1 empty.
11:45	5.0	14.5, 14.0	9.0, 9.0	1.0	1.0	#9 empty
12:08	7.35					
12:12						

During the raising of the tamper prior to adding more solution the dump valve released, terminating the experiment for the day. Further investigation showed the #3 chamber had tripped, & that this in turn was caused by a transient voltage fluctuation accompanying the starting of the tamper mechanisms. A surge occured on both 3 & 4, although 3 alone tripped, & the effect was reproducible. The area around the dump pan was severely contaminated for a foot or two in each direction and much time (several man-hours) spent in effecting partial decontamination.

Drainbock

#1, #3, #9 contain the major part of the soln; exact amt per cylinder unknown.

#2 contains a small amt added by mistake.

#5 contains rinse water from dump pan suitable for use in dilutions

JMM

1/10-11/49-

Cleaned up spill - Washed up, dump tray, put washings into #5 cylinder to be used for dilution. #

→ #5 Cylinder now almost full

Instrument men (Quinn, Olsen, Barthus, Carmichael, Ferguson) worked on instruments & eliminate surges —

Installed 6' stainless tube as guide through which #1 source can travel —

RE: Instruments -

#3 - Some time ago (~ 2 mo) the capacitance in the pre amp of #3 was reduced by 100 mmf in order to speed up the circuit & the trip operation. However this increased the instability to transients, etc. The instrument crew believes this to have been the cause of the trouble on 1/7 (it is not clear why #4 showed a surge). Today (1/10/11) #3 recorded responded to ~~co~~ scaler on-off ~~Switch~~ switch, decreasing in deflection ~~or co~~ as switch was operated. These two difficulties have been apparently remedied by

① Replacing 2 resistors in #3 reduced its response to the trouper switch but has probably increased its response time. (The capacitance in #4 was reduced today to match #3, reducing the response time in #4).

② The interval timers of I & II and the thyratron which ~~the~~ activate the counters were fed from a separate AC line by-passing the Sola, reducing the sensitivity of #3 to the counter circuits -

Calibration
Moffett
Cronin
Mooneyham

A. Measu

Cylinder #1
#2
#3
#9

B. Instrum

Zero

C. Experim

Time	Soln Ht. (cm)
10:20 AM	—
10:32	0.4
10.42	1.25
10:52	5.6
11:52	8.6
12:32	10.9
12.50	11.9
1:17 PM	12.4
1:34	12.5
1:52	12.65
2:06	12.9 (N

Old position
Separation of 2.9 cm
New.

See page 19 for separation

H/X = 29.9

Callihan
Moffitt
Cronin
Mooneyham

Experiment 198

1/12/49

Two 8" Cylinders (Al) In Contact - Tamped

H/X = ~~29.1~~ 26.5

A. Measurement of soln. height in cylinders

	R_1 cm.	R_2 cm.	ΔR cm.	$\times \frac{\rho_{soln.}}{\rho_{soln.}}$	= Soln. ht. cm.	or Soln. ht. in 8" cylinder.
Cylinder #1	69.7	34.4	35.3	1.53	53.9	13.5 cm.
#2	54.6	48.1	6.5	"	9.9	2.5 cm.
#3	68.6	~~34.9~~ 35.4	33.2	"	50.6	12.~~7~~ 6 cm.
#9	68.~~5~~	35.5	33.0	"	50.4	12.6 cm.
					Total	41.3 cm.

$\frac{\rho_{man.}}{\rho_{soln.}} = \frac{2.96}{1.94} = 1.53$

B. Instrument check

Trip points #3 - 85 x 100 #4 - 4.5 x 100 PM-10

Scales #4 - x10 #5 - x2 #6 - x25 #1 - 76.5 #2 - 78

Zero Fixed control rod at 14.5 cm. when 2 cm. above bottom of cyl. - not lower due to interfer → ~~.30~~ at 12.5 cm.

Source 5.8 cm. (actually 5.0) ←

C. Experiment Mov. control rod should exceed 85.5 cm. with compensator at 85.5

Time	Soln. Ht. (cm)	#1	#2	C_0/C_1	C_0/C_2	Remarks
10:20 AM	—	—	—	—	—	Filling from #9
10:32	0.~~4~~	—	—	—	—	#9 empty
10.42	1.25	—	—	—	—	Filling from #2 - empty
10:52	5.6	C_0=15 14.5, 15	C_0=10 10, 9.5	1.0	1.0	Filling from #3
11:52	8.6	22	~~23~~	0.682	0.555	#3 empty, Filling from #1
12:32	10.9	40	42	0.375	0.238	Still filling from #1
12.50	11.9	82.5	100	0.182	0.100	
1:17 PM	12.4	259.5	324	0.058	0.031	
1:34	12.5	not yet critical; using both control rods - mov. cont. rod about twice as valuable				
1:52	12.65	not yet critical				
2:06	12.9 (N)	Critical with ~~5.4~~ 5.~~2~~ cm. of the fixed control rod in the soln. Mov. control rod out				
Old pointers		Dolly indicator = 2.5 cm. Mov. cont. rod compens. = 85.7 (typ) cm.				
		Top. tamp. mov. = 15.0 cm.				
Separation of 2.9 cm		Dolly indicator = 5.4 cm. Mov. cont. rod. compens. = 84.3 cm.				
New.		Top. tamp. mov. reset to read 15.0 cm.				
See page 19 for separation data	(P)	Critical again with No solution added	Fixed Control rod at 23 cm. Mov. control rod out 23.0 - 12.5 = 10.5 cm. Site glass reads 12.8 cm. 12.8 - 10.5 = 2.3 Fixed rod 2.3 cm. in the soln.			

DK

Ex. #198 (cont.)

3:30 PM Just as another operation was about to be tried, the solution was dumped. No instruments were being adjusted ~~[illegible]~~ or manipulated when #3 tripped. #3 oscillated 14-15 small scale divisions before the dumping occured. The door on #3 was open at the time and the pan removed for repair.

The solution was drained back into cyl. #1, 3, and 9 with the washings going into #6 (~2.5 l.). No contamination of the floor under the dump pan was detected. Score 2 dumpings; 5 wk-days.

First interaction water experiments to go critical anywhere, anyplace, anytime were accomplished.

8:00 AM Removed →

8:30

9:15

2 - 8"
Instrum
Count
"
Don Cham
" "
Vibrating
Don Cham
Process

Dum

Sol

#1
75.3
29.4
45.9

ΔH

Sol. Ht. 70.3

in term of 8" cyl. 17.6 c

Note: Separati
same
appro
ab

the fol

From page 19

Note - From phone conversation with Olson (Y-12)

1. Present amplifier should be completely rebuilt using old diagram and new parts where necessary. (#3 DC amplifier leaving out superfluous components
2. Difficulties (Erratic tripping of safety device) could probably be traced to loose connections.
3. For best results new amplifier should be warmed up over night.

7/4/49 DE

Exp# 198 #B
Two 8" al Cylinders
Separator ~~0.4 cm. 3.3~~ 0.4 cm*
$H_c = 12.8 + \frac{1.4}{2} = 13.5$ cm.
$H_x = 29.9$
Conc = 0.394 gm x/gm sol = 0.759 gm x/cc sol.
$\rho_{sol} = 1.926$
$V_c = 4.388$.
$M_c = 3.32$ kg.

~~1488. 198A~~

~~3.3 cm 0.4 cm~~ 0.0 cm*.
$H_c = 12.7 + 0.7 = 13.4$
29.9
0.394 gm x/gm sol = 0.759 gm x/cc
1.926
4.34 l
3.29 kg.

* Note calibration of separator on pg 19-

H/X = 29.9

Ex. 199.

1/13/48

2- 8" #1 Cylinders Water Tamped

Personnel
Morfitt
For
Cronin

Instruments turned on and trip points and Response checked. 8:00 AM

Counter #1 - OK
" #2 - OK
Ion Chamber #3 - Trip point 88-90 on x100 scale. Removed →
" " #4 - " " 5½-6 on x100 scale
Vibrating Reed #6 - Responds OK
Ion Chamber #5 - Responds OK
Process Monitor - Respond OK

Note: Instrument men notified - Olsen, Quinn, Lt Kins about difficulties yesterday. see page 18

Dumps Valve + Spring reset. Pan re-covered and sealed 8:30

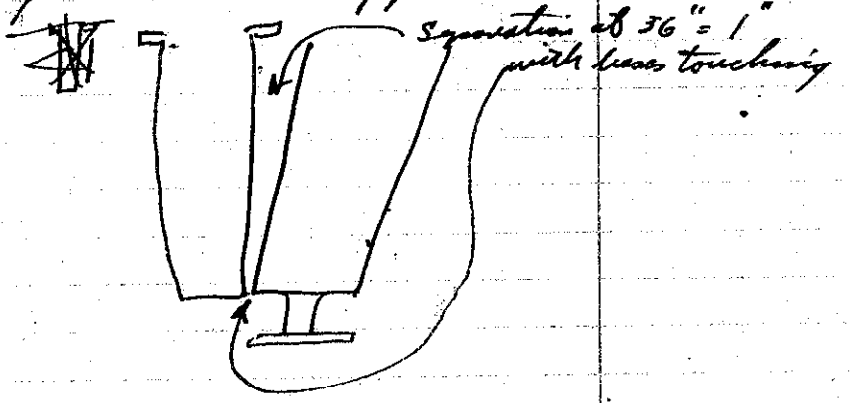
Solution Inventory 9:15

	#1	#2	#3	#4	#5	#6	#7	#8	#9
	75.3 cm.	Empty	69.6 cm.	Empty epidiascope glass leak in solution line	Pan missing	Pan missing	Empty	Empty	64.3 cm.
ΔH	29.4		34.6						39.4
	45.9 cm		35.0 cm.						24.9 cm
Soln. Hgt.	70.3 cm		53.6						38.1 cm
in term of 8" cyl.	17.6 cm		13.4 cm.						9.5 cm

Total 40.6 cm.

Note: Separation of two cylinders checked, and at scale reading same as yesterday (5.4 cm) actual separation was only approx 3 mm at the base with a separation of about 5 mm at solution level 13 cm.

Cylinders when touching at the base appear to have the following geometry.



Ex. 199 (cont.)

11:00 AM

Decision was reached to repeat the experiment yesterday with separation indicator at 5.4 cm which is an actual separation of 0 mm at base at 9" height separation is 3 mm

Morfitt
Callihan
Fox
Cronin

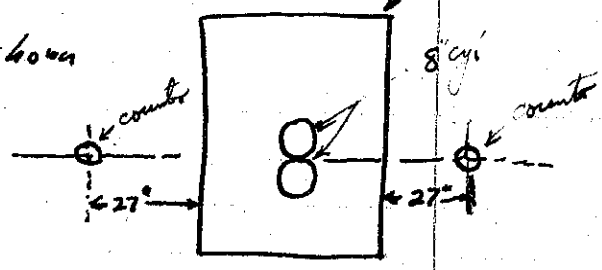
	Scale	Actual	Comp. Scale
Cylinder Separation:	5.4 cm	0 bottoms in contact	
Movable Cyl. Control Rod:	3.5 cm	0	86.0 cm
" " Source:	Not in use		
" " Top Tamper:	15.0 cm	15.0 cm	—
Fixed Cyl Source:	5.8 cm	5.0 cm	
" " Control Rod:	15 cm	0	

Note
#3 Trip Circuit has been by-passed

Movable Top Tamper Set

76.5 top of Plate to Top Tamper
65.4
91.9

106.9
91.9
15.0



Adjusted position of counters as shown

Source however is not in center of reactor.

Cronin out at 12 noon.

12:17 P

Instrument reads

#3 —	out 1 order	#4 trip point checked and Trip point is at 6.1 on X100 scale.
#4 —	10	
#5 —	2	
#6 —	25 mv (Red).	

Cronin Back

12:22 Filling dead volume from #3
12:42 #3 empty with solution close to zero level in cylinder
12:48 Filling from #9 cyl with movable cylinder clamped off.
12:50 Solution height . 5.0 cm (before blow back + before unclamping)
4.9 cm (after blow back to clear sight glass line
4.6 cm after unclamping hose (2 min)
feed - hose being moved to remove any air locks or other obstructions
2.65 cm after equilibrium (

1:00 P Counter
Outside
1:10 P Water to
1:07 P #9 cy
1:15 P #[illegible] cyl
1:20 P Movable
Fixed
2/3
C_0 = 1
Sol'n Ht
1:32 P 9.0+
1:58 P 10.7
2:23 P connected
2:32 P 12.0
2:48 12.75
3:13 13.0
Fixed
Movable
3:33 12.80

Conclusion Cri

Ex. 199.

Moffitt
Callihan
Fox
Cronin

1:00 P Counters at this set level = #1 - 100 c/2 min } possibly due to
#2 - 40 c/2 min } geometry

Outside reflector (water tank) being filled.

1:10 P Water tank ¾ full.

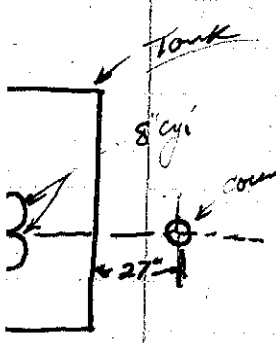
1:07 P #9 cyl empty sol'n ht. = 4.9 cm

1:15 P #1 cyl to 6.0 cm
at equilibrium = ~~5.6~~ 5.5 cm

1:20 P Movable control Rod raised to about 10 cm above top of tamper
Fixed control Rod taken out temporarily (raised to top of cyl)

Back ground counts ht = 5.5 cm tamper down Rods out.

#1	#2
20.5	11.0
19.0	10.5
2)39.5	2)21.5
C_0 = 19.75	10.75



	Sol'n Ht	Equil. ht.	counts #1	counts #2	C_0/C_1	C_0/C_2	Remarks
1:32 P	9.0+	8.80 cm	80	20	.658	.538	Rods out about 100 counts
1:58 P	10.7	10.50	46.5	35.0	.425	.307	Rods in Tamper up
2:23 P	corrected	10.65	34.5	24.0			
2:32 P	12.0	11.75	89.0	76.0	.222	.142	
2:48	12.75	12.60	Not able to count >500		Not Critical		
3:13	13.0	12.95			Critical with Fixed Control Rod IN		#1 Empty

Fixed Control Rod all IN
Movable Control Rod = 13.8 cm scale

3.5 cm gives 10.3 cm of Cd rod from bottom

3:33 12.80 12.80 Fixed Control Rod IN
Movable Control Rod Out. } Critical

Conclusion: Critical at 12.70 cm ± 1 mm

Ex. 199

3:58 Cylinders Separated 2.9cm ~~X~~ ~~X~~

Fixed Source came off pulley and was replaced.

	Scale	Actual	Comp
Cylinder Sep.	8.2	2.9cm	—
Movable Control Rod	3.5	0	~~86.0~~ ~~85.1~~ 84.55
" Tamper	14.4	14.4	—
Fixed Cyl. Source	5.8	6.0	—
" " Control Rod	15.0	0	—

Solution ht.	#1	#2	c_0/c_1	c_0/c_2	Remarks
12.80	94.5	80.0	.209	.134	
12.95	101.0	82.5	.197	.130	From #1 cyl by blowing line dry.

4:30 Fox left.

Ex. 199-D

4:45 Cylinders Separated 1.45

	Scale	Actual	Comp
Cyl Sep.	6.75	1.45	—
Movable Control Rod	3.5	0	85.4
Tamper	14.4	14.4	

~~4:50~~ 4:58 Collihan left

Drain into #1 cyl.

Sol. Ht.	#1	#2	c_0/c_1	c_0/c_2	
12.95	372	338	.053	.0318	
12.50	132	110	~~.080~~ .149	.087	
12.00	85.5	73	.231	.147	
11.00	51.0	36.5	.387	.294	
10.10	39.5	26.0	.500	.413	
8.30	28.0	17.5	.705	.614	
5.70	21.0	11.25			} Background
5.70	21.0	10.5			

#1 closed off
#3 opened → 3.95
#3 closed 0
#9 contains D.V.

Personnel Morfitt Orenin

This. BF_3 ion cha... tripping cir... At ~~accuracy~~ ~~beginning~~ was a... critical @ 12.7 cm. At ... more ab... taken a... at least ... At ... was not ... plotted; criticality ... Only 12... no ... the Rese... tempera... experiment ...

3M/eq DC

Exp 199 8" al...
Separation
Hc = 12.7 +
Hx = 29.9
c_{one} = 0.39
A_{fg} = 1.0
Ve = 4.
Me = 3.

Exp 199

~~Exp~~

K 84.55

This Experiment was run using both counters, one BF_3 ion Chamber in a tripping circuit and one not in the tripping circuit.

Remarks

At zero separation, ~~since the first cylinder tapered away from the movable cylinder, water although it was kept out of it completely was sufficient material, probably,~~ there was sufficient material to become slightly super critical. @ 12.9 cm critical @ 12.7 cm. At a separation of 2.9 cm however only two points were obtainable (12.80 and 12.95) which using the background taken at 5.6 cm indicated the need for 1 cm more solution to become critical.

From #1 Cyl by blowing line dry.

At half the above separation (1.45 cm) the system was not critical, so counts were taken on the drain back as plotted; Criticality at the best extrapolation would be at 13.25 / 13.20 cm (only 12.95 cm of solution available)

Personnel Morfitt Cronin

No difficulty in operation. For insurance however, the Reset button on the tripping circuit was held in when tampers were moved, a procedure established early in the experiment due to irregularities in treatment on trip circuit

Cronin & Morfitt

3 Pl/eg DC

Exp 199 A

8" al

D

Separation 0 cm.

$H_c = 12.7 + \frac{1.4}{2} = 13.4$

$H/x = 29.9$

$conc = 0.394 \frac{gm\ x}{gm} = 0.759 \frac{gm\ x}{cc}$

$\rho_{gr} = 1.926$

$V_c = 4.342$

$M_c = 3.29\ kg.$

} Background

1.45 cm

$H_c = 13.25 + \frac{1.4}{2} = 13.95$ cm

$V_c = 4.522$

$M_c = 3.43\ kg.$

24 Callahan
Macklin
Fox

1-14-49

Drained line by Vacuum into #9

It was observed that one had a large hand count (3-5 hundred) after swabbing water out of bottom of tamper tank. On spot in bottom of tank gave about 200 counts. This may have been due to spattering of sol. when taking out top tamper on pipe egl.

8" #1 Al cylinder washed down with ~ 1/2 L d.d water - washings pulled into #6.

8" al #1 cylinder removed.

Stud removed from strap + replaced by double end threaded bolt (this is in 3" pipe flange at end of #1 cylinder -

Two block plates installed - neither checked for leaks.

8" #1 Al cylinder, ends covered with brown paper + put in Rm 7, tamper - not covered, also stored.

There is much corrosion in this al cylinder - a purple brown compound -

1/4" + 1/2" thick sponge rubber procured. former for replacement tank end gasket when needed; latter as water flange gasket, #1 cylinders, as means of better aligning them.

Leak in 3" water line covered with masking tape -

Glyptal removed from 1/4" ell, at 3" ell, + new coats applied - may stop that leak.

Plug, drain dump pan, tightened + painted with glyptal.

No contamination (@ <100 c/ma) found around air discharge in operating room.

Nail to Lucite air vent open installed.

Instrument men (Quinn, Olsen, Barthen, Carmichael, Fargurson) here off + on all day - Present status

#1 } { OK - Now clear or
#2 } { next

#3 - Rejuvenated Amplifier installed - worse than one which it replaced, so former one put back in - at present it responds to

Tamper switches - Kick towards Zero - its stripper is shorted out - if its stripper were to be activated, though, its red light will come on - On Sat + Sunday keep

~~tube~~ observing this light for possible potential drop -
#14 OK
#15 OK
#16 Reed - out of order - but present instability may be due to warm up.

A rather extensive leak had ~~occ~~ occurred at ~~fitting~~ dump pan exhaust valve (the cap on valve was not tight) This showed have been cleaned up before it dried. Solid washed from pan cover back into pan. Pan contains fair amount of solid.

Next experiment: 8" movable - tamped, single cylinder.
H/x = 29.8

DC 1/14/49

---

units #9

a high
Wyoming
- tank
e. about
been due
keng Dept

2 L d.d water -

nd
#1 cylinder -
w leaks.
pope ←

a purple

former for
latter
= means

ing tape -
+ new

glyptal.
discharge in

mechanical
+ shaker

wave
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PERSONNEL
CALLIHAN
CRONIN
FOX
McLENDON

EXPERIMENT #200 — H/X = 29.9 — 1-15-49

8" Al - MOVABLE, SINGLE - TAMPED - H/X = [redacted]

$\frac{2.96}{1.94} = 1.52$

TRIP POINTS:

#3 - OUT OF ORDER

#4 - 5.5 X 100

INSTRUMENT CHECK:

I, II, 3, 4, 5, P.M. - OK

REED - OUT OF ORDER!

TOP TAMPER ADJUSTMENT:

DISTANCE - TOP OF PLATE TO TOP OF TAMPER = 74.0 cm.

THICKNESS OF " = 15.4

89.4 cm

SINCE TOP OF BOILER PLATE TO BOTTOM (TOP EDGE) OF CYLINDER = 106.9 cm

89.4 "

THUS - TAMPER INDICATOR SET — 17.5 "

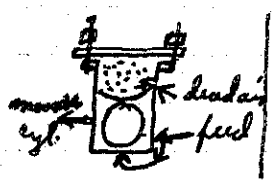
	SCALE	COMP. SCALE	ACTUAL	
CYLINDER SEPARATION:	4.4			
MOV. CYL. CONTROL ROD:	3.4	86.9	0	
" " SOURCE:	8.0	72.5	0	(ON BOTTOM)
FIXED " ":	REMOVED!			
" " CONTROL ROD:	15.0		0	

NOTE: FIXED CONTROL ROD & SAFETY ROD IN TAMPER ~ 4" FROM MOVABLE CYLINDER WALL. —

SOURCE POSITION: 13.0 — 5 cm -

SOLUTION HT.	#1	#2	#1 M⁻¹	#2 M⁻¹	REMARKS —
10:55					
11:00	(?)				D.V. Filled from #9

Due to difficulties caused (?) by blanking off 3" section - solutions drained and ~~not~~ inventoried as shown. As much air as possible was excluded from the line to prevent increase in size of the dead air space in 3" section.



If care is taken may be no increase in air space and lesser troubles trapped in sight glass line.

The fixed cylinder lead was blanked off at 3" flange

Solution #1

h_1	75.0
h_2	29.6
Δh	45.4
cm in 4" cyl	69.3
cm in 8" cyl	17.3

Movable fixed

Solution

SOLN

	SIGHT GLASS	TAMP AT @ (cm)
3:00 pm		
3:05		
3:09		
3:15		
3:30		
	HEIGHT	
3:35	8.8	7.8
3:45	13.4	11.2
4:00	16.3	14.3
4:08	19.4	17.1
4:19	20.0	17.6
4:30	21.2	18.8
4:43	22.2	19.8
4:48	22.4	20.0

Start gasket.

DRAIN BACK: #

1-15-49

$\frac{2.96}{1.94} = 1.526$

ED- H/X = [redacted]

ENT CHECK:
P.M. — OK
UT OF ORDER!
= 74.0 cm.
15.4
89.4 cm

EDGE) = 106.9 cm
DEP 89.4 "
17.5 "

ACTUAL

Solution Inventory before proceeding

	#1	#3	#9
h_1	75.0	65.5	62.8
h_2	29.6	38.3	40.8
Δh	45.4	27.2	22.0
cm in 4" cyl	69.3	41.5	✕33.6
cm in 8" cyl	17.3	10.4	8.4

Movable control rod zeroed and checked with previous reading. Fixed control rod 10 cm above bottom of cyl at 8 cm on scale

Solution just visible in Tygon tubing —

			Sight Glass	Δh	
0					
0 (on bottom)	3:00 pm	Sol'n Ht. (measured by tamper contact)			
	3:05	2.4	3.2	0.9	Filled from #9 to ht. indicated.
0	3:09	5.1	6.5	1.4	Started adding from #3 @ 2.4 cm.
	3:15	7.8	8.8	1.0	

From

3:30 Started filling tamper — Found water leaks around gasket. — Repaired & filled tank.

5 cm —

	HEIGHT Sight Glass	Tamper @ Cont. (cm)	#1	#2	C_0/C_1	C_0/C_2	
2:35	8.8	7.8	7.7 {8.0, 7.5}	{10.0, 10.0} 10.0			
3:45	13.4	11.2	12.0	14.5	.642	.690	Continued adding from #3. —
4:00	16.3	14.3	30.0	19.5	.385	.513	Start adding from #1 @ 11.2
4:08	19.4	17.1	39.0	34.5	.198	.290	
4:19	20.0	17.6	44.5	41.5	.173	.241	From #1
4:30	21.2	18.8	76.5	67.0	.101	.149	
4:43	22.2	19.8	188.5	165.5	.041	.060	
4:48	22.4	20.0	298.5	252.0	.026	.040	

REMARKS —

Filled from #9

solution

in as possible

the dead

DRAIN BACK: #1 — 17 cm in 8" cylinder.
3 — 9 " " "
9 — Balance including dead volume

These should be measured by N. —

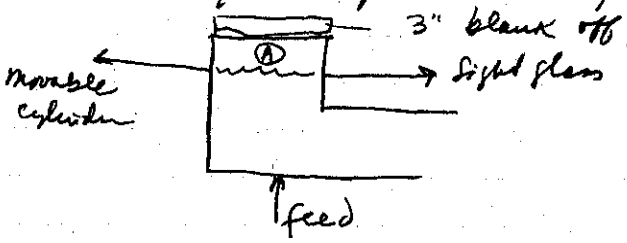
ed and

28 1/11/49 Exp 200 Cont

1/15/7

This was an unsatisfactory experiment to do.
① The sight glass reading was consistently higher than the height indicated by tamper during filling. This was as much as 10 cm at start, then after much wiggling of connecting tube was reduced to about 2 cm which was about constant during the run.

② There is an element of danger in the experiment as done by the present rig as follows:



Space (A) is filled with air & calcet additional air. If there were to be a surge of air in feed line (from say an empty cylinder) at near criticality it would stop in A and displace a slug of liquid out of the connecting tube and into the (single) reactor.

③ The following was the procedure:
a) About 5 cm solution was put in reactor (measured by instruments showing source to be covered).
b) The levels in the storage cylinders were measured (N_2) and the N_2 displaced from solution manifold, to avoid putting air into (A).
c) The #1 control rod was reversed on its pulley to put it close to #2 cylinder - thereby giving two effective control rods.
d) Operation was about normal except solution height was measured by #2 top tamper position. The #2 top tamper end indicator had been set by measuring its position with respect to plate & checked at another level).
e) Degree of solution addition determined by instrument response - in general no more solution was added than rods & tampers were worth.

④ The data are not standard as plotted, but both Counters extrapolate to 20.5 cm.

which height inde
Dr 1.45
Sugg
{
2
3
Ca
J. 45
1/13/4
3/4/49 DC
Exp 20
#2 8"
Hc =
H/x = 2
Conc =
Ag =
Vc =
Mc =

= to do.
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per
at start,
was
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is filled
select
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2 cylinder -
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solution
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been set
mped &
ned).
med by
no more
stages

led.
20.5 cm.

which is to be compared with 19.3 cm critical height (uncorrected) in #1 cylinder alone. This indicates a 20.5 - 19.3 = 1.2 cm correction - On earlier experiments the correction used was 1.45 cm for 8" cylinder -

Suggestions: ① Do 6" cylinder next - #2 need to be fitted with tubing - in exp. room now. Glycerine & clamps in cabinet, exp room.

[Instrument status: #1, 2, 4, 5 OK - #3 no good & its trigger shorted out. #6, Reed seems ultrasensitive went to 1000 scale & then had to regard.]

② We probably should take samples of this solution now at this point.

③ Upon Connecting cylinder & extrusion to ~~tube~~ truck should be replaced with ~~not~~ pipe leaving a ~~one~~ short section of Lucite - Value & pipe formerly in has been washed & is in Run 10 -

Call me - 5432, if there is a question - DC
1.45 D
1/15/49 -

3/4/49 DC

Exp 200
#2 8" Al cylinders, Tamped.
H_c = 20.5 cm.
U/X = 29.9
Conc = 0.394 gm X/gm = 0.759 gm X/cc
ρ_g = 1.926
V_c = 6.65 ℓ
M_c = 5.05 kg.

1/16/19

Interrun Time.

For Moneghan Murphy

1. Drained Soln from Inner Tube.
2. Took Sample Measured SpG = 1.926
3. * Two sets Analytical Weighings for H/X See Anal. Wgt. Bk.
4. Installed. Removed External Connection between Cylinders with Tygon Soft Glass
5. Fitted up 6" Cylinder with double tube. Pressure tested Some. OK
6. Removed Wash Tank & solution blown off flange & installed 2 6" cylinders.
7. Moved cradle back to final cylinder control position.
8. Removed movable control rod.
9. Washed down movable cylinder & connecting line with 200 cc double distilled water before removing from system & after taking sample. Solution drawn into cyl #6. No spills in any operations

Length of liners for #2 cylinder

inside 74"
outside 71" (NB. top shirt here should be 73")

*

Two 6

#3 out

Some @

Time

3[0]
3[25]

4[05]
4[12]
4[20]

4[53]
5[09]

5[25]
5[47]
6[09]
6[33]

Hgt.

Dec

6.0

Rate of Comp

6.1
10.–

17.1
18.5

19.6
20.
21.
21.

Wi

Slight a

NB → Co

Readi

Dolly

New Dolly

Rest

1/16/49

For Moneybow Morfitt

Experiment 201 A

For Moneybow Morfitt

Two 6" Cylinder Tamped in Contact H/X = 30

Trip Point on # 5.3

H/X = 29.9

#3 out of circuit; #4 on 10-scale #5 on 6-scale, #6 N.G.
Both counters O.K.

weighted 4 & 4' Bk. Cylinders

Source @ 7.8 cm Actual height 7.0 cm to contact rod on movable cylinder, Zero on Fixed Central Rod @ 13.0 cm.

Cylinders Slightly out of line 1/2" (out of vertical) separation at 36 height in contact at bottom. Got down inside to check.

Time	Hgt. (cm)	#1	#2	C_1/C_{01}	C_2/C_{02}	Remarks.
3[00]	Dead Volume	~~One cylinder only~~. from #9				#9 empty.
3[25]	6.0	#1 Cylinder Only.				From #3

Run two equilibration checks here Finally OK at dropping rate of 2 cm/min. Source reset to 5.8 on scale.

4[05]	6.15	12.5, 12.5	6.0, 6.0	1.0	1.0	From #3
4[17]	10.—					#3 H.T.
4[20]		15.	8.5	.83	.706	From #1. Tamper check
4[53]	17.1 cm.	32	22	.391	.273	
5[09]	18.5	43	34	.29	.18	
		Source Jerk (OK)				
5[25]	19.6	65	54	.19	.11	
5[47]	20.5	115	101	.11	.06	Est. Crit 21.6
6[09]	21.2	—	—	—	—	" " 21.7
6[33]	21.5	—	—	—	—	

to be 73")

With Rod all way out Source Jerk gave curve on # Just Critical Slight drop was noted after 2 minutes but not adjudged Significant

NB → Conclusion Critical at 21.5 cm. ± 0.1 cm.

→ EXP 201B

Reading on Tamper 23.5 cm.
Dolly Indicator 0.9
\+ 2.9
New Dolly Reading 3.8 cm

Separation 2.9 cm.

Reset Tamper [redacted] points to 23.5

Counter #1	71	C_0/C_0 = .18
Counter #2	55.5	C_0/C_0 = .11

SEPARATED 2.9 cm.

Soln Level	C_1	C_2	C/C_1	C/C_2
24.1	187	172	.061	.035

According to calculations we were due to go dry at any minute. We stopped & took multiplication measurements as given above. Multiplication was about 30 & two individual curves extrapolated fairly well to

Est crit. 25.6 cm. @ 2.9 cm separation with H_2O

Further counts were taken on the downstroke as given below.

	C_1	C_2	C/C_1	C/C_2
18.4	96	32	.27	.19

Drawback

in terms of cm of height in one-6" cylinder

#1 - 24 cm = 28.5 cm in single 5.5" cylinder

#3 24 cm = 28.5 " " "

#9 Dead Volume + 1 cm. = 1.2 cm in single 5.5" cylinder

Comments on accuracy, instrument

The zero for the fixed cylinder was determined by measuring top temps (which was same as other day) & noting the agreement between solution height as read by sight glass & point at which top temper hit solution. From this we would say zero is correct within minimum observable error of possibly ±0.2 cm. Zero on movable cylinder had to be determined in some way since it is impossible to see down into the 6" cylinder.

Instrument Reed
in an
believed, extra
necessary to
were being
respond well
because of
& not lower

3/14/49
DC

Exp 201
2-6" Alkyl
separation
He = 21.5
Hx = 29.9
Conc = 0.3
App gr = 1.
Vc = 4.
Mc = 3

Instruments

Instrument Reed is at present completely inoperable. ✓ #4 ion chamber believed, in an extremely [redacted] extremely erratic at times making it necessary to hold down reset button while tampers & counters were being adjusted. #5 chamber although it seems to respond well, cannot be used on the less sensitive scales because of a high "zero" reading the main zeroing knob does not lower [redacted] reading sufficently. #3 NG as before

J W McAfee

3/4/49 DC

Exp 201 A
2-6" Al cylinder tamper
separation ~~0cm~~ 0.1cm.
$H_c = 21.5 + \frac{2.6}{2} = 22.8$ cm.
$H_x = 29.9$
Cone = 0.394 gm x/gm = 0.759 gm x/cc
$\rho_p / \rho_x = 1.926$
$V_c = 4.16$ ℓ
$M_c = 3.16$ kg

201 B
-
2.9 cm
$H_c = 25.6 + \frac{2.6}{2} = 26.9$ cm
$V_c = 4.91$ ℓ
$M_c = 3.73$ kg.

1/17/49

Macklin
Fox
Mooneyham
Callihan

Removed & stored 6" cylinders.

Installed 5½" cylinders - The fixed cylinder water flange is gasketed with ½" sponge rubber sheet in order to aid in alignment of the fixed cylinder.

The flexible connection between cylinders within the tank is as follows:

Solution line - grey-brown gum rubber tubing - ½" ID × ¼" wall

Outer tube - Same as before - grey-brown rubber - 1½" ID × ¼" wall.

This solution tube fits the connections (metal) more snugly. Non-adjustable hose clamps were used to fasten it - the non adjustable fit inside outer tube better than the adjustable, particularly since it is so difficult to cut off adjusting ~~swing out~~ thumb screw. However this inner tube has a smaller diameter outside leaving a larger annulus between the tubes which ~~to~~ may make it subject to more easy kinking. Also it is more buoyant and must be weighted into the water.

Bukker [?] & Carmichael worked on instruments most of day. #4 & #5 seem ok, and 1 & 2. #3 is sensitive to #5 Brown recorder switch. #3 tripper still shorted out. Reed head replaced by one from Burns - still not operating, however.

It is proposed to run 5½" cylinders first in contact, then at some separations —

It is necessary to ~~tu~~ mount #2 - 5½" cylinder so its entrance spout is ~~tow~~ towards operating room to prevent its collision with #1 cylinder.

JC

1/18/4[9]

Callihan
Cronin
Mooneyham
Henry

Instrumen[...]
Trip[...]
Sca[...]

Indicator[...]

Control R[...]
Source
Cylinder
#2 Sour[...]

Experimen[...]

Time	Ht (cm)
12:35P	Considerabl[e] [...] between [...] to #2 [...] after [...] connect [...] to prove [...]
2:00	2.95
2.02	
15	7.6
20	7.8
2.25	11.3 (Blu[e])
30	10.6 (Glass); 10.2 #1 Temp; 10.6 #2 "
40	15.6 (S.G.); 15.1 #1 Temp; 15.6 (#2 ")
55	18.9 S.G.; 18.3 #1 T.; 18.6 #2 T.
3:12	22.0 S.G.; 21.4 #1 Temp; 21.9 #2 "
27	23.9 S.G.; 23.9 #1 Temp; 23.3 #2 "
45	24.2 S.G.; 23.6 #1 Temp; 24.2 #2 T
4.05	24.8 S.G.; 24.2 #1 Tem[p]; 24.6 #2 [...]

1/18/48

Callihan
Cronin
Monaghan
Henry

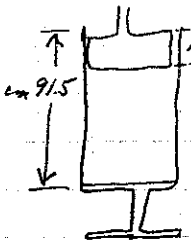
$H/X = 29.9$

Experiment 202

Two 5½" Aluminum Cylinders in Contact – Tamped

$H/X = -30$

Note: Fixed Source Pulley bracket slotted for adjustment 2. Fixed top tamper adjusted by direct measurement.



91.5 cm
base 1.2
inside = 90.3 cm
tamper 15.4
74.9
off to top of tamper 0.9
74.0 cm bottom of tamper to base inside

Instruments

Trip points: #3 – Set at 78 x 100 Not operating. #4 – 55 x 100

Scales: #3 x 10; 4 x 10; 5 x 2; Read out of order –

Indicator Positions (see also pg 36).

	Scale	Compensator	Actual
Control Rod #1	10.3 cm		3.5 cm (Bottom from bottom of #1 cylinder).
Source #1	7.8 "		7.0
Cylinder Separation	0.5 "		0.5 cm (head on #1 prevents closer approach)

#2 Source + #2 control rod not in use.

Experiment

Time	Ht (cm.)	#1	#2	M_1^{-1}	M_2^{-1}	Remarks
12:35P						Filling #4 from #9.

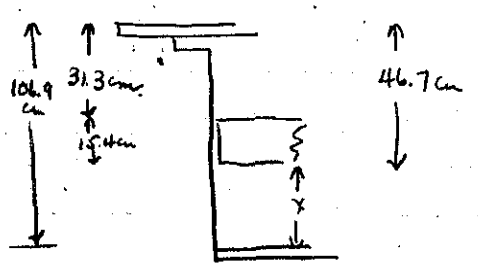
Considerable difficulty was encountered in establishing that there is free flow between the cylinders. Closing off #2 + filling #1 from zero to 5 cm then opening to #2 resulted in a residual Δh of 3 mm after 6 min + 0.1 cm after about ½ hour. This longer equilibrium time may be due to the connecting tubing now being ½" – formerly ⅜" – Decided to proceed – as greater heights are reached this may be less of a problem

Tamper fixed – #9 Empty. Filling from #1 –

2:00	2.95				
2.02					
15	7.6	Both tampers down #2 tamper – 7.5 cm, #1 – 7.2 cm at contact.			
20	7.8	13.5, 12.0 } 12.8	12.0, 12.5 } 12.3		
2.25	11.3 (Blue back)				
30	10.6 (Glass)				
	10.2 #1 Tamper	16.0	14.0	0.80	0.88
	10.6 #2 "				
	~~10.7~~	~~23.5~~			
40	15.6 (S.G)				#1 Empty. Filling from #3
	15.1 #1 Tamper	23.5	24.5	0.345	0.302
	15.6 (#2 ")				
	18.9 S.G.				
55	18.3 #1 T.	34.5	38.0	0.371	0.324
	18.1 #2 T.				
	22.0 S.G.				
3:12	21.4 #1 Tamper	62.0	74.0	0.207	0.166
	21.9 #2 "				
	~~23.5~~				
	~~23.6~~ S.G.				
27	22.9 #1 Tamper	116.5	146.5	0.110	0.084
	23.3 #2 "				
	24.2 S.G.		~~247.0~~		
45	23.6 #1 Tamper.	195.0	~~246.~~ 246.5	0.065	0.050
	24.2 #2 T				
	24.8 S.G		479.0		0.026
4.05	24.2 #1 Tamper	371.5	488.5	0.034	0.025
	24.6 #2 "				

Exp 202 (Cont).

Re- Movable Cylinder Tamper.



X = 106.9 − 46.7 = ~~46.~~ 60.2 cm bottom of tamper to top of bottom of Cylinder
#2 tamper indicator so set.

#20 →

4:20 SG- 25.1 cm
#1 Tamp 24.5
#2 Tamper 24.8
NOT CRITICAL

CRONIN OUT- 4:30P.

4:50 Sight Glass 25.2 cm
#1 Tamper 24.7 "
#2 Tamper 25.0 "
NOT CRITICAL

5:10 Sight Glass 25.5
#1 Tamper 24.9
#2 Tamper 25.0(?)
Critical with Rod at 21.0 cm, i.e. 11.3 cm rod below solution level.

→ Critical · 25.3 cm of solution as measured on sight glass.
25.3 + 0.25 = 25.55 ≈ 25.6 cm ~~25.9~~ 25.6 cm corrected for sight glass zero.
Now to deposit cylinder 2.4 cm additional - i.e. total dep. = 2.9 cm.
#2 Top tamper indicator now at 27.6 cm.
Source replaced to 7.8 cm.
Dolley indicator now at 8.5 cm.
Moved dolley to 2.9 cm, i.e. 2.9 cm deposition
Reset #2 Tamper to 27.6 cm.

→ There was every indication that the activity decreased continuously during cylinder deposition.

			C_1	C_2	M_1^{-1}	M_2^{-1}
5:27P	Sight glass	25.5 cm				
	#1 Tamper	24.9 cm				
	#2 "	25.3 cm	74.0	88.5	0.173	0.139
45	Sight glass	27.1 cm				
	#1 Tamper	26.6 "	120.5	149.0	0.106	0.083
	#2 Tamper	26.4 "				
55	Sight glass	28.3 cm				
	#1 Tamper	27.7 "	332.5	431.5	0.039	0.029
	#2 Tamper	27.8 "				0.029

Exp 202 (Cont).

With all available solution it was possible to fill two cylinders to 28.3 cm on right glass. With 2.9 cm separation this gave a $M^{-1} = 0.03$ - Extrapolation of this and two preceding points gives $H_c = 28.9 \pm^{0.4}_{0.0}$ cm. = ~~29.5~~ cm corrected for right glass zero. 28.9+0.5 = 29.5 ∴ $H_c = 29.5 \pm^{0.4}_{0}$ cm

bottom of bottom of Cylinder cut.

It was thought of little value to attempt measurements at a different separation -

→ Instrument 1 & 2 - OK -
3 - erratic at times - having general unsteady background, no observed response to switchings. | Dr did not stop. → Ec Brown does not turn up proper. Inst. Maintenance is working on it.
#4 - OK
#5 - OK
#6 - Out of order - New Speedomax motor installed

i.e. 11.3 cm used.

Drain back: #1 - 31.0 cm in one 5½" cylinder ≡ 9.3 cm in 1-10" cylinder
#3 - 25.6 cm in one 5½" cylinder - = 7.7 " " 1-10" "
#9 - Dead volume -

t glass. no. p. = 2.9 cm.

The #1 top stopper was rinsed off & removed - in order to check the zero of the right glass - for this cylinder
The zero was found to be at ~~0.0~~ 0.6 cm on scale - That is, all sight glass readings are low by 0.6 cm. Expanded on next page

There was every indication that the activity decreased continuously during cylinder separation.

The top of boiler plate has ~1000 counts -
Please label wash bottles to show their contents -

An attempt was made to drain flexible tubing inside tank -

Suggest 10" cylinder next -

The ½" ID connecting tube now on 5½" cylinder is not satisfactory - too much time required for equilibrium -

DV

See pg 38 for summary

1/19/49

Moorpark
Mod. II
Cornin
Cathcart (Kday)

Interview Time

1. Checked zero on Cylinder #1 (5½")
When solution "down" with guide Sight glass after Slow-Lock
-2.5 mm.

2. 5½ Cylinders (fixed and movable) removed and stored

3. 10" Fixed Cylinder and tamper installed. (bolts not tightened

10" Movable Cylinder
4 section cut out to allow control Rod to swing close to cylinder.
0- Cylinder painted with Glyptal

4. Prints for 5" Cylinders Reviewed and sent to shop including top tamper.

5. 4" Cylinders for storage order from shop.

6, Leads in end plug on dump pan drain repaired.

1/20/49 COMPLETED INSTALLATION of 10" CYLINDERS.

20/4/49
DC

Exp 202 A
2-5½" Al Cylinders, Hanged
Separation 0.5cm
$H_c = 25.6 \pm \frac{3.0^k}{2} = 27.1$cm
$H/x = 29.9$
cone = 0.394 gm X/gm = 0.759 gm X/cc
$S_{fp} = 1.926$
$V_c = 4.15\ell$
$M_c = 3.15$ kg

202 B

$= 29.5 + \frac{3.0^k}{2} = 31.0$ cm
2.9cm
-
-
-
$= 4.74\ell$
$= 3.60$ kg.

1/20/

TWO

a) TW

INS

IND.

~~COUNTER~~

COUNTER

10:55A FILL ING
11:05 CHECKED
Sight gl
Installe
~~12:10P H = H (c~~
~~12:10P 1.4 cm~~
12:10P CLOSED
H = 1.4
12:15 = 4.1
= 4.1 c
12:18 Opened
[Reed
12:22 ~~at~~ Cl
25 H = 3.5
du
30 Filled

1/20/49.

MORFIT

FOX

CRONIN

CALLIHAN.

EXPERIMENT 203 - | H/x = 29.9 |

TWO 10" Al CYLINDERS - TAMPED, H/x = 29+

a) TWO CYLINDERS IN CONTACT.

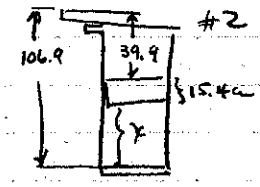
INSTRUMENTS: TRIP POINTS: #3 - 74 x100

#4 - 5 x100.5

SCALES - #3 x100 #4 x10, #5 x1, #6 x25

INDICATORS:	SCALE	COMPENSATOR	ACTUAL.
#1 SOURCE -	NOT IN USE		
#2 SOURCE	~~12.3~~ 7.8 cm.	~~77.8~~ 78.2	3 cm.
#1 CONTROL ROD	8.4	—	0
#½ CONTROL ROD	3.5	83.0	0
MOVABLE CYLINDER	~~12.0~~ 11.7	—	0
~~COUNTERS: #~~			
#2 TAMPER -	~~5.6~~ out	—	51.6
#1 TAMPER.	out.		

TOP #2 TAMPER to TOP of PLATE = 39.9 cm

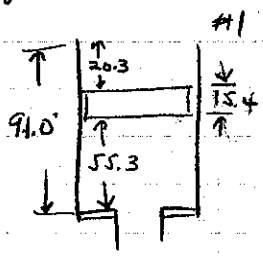


x = 106.9 - (39.9+15.4)
= 51.6 cm.

COUNTERS - #1 27" from edge of tank
#2 27" from edge of tank
} This arrangement puts #2 3" nearer source than is #1.

10:55A FILLING DEAD VOLUME FROM #9.

11:05 CHECKED for solution leaks.
Sight glass checked - Reading = ~~0.1~~ 0.0 cm with liquid at grid.
Installed #1 tamper & set its indicator at 55.3 cm



~~12:10P # H (cm) C_1 C_2 M_1^{-1} M_2^{-1}~~

~~12:10P 1.4 cm~~

12:10P Closed valve between ~~tan~~ cylinders, filling #1 for free flow check.
H = 1.4 cm #9 empty, filling from #3.

12:15 = 4.1 cm — before blow back.
= 4.1 cm after blow back.

12:18 Opened connecting valve - no flow - probably air lock - hose shaking now in progress, H = 2.5 cm -
[Reed, #6, out of order, #5 very unstable]

12:22 Re-closed connecting tube valve - added .1 cm to #1 cylinder.

25 H = 3.5 cm (in #1 cylinder). Upon opening valve sight glass dropped 0.5 mm in 1 min - this is about one half the head.

30 Filled tamper tank.

Experiment #03 (Cont).

	H (cm)	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks.
12:45	2.1					Slow filling from 3 -
48	~~4.1~~					#3 Empty.
50	3.8 (right glass) 2.8 (#2 tamper contact #1 tamper not in contact, limit switch.					
		8.0	15.0			
		8.0/8.0 = C_0	16.0/15.5 = C_0			
1:06	~~5.4~~ ~~5.5~~ } before blow back. 5.2					Filling from #1
	5.0, S.G. } (after 5.1, #1 Tamper } blow back. 5.0 #2 "	11.5	19.0	0.696	0.795	
:26	5.8 S.G. 5.6 #1 Tamp ~~5.6~~ #2 "	13.5	22.5	0.592	0.689	Both control rods puttin
40	6.7 6.8 S.G 6.5 #1 Tamper 6.5 #2 "	17.5	28.0	0.457	0.552	Sche
55	~~7.7~~ 7.8 S.G. 7.5 #1 Tamper 7.5 #2 "	24.0	36.0	0.333	0.430	
2:10	~~8.7~~ ~~8.9~~ cm S.G. 8.5 cm #1 T. 8.3 " #2T	38.5	53.5	0.208	0.290	#1 Empty. Instrument #4 responds to tamper switches.

3/4/49 DC

4p 20:
Two
Sepa
Hc =
H/X =
Core
Sph
Vc
N

The multiplication curves given by the two counters are not colinear & interpolate to: #1 10.2 cm & #2 = 10.8 cm. It is planned to move #1 - 3" towards the reactor - this puts the the counters equidistant from the source. Counts will be taken on drain back to investigate ~~its~~ counter geometry. #2 is unmoved.

				M^{-1} based on 2:32 PM zero I	M^{-1} based on 2:32 PM zero II	
2.30	8.6 SG 8.5 #1T 8.4 #2T	43.5	55.5	0.230	0.279	Draining water #1
:42	7.0 SG 6.9 #1 T 7.3 #2 T	22.0	29.0	0.455	0.535	
:47	4.9 S.G 4.9 #1 T 5.3 #2T	13.0	20.0	0.770	0.775	
56	2.9 SG 3.0 #1 3.0 #2	10.0	15.5	1—	1	

Draining water #3 to zero -
D.V. into #9

1/20/49 Exp 203 (Cont)

Remarks.

Filling from 3 -
3 Empty.

eling from #1

Both control rods puttin

#1 Empty.
rument #4 responds
to tamper switches. 3/9/49 DC

Counters
2 cm
rom the
from the sources.
der geometry.

Draining into #1

Draining into #3
to Zero -
D.V. into #9

Conclusion -

a) Two ten inch al cylinders, in contact + tamped were filled to 8.7 cm (each) with available solution (H/x = 29.8). They were not critical but extrapolation gives Hc = 10.2 ~~10.8~~ cm.

b) Estimate present inventory at this H/f = 9.8 kg X. Held up, believed to be in #5 + #6 + recovery. #5, #6 contain about 10 ℓ and about 1-1.5 kg. of X

c) Attempt to improve counter geometry unsuccessful —

Schedule - Dilute to H/x = 45 - Do 10" cylinder experiments. Dc.

Exp 203 -
Two 10" al cylinders, stacked.
Separation - 0 -
Hc = 10.5 + ~~11.0~~ $\frac{0.93}{2}$ = 11.0 cm
H/x = 29.9
Conc = 0.394 gm X/gm = 0.759 gm X/cc.
Sp gr = 1.926
Vc = 5.57 ℓ
Mc = 4.23 kg.

1/21/49

Calculations of H/X – Exp 194-203 inclusive

		gm U/gm sol.	gm U/gm sol.
a) Analyses – Samples	194	0.418	0.394
	194A	0.426	
	200	0.417	0.394
	200A	0.426	
	ave	0.422	

Spectrographic	Sample 194 ppm	Sample 194A ppm	ave % wt fraction
Cd	100	100	0.0001
Cr	100	60	0.0001
Cu	500	400	0.0005
Fe	500	300	0.0004
Ni	2000	2000	0.0020
Zn	100	100	0.0001
Al	100	100	0.0001
		Total	0.0033

Uranium 0.422 gm U/gm sol.

Oxygen content due to UO_2F_2 = 0.057 = $\frac{32}{235.2}$ 0.422

F_2 " = 0.062 = $\left(\frac{38}{235.2}\right)$ 0.422

Impurities = 0.003

0.550

H_2O 0.450 gm/gm sol.

H_2 0.050

O_2 0.400

$H/X = \frac{\text{moles } H_2}{\text{moles } X} = \frac{0.050/1}{0.394/235} = \frac{0.050}{1}\ \frac{235}{0.394} = 29.8$

Monday

for Cronin
Quinn
Olsen
Callihan

D.I

A
R
C

Dun

2:30P Filled
Checked
3:00 Filled
3:10 H 10.2 cm

3:15 Filling
:20 12.0 cm.

3:35 11.8
3:55 19.0
4:05 25.1
4:15 38.0
25 ~~46.8~~ 46.7 ~~42.2~~

46.5

Inventory

Conclusion -

* This part
solution, adde
cylinder at t
All cylinder is
knowing the H/

1/21/49

Exp 204

Marshall
for
Cronin
Quinn
Olsen
Callihan

Dilution from H/X=29.8 to H/X=45.*

At present there at ~12.8 ℓ of H/X=29.8
Required are ~ 6.5 ℓ of water
To be used are ~ 1 ℓ washup from lab.
~ 3 ℓ " " #6
~ 2½ ℓ " " #5

Dead volume = 3.5 ℓ.
9.2 - 8" Cans = 3.0 ℓ
6.5 ℓ. to be added

TRIP PTS -
#4 - 5.25 x100
#3 - 78 x100 -
Instrument Scales -
#3 x100
#4 x10
#5 x2
#6 - 25 -
Source at 10 Cm -

Wt fraction

Installed 8" ~~cylinder~~ #1 cylinder for mixing - submerged

0001 2:30P Filled dead volume from #6 -
0001 Checked zero of sight glass - scale = 0 when grid is covered.
0005 3:00 Filled to 6.9 cm from #5, mixed by blowing through sight glass.
0004 3:10 H 10.2 cm C1 17.5 C2 21.5 This 10.2 cm was height after mixing - Drain back to 9.2 cm into #5 -
0020
0001
0001 ~~Filling~~
3:15 Filling from #9. N1 N2
1033 :20 12.0 cm. 19.5 23.0 0.90 0.94

Drain solution out 3:20P.

5:35	11.8	27	37	.649	.581
3:55	19.0	35.5	60.5	0.494	0.356
4:05	25.1	39.0	71.0	~~0.247~~ 0.450	0.306
4:15	38.0	44.0	80.0 81.0	0.398	0.266
25	~~46.8~~ ~~42.2~~ 46.7	45.0	83.0	0.389	0.259

#9 Empty, Filling from #3 -
#3 Empty, Filling #1 -
For 4 Maximum -

This height was measured from 42.2 to 46.7 by mixing solution probably - an accumulation of losses out in 3" cell.

46.5 With ½" IPS line full

~~Draining~~ Draining into #1.

Inventory

#1 - 15 cm
#3 - 15 cm.
#6 - 15 cm
#9 - 1.7 cm
} in 8" cylinders plus D.V.

$\rho_{\#1}$ = 1.667 gm/cc

$\rho_{\#9}$ = 1.662 gm/cc.

#5 contains ca 4 ℓ washup

Conclusion - 8" Al cylinder, submerged - ∞ safe at this H/X -

* This part of the experiment performed chiefly to mix & dilute the solution, added no real new criticality data, since the stainless steel cylinder at this concentration was safe at 2 height & an unstamped Al cylinder is presumed to be more safe. There is no real need of knowing the H/X more accurately than is given here.

MOONEY HAM
FOY
McLENDON
CALLIHAN.

Density of solutions prepared 1/21 measured ~~and~~ as 1.66 gm/cc which corresponds by the curve to H/x ~ 41. This is too low so plan to dilute further with soakage from #5 -

N.B. About six man hours were spent cleaning Room 10 ~~plumbing~~ mostly a spit, (~ 1 gm) which apparently occurred Sunday 1/16/49 and resulted from solutions left in the ½" pipe connection for the two reactor cylinders. This Sunday crew had been erroneously informed that the plumbing had been cleaned. This points up the necessity of carefully labeling items, and of cleaning up as we go. DL.

Measured solution in #5 assuming it to be of density = 1 gm/cc.

Manometer ~~Δh~~ h_1 h_2 Δh

Conv 43.0 17.2 ≡ 50.7 cm in #5
≡ 4.1 ℓ

Calculations based on present density indicates 2.8 ℓ required from #5 -

Proposed to add more dense ~~the~~ solution to reactor, then from #5, then balance of dense. amount taken from #5 to be determined by periodic manometer measurements.

This will requires taking solution from #5 until Δh on manometer is 5.5 cm

Time	Sol. ℓ
12:35 PM	
12:45	4.2
12:50	14.1
1:00	17.5
1:05	20.1
1:15	25.0
1:22	33.0
1:26	34.5
1:40	39.0
1:50	44.2
2:00	45.4
2:05	50.2
2:06	49.5
2:17	59.0
2:20	58.4

Trip Se

Conc:

Exp 204 A H/X = 52.9 1/22/49.

Fox
NICLENDON
MOONEYHAM-
CALLIHAN

8" Untamped - 4 mix solution - H/X = 53

TRIP POINTS - #3 - ~~7.4~~ 7.4×100; #4 - 5.4×100.
Scale - #3×100; #4×10; #5×2; #6×.25

Source 13 cm. above bottom - scale reading 10.0 cm.

Time	Sol. Ht.	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
12:35 PM		—	—	—	—	Filling from #9
12:45	4.2	—	—	—	—	#9 empty
12:50	14.1	19.7 19.5, 20.0	49.0 42.0–50.0	—	—	Adding ~~[illegible]~~ from #6
1:00	17.5	—	—	—	—	#6 dry
1:05	20.1	28.0	87.0	0.704	0.554	Adding from #3
1:15	25.0	31.5	111.0	0.626	0.443	" " "
1:22	33.0					#3 empty
1:26	34.5	38.5	150.5	0.499	0.326	
1:40	39.0					Adding washings from #5
		Bubbled air into 8" cylinder and blew back site glass. New site glass readings				
1:50	44.2	43.5	175	0.453	0.280	
2:00	45.4	Blew back to homogenize				
2:05	50.2	Mix and blow back; reading more ↗				Adding from #1
2:06	49.5	43.5	183.0	0.453	0.268	" " "
2:17	59.0	M^{-1} vs. Soln. Ht. curve flat				#1 empty
2:20	58.4	44.5	192.5	0.446	0.255	Mixing and blowing back

Conc: 8" Al untamped single cylinder not critical at this H/X

Inventory: (7.1 cm in 4" cyl in #5)

#1	15 cm in 8" cyl.	$\rho_1 = 1.564$ H/X = ~51
#2	13.4 cm.	
#3	15 cm.	$\rho_3 = 1.566$
#6	15 cm.	
#9	D.V	$\rho_9 = 1.566$

46 1/22/49 (Cont)

Cronin Fox Moffitt

Two – 8

The dilution from #5 was overshot i.e. about 2 – 8"cm excess added which has reduced density to 1.566 and raised H/X to about 51. This is tolerable though not preferable.

Specific gravity →

Removed 10" #2 Cylinder. Tamper threads were apparently frozen to the stainless connector and all threads were removed. Damage may be irreparable. This right-left hand thread coupling is not satisfactory. Top of 10" tamper had large encrustations of U.F. – The brick was removed mechanically and is now going into wash to in #34 hood. solution. Can be combined with other

Trip Scales

Bac Sol'n Ht. 5.8

Analyses 1/28/49
#204 – 0.3139 gm U/gm
#2048 – 0.3144 gm U/gm
= 0.2939 gm X/gm sol.
H/X = 52.9 ←
Uncorrected for impurities. These will lower the value to ~52.8
re-Checked 3/7/49 by DC v/gm.

Took two samples taken for lab. These have been packed in wooden carrier & put on top of safe – (See Anal Wkt Book, pg 14)

12:20	5.7
12:25	7.4
12:40	8.3
12:51	10.2
1:04	11.6
1:17	12.–
1:43	12.8
1:55	12.9
2:12	12.

One Zuto has weak battery, it is in box on safe also.

Aligned #1 8" Cylinder – water flange seal not guaranteed.

Had spill in taking apart flange, (entrance to tank) which connects Cylinders. Cleaned up; although the washing on 2" table in lab. need to be considered, in the black opal can.

205A →	Con

Movable 8" reactor in position – Hose not connected.

2:20	Tampers lo
2:25	12.9

Instruments operated well today.

DC

Cronin
For
Morfitt

H/X = 52.9

1/23/49

Experiment 205A

(? see 1955 DC 7/14/49)

Two - 8" Aluminum Cylinders, (in contact) Tamped

Trip Points: #3 = 84 #4 = 6.1 (Readjusted to this value) H/X = 53

Scales #3 x100, #4 x10, #5 x2 #6 x25

Tampers #1 & #2 Measured & Adjusted.

Zero Readings

	cm
#1 Source	OUT
#2 Source: Compensator	78.4
Control	-0.5
#2 Control Rod. Compensator	85.2
Control	3.5
#1 Control Rod	8.0
Separation	8.0

SOURCE READING 4.5

Background Counts

Sol'n Ht.	#1	#2	
5.8	(13.5)	(17.0)	use.
	13.0	17.0	

		Background		K.	K.	Remarks
12:20	6.7					Filling from #6
12:25	7.4	~~24.0~~	~~25.0~~	~~.62~~	.71	6 H.T.
12:40	8.3	21.0	24.0	.62	.71	
12:51	10.2	32.0	34.5	.42	.49	
1:04	11.6	67.0	66.0	.20	.26	
1:17	12.3	130	124	.104	.137	Est crit @ 13.0
1:43	12.8	—	—	—	—	Est crit @ 13.0
1:55	12.95+	Just subcritical with Tampers down rods in.				Est crit 12.9
2:12	12.9	Critical with 3cm #1 control rod in.				

	Old Setting	New Setting	
#2 Tamper	16	16.0	} Separated 2.9 cm.
# Separation	8.0	10.9	
#2 Compensator	85.2	83.7	
Source Comp.	78.4	76.9	

Separated 3.8 cm - see 1960 DC 7/14/49

205A → Conclusion: Critical @ 12.85 ± 0.5 mm. when in ~~contact~~

Experiment 205 B. Ditto 205A with ~~2.9~~ 3.8 cm separation

2:20 Tampers lowered, Control Rods Removed. Counted.

2:25	12.9	66	65	.205	.26

205 B Continued

(20.1 c).

At this point, the field cylinder source was brought into position & the system recounted.

3:05	12.9	70	69	(.19)*	(.25)*	

Source #1 was checked to see where response plateau was, (yes not determined exactly) @ 5 cm. & #5 counts moved to give best response on motion of small source alone. Response small but real

3:30	13.6 13.9	113	109	(12)*	(.156)*	Est crit 14.6 cm. changed to #2

danger of #3 going empty

* The numbers in parentheses are the reciprocal multiplication determined in the usual way but with the extra (field source) contributing extra neutrons. Compare 2:25 PM & 3:05 readings, ~~[illegible]~~ without #1 source & with #1 source respectively. Though the readings are uncorrected for any change in background, they are conservative in the sense that the extra counts mean lower reciprocal multiplication at a given height thus predicting a lower critical height than actually would be expected.

3:55	14.4	Not critical Too high & count. Est crit. 14.6 cm. From Cyl #2
9:00	14.7	~~Super~~ Critical with 11.0 cm #2 control rod.

Since 14.4 not critical, 14.7 super-critical, reproducibility of source jobs 0.5 mm.

205-B → Conclusion: Critical @ 14.55 ± 1 mm. @ ~~3.9~~ 3" cm separation.

	Old Reading	New Reading	
#2 Tamper	16.1	16.1	Separated 4" (One Radius)
Separation	10.9	18.2	
#2 Core	83.7	80.1	
Source Comp	76.9	73.3	

Experiment 205 C

Two 8" Al Cylinders Tamped at 4" (10.2 cm) separation (One Radius)

4:45

4:55
5:08
5:25
5:32
6:40

However, At wa

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205 C (cont)

brought	9:45	14.4	39,41	41,40	.34	.92
		Filling from #3 again & empty. empty @ 15.2 cm.				
		Estimated criticality 17.0 cm.				Filling from #2
15)*	4:55	16.0	66	65	.20	.26 Est crit 18.2 cm
	5:08	17.2	157	151	.086	.113 Est crit 18.1 cm.
and room,	5:25	18.0	Critical with 15 cm #1 control rod in.			
in bed	5:32	17.9	" " 7 cm #1 " " "			
2 but real	6:40	17.7	Just critical with both rods completely out			

6)* Est crit 14.6 cm. — changed to #2

Conclusion: Critical @ 17.7 cm. + or cm @ separation of ~~4~~ ½ diameters.

Drainback - Inventory — cm in 8" cylinder

#1 -	15
#2 -	
#3 -	15
#6	15
#9	D.V.

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~~4~~
Ths
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ecting a
r.

4.6 cm. From Cyl #2
ontrol rod.

if of upper two
, 7.9 cm separation.

However, It was decided not to continue separating the cylinders farther until the following "source question" has been investigated.

) separated
4"
(One Radius)

In our opinion (subject to further verification) the small "fixed cylinder source" #4 is of little or no value in fulfilling its function. It does not appear to be strong enough to be used as a criteria of criticality by the source jerk method. Only under the most careful conditions could any detectable

ration (One Radius)

effect be observed on motion of the small source.
At this power level at which criticality is usually
approached it effect was nil.

Within one ~~mm~~ nnn (8" cyl.) of criticality with both tampers
down, control rods in, no effect was noted on any instrument
on completely removing small source & remeasuring.

At small separations (<2") only one source is needed. At large separation (~4") the small source is useless. It is in this region that a second source seems desirable, to keep cylinders from becoming critical independently.

A check after the experiment showed the source had been at approximately 7 cm from bottom (source had been set at extreme lower point of ~~unit~~ unit.)

Suggest:
1. Close strength small source
2. Try NaI source in water
3. Obtain 0.1 curie RaBe source if available.

1) Tight
atten

2). Obtai
when
n/sec
These
was.

3). Explan

4). Simple

5) ~~But~~ -

6) On

1/24/48

Macklin
Mooneghan
Fox
Callihan -

1) Tightened close nipple into 3" pipe in an attempt to stop leak. Nuds to be tested.

2) Obtained source from Mann, X-10, about 1/2 strength of larger of the two used 1/23 (1.3×10^7 n/sec on 8/8, 47; ours was 2.86×10^7 n/sec 8/11/47) These two, in the two cylinders, may be satisfactory. The X-10 source was mounted in a holder made here & shipped. X-10 holder ~~temporary~~ in big crate.

3) Ordered chart paper.

4) Samples to Lab.

5) ~~Started~~ Started shop in 5" fixed cylinder fabrication.

6) Ordered two BF_3 counters from X-10.

52 1/23/49

Exp 205 (Cont)

H/x = 52.9

MOONEYHAM
PRESSEY
CRONIN
CALLIHAN.
CONEYBEAR

2-8" Al Cylinders Tamped

H/x = 50

A stronger source has replaced the ~0.1c used 1/23/49 in Cylinder # 1. in order to protect against a single cylinder reacting critically in the absence of a source. The interaction investigation is to be extended.

Exp - 205d

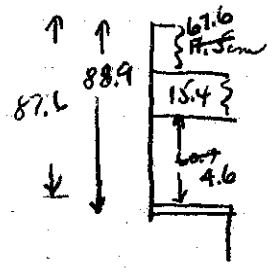
Sources — ~~#2 — X-~~

#1 Cylinder - K-25 source ~ 1c
#2 " X-10 " ~ 1/2c.

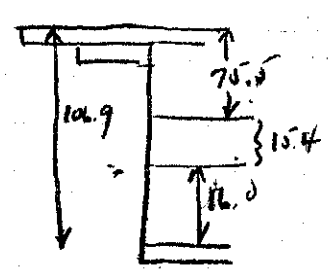
INSTRUMENTS: TRIP POINTS #3 - 90x100; #4-7x100
Scales #3 x 10; #4 x 100; 5x2; #6 x 25.

	Scale	Compensator	actual.
Source #1	1.5cm	—	5cm
Source #2	17.0	73.3 cm	5cm.
Control Rod #1	8.0	—	0
Control Rod #2	3.5	84.7	0
Cylinder Separation	8.9cm.	—	~~1.5cm~~

#1 Tamper.



#2 Tamper



1.5cm separation

Filling from #9 INTO FIXED cylinder
#9 MT at 2.3cm Filling from #2
Ht. = 5.1 cm Valve opened between cylinders. (cross-valve)
Ht. = 1.95 cm. Filling to 4.4 from #2. with cross valve shut.
Valve opened. Soln dropped from 4.4cm to 3.4 in 2 min.
Filling tank with tamped water.
6.1cm No. 2 cylinder is MT. Filling from #6
#1 Top tamper indicates = 5.7cm #2 at 6.3cm. Soln level = 6.1
Ht = 6.1cm #1 = 16.5 #2 = 17.0 (16.5) C_0/C_1 = 1.0 C_0/C_2 = 1.0
#1 T.T.I. = 8.0cm #2 T.T.I. = 8.5cm Soln = 8.4
H = 8.4cm C_1 = 23.0 C_2 = 23.0 .72 .72
#1 T.T.I. = 9.9 cm #2 T.T.I. = Ht = 10.3 cm
10.3cm C_1 = 40.5 C_2 = 39.5 .41 .42

	Ht.
4:20p	11.9
4:30p	Filling
4:40	12.5
:50	13.0
5:20	13.3

CONCLU.

To
~~14.6~~ c

Cylinder position
#1 Source
#2 Source
#1 C.R.
#2 C.R.
#1 Tamper
#2 Tamper.

(Bleed ba

6:00	13.3cm.
	Filling
6:15	15.7
:22	17.0
:30	16.9
	Filling
:45	17.9
7:10	18.2

CONCLUSIO

(1)

2:37pm	
2:48pm	
2:50p	
2:54p	
3:09p	
3:12p	
3:21p	
3:38p	
3:50p	
4:00p	
4:05p	

	Ht. (cm)	C_1	C_2	c_o/c_1	c_o/c_2	
4:20 p	11.9	87	90	.19	.18	
4:30 p	Filling from #3					
4:40	12.5	169	174	0.098	0.095	PRESSEY & CONEY BEAR OUT.
:50	13.0	777	797	0.021	0.021	
5:20	13.3	CRITICAL WITH	#2 C.R. at 138cm. and			
			#1 C.R. 8.0cm			

CONCLUSION: 2- 8" Al Cylinders Tamped H/x ~ 50 1.5 cm separation between edges - critical at 13.15 ~~±0.05~~ a/cm -

Exp 205 C-

To measure critical conditions at separation of 14.6 cm (= 35.0 cm separation of cylinder centers).

	Present positions. Indicators	Compensators	New positions Indicators	Compensators	New Actual
Cylinder position.	8.9cm	—	17.0		14.6 cm edges.
#1 Source		NOT TO BE changed.			
#2 Source	17.0cm	73.3cm	12.0	66.7	5cm
#1 C.R.		NOT TO BE changed			
#2 C.R.	3.5	84.7	3.5	78.1	0
#1 Temper		NOT TO BE changed.			
#2 Temper.	18.7	—	18.7.	—	

(Blew back sight glass, no change in reading.)

6:00	13.3cm.	14.0	14.0		Use this as new Co -
	Filling from #6.				
6:15	15.7	23.0	~~20.5~~	0.63	0.71
:22	17.0	#6 Empty.	~~37.0~~	~~33~~	
:30	16.9	37.0	33.0	0.39	0.44 Est 18.7 - Hc
	Filling from #3 (21.1 - MT).				
:45	17.9	166.0	166.5	0.087	0.087
7:10	18.2	CRITICAL WITH #2 ROD OUT. and			
		#1 AT 26.0 cm Cd. tips bottom at top of Solution.			

CONCLUSION: CRITICAL at 16.1 cm ± 0.05, 2-8" Al cylinders, H/x = 50, tamped system - cylinder centers separated 35 cm = 14.6 cm between edges

Exp 205 (Cont'd)

1/26/49

Inventory
1 - 15 cm in single 8" cylinder.
2 - 15 " " " " "
3 - ~ 16 cm - single 8" cylinder.
4 - Empty
5 - 7.1 cm in 4" cylinder (washings).
6 - 15 cm in single 8" Std.
7 - Empty
8 - Empty.
9 - Dead volume —

1) Instrument: #3 went haywire at last point (above) danger of tripping so thought best shut down.
Others OK -

2) At least two more points should be taken at this HV with 8" cylinders - one at ℓ separation > 35 cm and one ea 28 cm.

3) The data of 1/23 should be recalculated in view of possibility of cylinders being keyed apart by bead on #1 at the indicated "CONTACT" position —

4) The present source arrangement worked very well. As I near critical by the control rods and sources were brought out step wise — i.e #1 CR, #1 source then each a few centimeters then similarly for #2 CR + #2 source — etc. A more judicious placing of detectors (chambers) might be made at the larger separations to see if one set is activated by one cylinder + a second set by the other —

Time	Trip
Preamp	
Modulator	#1 G
Multiplier	#2
	#1
	#2
	Cylin
	was shu
	Hyp
10:45	D
11:00	6.0
11:05	~ 9.0
11:15	9.8
11:27	11.0
11:40	11.2
11:47	12.2
Crown Entered Here	
	Conclu

1/26/49 Exp 205 (Cont) 205 F.

Trip Points 0 (#3) 6 (#4) Both sources 5 cm above bottom

Preasy
Moderhom
Mehfeld

	Scale Reading @ 0.
#1 Control Rd	8.0
#2 Control Rd	3.5, 89.7
#1 Source	-3.5
#2 Source	12.0
Source Compensator	73.3
Separator	7.1

#3 Taken out of trip Circuit.

Test for free flow etc made per class list.

205 F

Cylinders in contact. One 205 A the actual separation ✳ was shown to be 6 mm. on revised in previous notes.

	Hyt.	#1 Counts	#2 Counts	1/M1	1/M2	Remarks.
10:45	D 2.5 cm.	—	—	—	—	#4 Empty from #1.
11:00	6.2	19.0, 19.0	18.5, 18.0	1.0	1.0	
11:05	~ 9.0	—	—			#1 Empty From #2
11:15	9.8	35.0	35.0	.54	.53	
11:27	11.05	~~66.0~~ 67.0	~~67.0~~	.29	.28	
11:40	11.8	222	222	.085	.083	
11:47	12.1	Critical with rod 1cm above Soln.				

Conclusion Critical @ 12.05 ± 1 mm. when cylinders in contact.

Crown Entered Here

205 G.

	0'clock	Next
#2 Control Rod Compensator	84.7	84.9
#2 Temper Separator	16.7	16.7
	7.1	14.1
#1 ~~Source~~	~~84.7~~	~~84.9~~
#2 Source Compensator	7.33	69.8

Separation = 7.0 cm Exp 205 G

Prexy & Mo
Cal

		C_1	C_2			
	old ~~rising~~ background	19.0	18.5			
	Soln Ht.	C_1	C_2	C_o/C_1	C_o/C_2	
1:10 PM	12.1	10.0	13.0			use as new C_o
1:15						Filling from #2
1:21	15.9	12.0	13.5	.834	.962	#1 & #9 empty
1:32	14.85	17.0	19.5	.588	.668	#2 empty

Because of low count of 12.1 source checked and found to be stuck on top tamper. ~~source~~ b
Source ~~stuck~~ replaced in cyl.

1:50	14.85	158	159	.114	.113	(rising old background.
2:10	15.3	263	260	.068	.069	filling from #3.

2:35 15.95 Critical with ~~Exp 205 G~~ (tamper in contact)
#1 Control Rod 8 cm still in solution
#2 " " all out
tampers in contact

~~Separation~~

Exp 205 H 20.3 Separation from edges.

	old	new
Tamper #2	22.1	22.1
#1 Control Rod	—	—
#2 " "	81.9	75.2
Separation	14.1	27.4
#2 Source	69.8	63.1

		C_1	C_2	C_o/C_1	C_o/C_2	
2:45	15.95	26	22	.692	.82	
	Source checked for position	26	22			
3:35	18.0 cm					Conclusion Critical @ 17.85 cm. See below
						Control #2 Rod out
						" #1 Rod approx 1 cm in sol'n
4:05	17.7	57	66	.31	.273	drain into #3
4:30	16.4					

	old	new
Tamper =	23.0	23.0
Sep. =	27.4	21.7
#2 Source =	63.1	65.95
#2 Control Rod =	75.2	78.05
actual Sep. =	20.3 cm	14.6 cm

Dr Callahan in here.

Separation = 14.6

	Soln H
4:30	16.5
	17.4
5:30	~~17.4~~
Crew Callahan, Crowell, Moffitt	Blew
6:00	18.0
6:20	18.33
	Concl
7:00.	18.3
	C
	Very

Allgood DC

Pressy & Moneyhun out at ~~5:00~~ 5:00 PM, 4:15 respectively

Separation = 14.6 ~~cm~~

Exp 205 I (repeat of Exp 205 E)

	Soln HT	C_1	C_2	C_0/C_1	C_0/C_2	
4:30	16.5	16.5	16.5			← #2 Source out of Tamper
		36	33	0.30	0.546	← Source back
		37	33			
	17.45					
5:30	~~17.45~~	121.5	121	.149	.149	

Crew { Callihan, Crowell, Moriarty } Blew back @ this point & clear levels.

6:00 — 18.0 cm — Just barely sub-critical (Bottle Rocks out.)

6:20 — 18.35 — Critical with #2 Rod completely in & #1 Rod on 10 cm Scale.

Conclusion: Critical @ 18.1 cm ± 0.1 cm. (Note 205 e) @ 14.6 cm sep

	Old Reading	New Reading
Separation	21.7	50.1
#2 Control Rod Comp	78.1 ~~65.9~~	63.9
#2 Source Comp.	65.9 ~~78.05~~	49.7
Actual Separation	14.6	43.0

Exp 205 J

With Separation of 43.0 cm.

7:00. — 18.35 — Critical with #2 Rod completely in & #1 Rod at 18 cm on Scale.

Conclusion. Critical @ some height as 205 I. Very ~~Slightly~~ less interaction. ~~than~~ 205 I. = 18.1 ± 0.1 cm.

Exp 206 K

	Old Reading	New Reading
Movable Comp	21.0	21.0 ✓
Separation	50.1	15.8 (15.8 ?) DC
#2 CR Comp	63.9	81.0
#2 Source Comp	49.7	66.8
Separation Actual	43.0	8.7

use as new C_0
filling from #2
#1 & #3 empty
#2 empty

using old background.
filling from #3.

~~in control~~)

from edge.

→ Muyshe DC

.1 cm
cm. See below

drain into #3

Exp 205 K Sep = 8.7 cm (3 diff lengths)

	Sol'n	C_1	C_2	C_o/C_1	C_o/C_2
7:48 PM	16.2	223	221	.081	.081
		Intermission	Supper		

8:45 — 17.0 — Critical with #1 Rod all way out, #2 Control Rod set 11.0 cm.

Also Critical with #2 Rod all way out, #1 Rod @ 18 cm (Zero setting on p 52)

Drambar 2 mm.

9:00 — 16.8 — Not Critical with all rods out

Conclusion Critical 16.9 ± 0.05 cm with cylinders separated 8.7 cm 3 diff lengths.

Exp 205 L

	Old	New
Separation	15.8 / 15.8	12.9
#2 Control Rod	81.1	82.6
#2 Source Conf	67.0	68.5
Tamper #2	19.0	19.0
Actual separation	8.7	5.8

9:25 — 15.2 — 163 — 160 — .115 — .117

9:40 — 15.7 — Critical with #2 Control all way out & #1 @ 9 cm.

Drambar ~ 2 mm.

9:55 — 15.5 — Critical with #C Rod all way out & #1 C Rod @ 26 cm.

Conclusion Critical @ 15.4 ± 0.1 cm @ 5.8 cm sep.

10:10 — 14.

10:20 — 14.5

10:30 — 14.

1 — Rep
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solut
from

10:45 — 14.

Results: E

	#1	
Cm left in 8" cyl	16	

Exp 205 M Sep. 4.4 cm

(3 diff lengths)

	Old	New	
Separation	12.9	11.5	
#2 Sour Cyl	68.5	69.2	
#2 Rod Cyl	82.6	83.3	
Tamper	17.0		
Actual Sep	5.8	4.4	1½ Dr.

L, #2

10:10 14.85 Critical with #2 Rod @ ≈10 cm
#1 Rod ~~Stuck~~ In
Drawback ≈ 3.5 mm.

1 Rod

10:20 14.50 Critical with #2 Rod all way up
#1 Rod @ 16.5 cm.

10:30 14.4 Not Critical

as expected

Conclusion Critical @ 14.5 ± .05 cm @ 1½ Drawback (4.4 cm)

Exp. 205 N

1 Repeat of 205 M in every detail except criticality was approached by dropping solv. level ≈ 1 cm and attaining criticality by adding solution rather than by draining back. This experiment was performed because the question was raised as whether pressure drop in double hose caused a permanent difference in levels between cylinder #1 (fixed) & cylinder #2 (movable) should such a difference exist it might be thought to be a different amount depending on whether solution was being added to the system or drained from it.

15, 117 out

Drawback 1.6 cm

10:45 14.50 Critical with #2 Rod all way up,
#1 Rod @ 16.5 cm

out

Results: Each duplicate of 205 M QED

5.8 cm exp.

	Drawback #1	#2	#3	#4	#5	#6	#7	#8	#9
Cm left in 8" cyl	~~16~~	15	16	MT	≈2 cm WASHINGS.	15	MT	MT	D.V.

60

1/27/49 Thurs.

FOX
CRONIN
PRESSEY
CALLIHAN

The data obtained so far in Exp. 205 are inconsistent when Hc vs Separation is plotted. It is now proposed to reset the cylinders to their former relative positions as per indicator and measure the corresponding cylinder separations at bottom, top and ~ 16 cm from bottom in order to try to determine just where they were.

Exp	Indicator	Actual Measured Separations B Cm Top	16 cm from bottom	Bottom	ave B,C	(N.G. Indicator minus zero (=7.0))	Correction Factor	
A	8.0 cm	~~0.45~~ 0.6	~~0.7~~ 0.6	0.8	0.7	~~0.9~~	2:00	Filling
B	10.9	3.4	3.5	3.65	3.58	~~3.8~~	2:15	#9
C	18.2						2:21	Fill
D	8.9						~~2~~	H.
E	22.0						2:26	8.0 &
F	7.1	0.2 read	0.1	0	0	0		
G	14.1	~~6.7~~ 6.65	6.7	6.8	6.75	7.0		
H	27.4							
I	21.7						2:37	12.4
J	50.1	~~42.5~~ 42.45	42.65	42.85	42.75	~~43.0~~	45	14.4
K	15.8	8.3	8.40	8.50	8.45	~~8.7~~		
L	12.9						3:30	15.0
M	11.5	4.00	4.10	4.20	4.15	~~4.4~~	:35	15.8 / 16.5
N.	11.5						:42	~~16.6~~
—	70.1	62.40	62.70	62.90	62.80	63.0	:50	17.2
—	60.0 Δ 10.0	52.40	52.65	52.90	52.78	~~52.9~~	4:01	17.8
—	~~49.9~~	32.40	32.70	32.80	32.75	~~32.9~~	4:20	18.15
—	30.0	~~22.50~~ 22.40	22.60	22.90	22.75	~~22.9~~		
—	25.0	17.40	17.60	17.85	~~17.73~~	17.9		
—	20.0	12.45 ~~12.2~~ 8.3	12.60	12.70 ~~12.60~~	12.65	~~12.9~~		
See K, this is closer	15.8	~~8.2~~	8.4	8.5	8.45	~~8.7~~		
Repeat	30.0	22.4	22.6	22.75	22.68	~~22.9~~		
	27.6	20.0	20.2 ~~20.3~~	20.3 ~~20.2~~	20.25			

CONCLUSION: 8

INVE
1 –
2 –
3 –
4 –
5 –
6 –
7 –
8 –
9 –

1/28 This calibration did not hold after removing #1 tungsten.

Of the Exp 205 A
Re 2-8" dia cylinders tungsten

		B	C	D	E	F	G	H	I	J	K	L	M + N
Sep.	0.8 cm	3.6	10.9	11.7	14.7	0	6.8	20.1	14.4	43.0	8.6	5.7	4.2
Hc =	12.85 + 1.45/2 = 13.6	14.55 + 1.45/2 = 15.30 cm	17.7 + 1.45/2 = 18.4	13.15 + 1.45/2 = 13.9	18.1 + 0.7 = 18.8	12.05 + 0.7 = 12.8 cm	15.9 + 0.7 = 16.6	17.85 + 0.7 = 18.6	18.1 + 0.7 = 18.8	18.1 + 0.7 = 18.8	16.9 + 0.7 = 17.6	15.4 + 0.7 = 16.1	14.5 + 0.7 = 15.2
H/s =	52.9												
Conc =	0.293 gm × 1/gm = 0.45 a gm-sec.												
Dyn =	1.564												
Vc =	4.41R	4.96R	5.97R	4.51R	6.09R	4.15R	5.38R	6.03R	6.09R	6.09R	5.78R	5.22R	4.93R
Mc =	2.02kg	2.28kg	2.74kg	2.07kg	2.80kg	1.90kg	2.47kg	2.77kg	2.80kg	2.80kg	2.62kg	2.40kg	2.26kg

1/27/49

CALLIHAN
CRONIN
FOX
PRESSEY

Exp. 206 [52.9]

SINGLE FIXED 8" CYLINDER - H/X = 50, TAMPED -

TRIP POINT 5.7 X100 ON #4

INSTRUMENT SCALES # 3 X 10; # 4 X100, # 5 X5, # 6 X 25 -

Moovable cylinder 20cm (edge to edge) away from fixed.
No #2 Control rod or Source.
Source - 6 cm. from bottom.

B Cm	ave B&C	(NG INDICATOR MINUS ZERO (=7.1))	~~CORRECTION FACTOR~~						
.8	0.7	0.9		2:00	Filling dead volume from #9.				
.65	3.58	3.8		2:15	#9 Empty - A = 3.0 cm - Filling tamped. Top Tamped check.				
				2:21	Filling from ~~#~~. #3.				
					H.	C_1	C_2	N_1^{-1}	N_2^{-1}
				2:26	8.08 cm.	6.0	5.5		
						6.5	6.0		
0	0	0				6.5	5.5		
.8	6.75	7.0				6.5 ←	5.5 ←		
				2:37	12.4	7.0	6.5	0.93	0.85
85	42.75	~~43.0~~		45	14.4	#3 Empty. Source double.	Filling from #2.		
50	8.45	~~8.7~~							
				3:30	15.0	37.5	41.5	0.173	0.133
10	4.15	~~4.4~~		:35	15.8	52.5	56.0	0.123	0.098
				:42	~~16.6~~ 16.5	72.0	82.0	0.09	0.067
90	62.80	~~63.0~~		:50	17.2	174.5	155.0	0.052	0.037
90	52.78	~~52.9~~		4:01	17.8	377	469.	0.017	0.012
80	32.75	~~32.9~~		4:20	18.15	CRITICAL WITH CONTROL ROD BOTTOM AT TOP OF SOLUTION.			
90	22.75	~~22.9~~							
85	17.73	17.9							
70									
60	17.65	~~17.9~~							
5	8.45	~~8.7~~							
75	22.68	~~22.9~~							
3									
2	20.25								

Strangely dead. Due to Source being on top of tamper

CONCLUSION: 8" AL CYLINDER, SINGLE, FIXED TAMPED.
H/X = 50 - CRITICAL AT 18.05 ± 0.05 cm -

18.05 + 1.2 = 19.2 cm corrected for bottom 3" line

INVENTORY:

1 - 16 cm in Single 8" Cylinder
2 - 15 - - - - - (?).
3 - 14.4 - - - -
4 - NT
5 - ~2cm - 4" - washers.
6 - 15 cm in 8" cylinder
7 - NT
8 - NT
9 - DV.

3/4/49 DC Ex 206
#1 → 8" Al cylinder Tamped.
H_c = 18.05 + 1.45 = 19.50
H/X = 52.9
Conc 0.293 gm X/gm = 0.459 gm X/cc
ρ_{sp} = 1.566
V_c = 6.32 ℓ
M_c = 2.90 kg

Tamp.	J	K.	L	M + N
	43.0	8.6	5.7	4.2
	18.1+0.7 =18.8	16.9+0.7 17.6	15.4+0.7 =16.1	14.5+0.7 15.2
	6.09R	5.18R	5.22R	4.43R
	2.80kg	2.62kg	2.44kg	2.26kg

62

1/29/49.

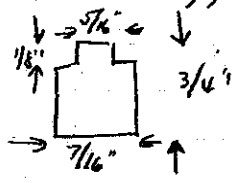
RE- X-10 Po-Be Source -

RE:

a,

This source was borrowed 1/24/49 (see pg 57, this book). It was removed from the brass capsule used at X-10 & placed in a stainless steel one made here. (The source is 3/4" ~~long~~ long, over all, 7/16" dia).

Construction: oxide, dipped in soft solder & then into a hard wax like substance.



The stainless capsule containing the source was painted with glyptal and baked. This arrangement was used on 1/25-26.

On 1/27 the source was removed from this holder preparatory to inserting it into a smaller one. (This new smaller holder never materialized). There was some evidence of there having been a leak of UO2F2 sol. into the capsule. There was a high wipable count on the source. Believing this to be uranium the source was worked in ~~benzene - the~~ glyptal thinner. The wax flaked off & the surface which had a high wipe count. The X-10 brass capsule was then examined and found to have about 500 α/min on the outside - at the opening of the cavity there was a 15-000 α/min (~~count~~ not transmitted by filter paper). Black powder could be shaken & wiped from the capsule - visible traces, barely so detectable, had ~ ~~15~~ 10000 α/min. It is concluded that the source was either not cleaned after packing or was leaking. This was reported to Mann who concurred. He also agreed to the following procedure - dip source in melted paraffin, replace in the Stainless capsule containing paraffin. This has been done. The X-10 capsule was superficially swabbed out inside - it is steel Lot - Outside was wiped to <100 count -

DC

b)

Instrume

Fox

MACKLIN
CRONIN (Hdq)
CALLIHAN-

Re: SOURCE IMPROVEMENTS (WE HOPE).

a) #1 CYLINDER difficulties seemed to be due to #1-8" top tamper having no funnel introducing difficulties in keeping the external guide tube aligned with the hole in the tamper. There was available an unused 8" top tamper, meant for the #2 system but unusable because it had been made ~~wrong~~ reversed by the shop, ie holes were a mirror image of plan. It has a funnel. It has been fitted with a half union so can put into #1 system. This, with the 6' S.S. tube may work satisfactory.

b) #2 System: A S.S. tube, 80" long 1" I.D., 1 3/32" O.D., is being prepared in the shop, ready 1/28 A.M. This, with some finagling, can be installed. It is proposed that it be attached to the movable plate (that carries the magnets) and slide through the 19/64" holes in the top & bottom plates. This tube will sit on the tamper funnel & ride with it. The tube may be too long - but they to ~~keep~~ cut it a minimum, the dolley can be raised or tipped for installation. The counter-bored hole in the boiler plate has been filed out to pass the tube. -

Instrument men here all day -

(see pg 57, this book).
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all. 7/16" dia).

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64
1/28/49 Sat.

EXPERIMENT 207

H/X = 52.9

FOX
CRONIN
SCHUSKE
CALLIHAN.

2 - 8" Al CYLINDERS -- UNTAMPED - H/X ≅ 53.

Trip Points #3 ~~-82 ×100~~ #100, #4 - 6 x100, #6 - ~5.5 x1000
Scales #3 ~~#100 ×10~~, #4 x100, #5 x 2, - #6 x

[N.B. RE: Zero of #2 Control Sheet - with cylinders 2.9 cm between edges i.e. indicator at 10.1 cm, with Cd sheet bottom level with cylinder bottom, ~~check~~ #2 control rod indicator at 3.5cm compensator at 70.4cm.]
#2 Control rod has now been removed + placed on top of plate]

The dolley indicator calibration found to be incorrect (pg 60 this book) due, presumably, to removal of #1 top stamper.

Calibration of Dolley Indicator -

Indicator	Actual Separation Bottom	30cm from bottom	ave.
6.7 cm	0	0.1cm.	
8.0	1.2 cm	1.5cm.	~~1.1~~ 1.3
10.0	3.1	~~3.4~~ 3.2	~~3.3~~ 3.1 ~~3.2~~
15.0	8.1	8.3	8.2
20.0	13.2	13.3	13.2
9.65	2.9	3.0	2.9

Also #1 cylinder was tipped by readjusting studs + nuts on 12" water flange to improve parallelity.

	Scale	Actual
#1 Source	7.5cm	6.0cm from bottom
#2 Source	NOT used	
#1 Control Rod	8.0	0
#2 Control Rod	NOT used	
Separation	6.7	0
#1 & 2 Tampers	NOT used.	

12:25P		Fill
45		#9
		H
:47		0.5
50		~~45~~ 5.
~~55~~		
55		7.5
1:00		6.1
1:07		8.1
1:20		9.8
27		12.3
39		14.6
55		~~17.8~~ 18.
2:00		19.5
05		20.5
~~27~~		~~27.3~~
:27		27.3
33		

Checked

CONCLUSION - a) 2 - 8

b) at

Inventore

Exp 207 (cont).

(= 53 -

12:25	Filling dead volume from # 9.					
45	#9 Empty - Dead volume filled -					
	H	C_1	C_2	M_1^{-1}	M_2^{-1}	
:47	0.5 cm.			Filling from #2 in to #1 C/I indicator only.		
50	~~45~~ 5.0			Opened connecting valve; required operation to establish flow.		
~~55~~				Filling #1 only again.		
55	7.5			Levels fell to 5.0 in 3' after		
				opening to #2 cylinder.		
1:00	6.1					#2 Empty; filling #6
1:07	8.1	83.0	~~41.0~~ 41.5			
		~~80.5~~ 81.7	41.0 41.3			
1:20	9.8	104.0	~~52.5~~ 53.0 53.0	0.79	0.78	
27	12.3	~~134.0~~ 133.0	72.0	0.61	0.57	#6 Empty; filling #3.
39	14.6	160	93	0.51	~~0.44~~ 0.47	
55	~~17.8~~ 18.3	213	131	0.38	0.315	
2:00	19.5					#3 MT; filling #1
05	20.5	239	155	0.34	0.267	

Raised #2 safety rods 15cm to investigate possibility of their suppressing the activity.

~~27~~	~~27.3~~	238	154		
27	27.3	347	248	0.235	0.167

DROPPED #2's SAFETY RODS.

33		330	234	0.25	0.177

Checked sight glass & end on drain back. OK.

CONCLUSION - a) 2 - 8" al cylinders, unstamped, in contact, H/X = 53, not critical with available soup or may not be at ∞ extension though this is not certain -

b). at a multiplication of ~ 5 the two #2 safety rods were equivalent to ~ 9mm ~~bigotti~~ solution.

Inventory #1 - 14.6 cm in single 8" cylinder.
2 - 15 " " " "
3 15 " " " "
4 MT
5 ~ 2cm washings.
6 10 cm in single 8" cylinder.
7 MT
8 MT
9 Dead volume.

2-8" al unstamped
separation = 0
H/X = 52.9
Conc = 0.293 gm U/gm = 0.459 gm U/cc
Sp Gr = 1.566.
H_c > 38 cm.
V_c > 12.32 ℓ
M_c > 5.65 kg.

314 lug
9C

1/29/49 Sun.

For Morrill Pressey

2"

1) Removed 8" cylinders + stored
2) Installed long (80") guide tube for #2 cylinder
3) Installed 10" cylinder with ~~tamper~~ -
4) #1 - 10" dop ~~tamper has no framed~~ ! - so ~~the~~ built guide support - attaches to union -
5) #1 - 10" was plumbed as it was installed - should be checked for content though -
6) The sleeve (rt + lft hand thread) connecting #2 tamper to its support was found in bottom of #2 - 8" cylinder at completion of experiment - apparently had worked loose - remove with tamper in future.
7) Evidence of new leak - to # 5 storage cylinder
8) a 3/4" Cd control rod is in tray in Rm 10 - needs to be worked if needed.
9) a 3/8" Cd control rod is installed in #1
10) Slab of Cd is attached in #2.
11) all ~~wires +~~ pullys should be checked for threading
12) all water + solution joints should be checked for leaks.
13) Instruments all ok, including Reed tripper - However the zero of the meter - ~~switch~~ trip switch is controlled by the ~~pot~~ same adjustment on the Reed panel which is used to adjust the Speedomax zero - Therefore change of Speedomax zero alters the differential between Reed signal and the trip point - This is a caution. RE - toggle switch lower left corner of tripper panel - to left interlocks tripper - to right by-passes tripper - it may be thrown to by pass without tripping -

Call if questions - 5343 ✓ DC 1101

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1/30/49 Gun.

H/X = 52.9

Experiment 20P

For Morlift Pressey

2" 10" A1 Cyl. Tamped

Trip Point { #3 - 85 / #4 - 6.8

Instruments. #3 - 10 #4 - 100 #5 - 2 #6 - 25

Trip Circuit on Red Bypassed.

	Reading	Actual
#1 Source	1.5 cm.	5.0 cm
#2 Source & Comp	5.0, 69	5.0, —
#1 Control	24.6	0 (using block)
#2 Control	Not in use	

From this point on, day was total loss, — to whit.

#2 (Movable) Top tamper was being lowered for 1st time hit limit switch & could not be raised again. Thermal cut-out opened. At first it was thought that tamper had hit bottom because of addition of "thread saver" but subsequent "investigation" showed this was not the case.

Following several attempts to free the tamper from the bottom of the #2 cylinder, each of which shed more heat than light on the trouble, the difficulty was traced to the newly-installed 80" (?) guide tube. The tube was of insufficient length so that when the tamper was lowered to within a centimeter or so of bottom (in contact with previous location of lower limit switch) the top end of the 80" guide tube dropped just barely (one mm or so) below the topmost support plate of the carriage. When an attempt was made to raise the tamper, this end of the guide tube did not go back thru the hole, but remained butted up against the lower face of the upper plate, covering the hole almost (99%) completely so that the condition was not immediately obvious.

Subsequent remeasurement of the alleged 80" guide tube indicated that in reality it was not more than 78½" long & possibly slightly less.

The lower limit switch was raised immediately & suitable warning posted on switch.

The tamper was removed & both tamper & cylinder inspected for damage. Cylinder OK, except for flange on which repairs were made.

Monday
1/31/48

Tamper was pressure tested @ 6#. Bottom of tamper bulges about 1/4 in around guide tube hole. Rest of bottom dished in as before. Decided (Fox, Pressy, Mapes) that tamper could be used with only second order effects. Device height is determined from pressure reading & "bulge & dent" would sort of compensate each other.

It is believed that clearance between tamper & cylinder walls was improved slightly. Tamper was painted in spots, dried with heat lamp & installed.

15" #2 cylinder then did not sit flat against both plates in attempting to tighten up on nut on cylinder studs, one stud torn off because threads on it were not cut down for coverage of nut. Stud even with washer in place. Drilled flange & installed bolt.

Retheaded some of indicator wires that crossed too many electrical wires.

Installed end on tamper tank.

Installed blocks on number one cylinder, dispensing with #2 control rod for contact experiment.

Time	Soln.
10:35 AM	—
10:40	2.2 (6
11:~~30~~	3.7 ~~3.7~~
11:30	5.7
11:45	7.7
11:59	8.8
12:50	9.5
1:10	9.8
1:30	9.9

A. I. C.

Conc:

B. Seperat.

Monday
1/31/48

Experiment 208

H/X = 52.9

Two 10" Aluminum Cylinders ~~Tamped~~ H/X = ~53

A. In Contact 2 mm. Cyl. Sep.

Callihan
Fox
Pressey
Mooneyham

TRIP POINTS. #3 = 80 x100 #4 = 5.7 x100

Instruments #3 - x10 #4 - x100 #5 - x5 #6 - tripper bypassed - x25

	Reading at Zero	Position
#1 Dolly Source	12.1 cm. 1.0 cm.	5.0 cm.
#2 Source	0 cm.	4.0 cm.
#2 Source Compensator	68.4 cm.	68.4 cm.
#1 Control Blade	25.0 cm.	25.0 cm.
#2 Control Rod	3.4 cm.	3.4
#2 " Compensator	82.8 cm.	82.8
#2 Tamper	63.1 cm. / top of plate to top of tamper, thickness of tamper 15.4 cm. ∴ tamper 28.4 cm. above bottom cylinder - indicator positioned accordingly	

A hole has been punched in the grill of the #1 8" Al. cyl. Do not allow #1 control rods below zero

Calibration of Dolly for 10" Al Cylinders

Scale	Bottom	One ft. up	Top	Av. of 6" Up
12.1 cm.	0.2 cm	0.1 cm.	0 cm.	0.15
13.1	1.4	1.1	0.9	1.25
17.1	5.2	4.9	4.8	5.05
32.1	20.2	19.9	19.8	20.05

Time	Sol. Ht. (cm)	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
10:35 AM	—	—	—	—	—	Filing from #9 NT
10:40	2.2 (after moving bars)	—	—	—	—	" " #1
11:30	3.7 #1 - 4.1 #2 - 4.6 5.6 - 5.7	6.0 6.0 } 6.0	14.5 13.5 } 14.0	1.0	1.0	#1 dry; from #6
11:30	5.7 #1 - 6.1 #2 - 6.5 5.6 - 7.8	8.0	19.0	0.750	0.737	#6 dry at 7.7 cm.
11:45	7.7 #1 8.2 #2 8.6 5.6 cm #1 9.3 #2 9.7	13.5	37.0	0.445	0.379	
11:59	8.8	26.0	69.0	0.231	0.206	Filing from #2
12:50	9.5	71.5	204.5	0.084	0.069	" " "
1:10	9.8	not critical				
1:30	9.9	Critical with #2 control rod out and #1 control blade 2.5 cm. above bottom of cylinder. Also critical with #1 blade out and #2 rod 8.4 cm. above the bottom of the cylinder.				

Conc: Critical at 9.85 ± 0.05 cm.

B. Seperated 3.0 cm (actual)

	Present	New
Sep. Indicator	12.1	14.9
#2 Tamper	11.5	11.5
#1 Source	5.0	5.0
#2 " , Compensator	4.0, 68.4	4.0, 67.0
#2 Control Rod Compensator	82.8	81.4
#2 " "	3.4	3.4

- bulges about 2 in" as could be determined of

cylinder to dried

bolts plate w studs run for conveyor flange

too many

#2 control

B. (cont.)

Time	Soln. Ht.	C_1 $C_{o1}=6.0$	C_2 $C_{o2}=14.0$	M_1^{-1}	M_2^{-1}	Remarks
1:45 PM	9.9	53.0	145	0.113	0.097	Filing from #2
1:55 PM	10.8					
		Critical with rod (#2) 6 cm. out and #1 blade all in.				
	10.6	not critical with both rods out.				

Conclusion: Critical at 10.7 ± 0.05 cm.

C. Separated to 7 cm. actually

	Position
Separation Indicator	19.0 cm.
#1 Source	5.0
#2 Source	4.0
#2 Source Comp.	65.0
#2 Control Comp.	79.4

Time	Soln. Ht.	C_1 $C_{o1}=6.0$	C_2 $C_{o2}=14.0$	M_1^{-1}	M_2^{-1}	Remarks
2:10 PM	10.6	32.5	87.0	0.185	0.161	
2:15 PM	11.1	56.0	160.5	0.107	0.087	Filing from #2
2:30 PM	11.6					#2 not MT yet. Filing for #3
	11.8	Critical with #2 rod out and 6.5 cm. of blade #1 above bottom				

Conc.: [redacted] $11.7^{-0}_{+0.05}$

D. Separated 10.5 cm. (actual)

	Position
Separation Indicator	22.5 cm.
#2 Source Compensator	63.25 cm.
#2 Control "	77.6 cm.

Time	Soln. Ht.	C_1 $C_{o1}=6.0$	C_2 $C_{o2}=14.0$	M_1^{-1}	M_2^{-1}	Remarks
2:50	11.8	80.5	223	0.075	0.063	
3:00	12.2	not quite critical				Filing from #3
3:10	12.3	Critical #2 rod out, #1 blade 6 cm. out above bottom				

Conc: Critical at 12.25 ± 0.05 cm.

Ex. #20
E Sep

Time	Soln
3:20 PM	12
	12

F Sep

Time	Soln.
3:35 PM	12.

D

3/4/49 JC

Sep 208. 2-10" al cyls

A

Separation 0.2 cm

MF 52.9

Conc 0.293 gm U/gm = 0

Mc 1.566

Wt - 9.85 + 0.45 = 10

Vc 5.22 L

Mc 2.40 kg

Ex. #208

E Separated 13 cm. (actual)

	Position
Seg. Indicator	25.1 cm.
#2 Source Comp.	62.0
#2 Control "	76.3

Time	Soln. Ht.	C_1 $C_{01}=6.0$	C_2 $C_{02}=14.0$	M_1^{-1}	M_2^{-1}	Remarks
3:20 PM	12.3 cm.	not critical				Filing from #3
	12.5	Critical with #2 rod out and #1 blade 6 cm. out				

Conclusion: Critical at 12.45 ± 0.05 cm.

F Separated 20.0 cm. (actual)

	Position
Separator Indicator	32.0 cm.
#2 Source Comp.	58.5 cm.
#2 Control Comp.	72.8 cm.

3:35 PM	12.5 cm.	Critical with #2 rod out and #1 blade 12 cm out				

Conclusion: Critical at 12.5 ± 0.05 cm.

Drainback:

#3	1.8 cm. in 10" cyl.
#2	7.8 cm. " " "
#6	7.4 cm. " " "
#1	8.0 cm. " " "
#9	D.V.

3/4/49 JC Exp 208. 2-10" al cylinders, tamped.

A.D. Mooneyhan

	A	B.	C	D	E	F
Separator	0.2 cm	3.0	7.0	10.5	13.0	20.0
MX	52.9					
Conc	0.293 g_{MX}/g_{Pu} = 0.459 g_{MX}/cc					
Apg	1.566					
Hc	9.85+0.45=10.3 cm	10.7+0.5=11.2 cm	11.7+0.5=12.2 cm	12.25+0.45=12.7	12.45+0.45=12.9	12.5+0.5=13.0 cm
Vc	5.22L	5.67L	6.18L	6.43	6.54	6.59
Mc	2.40 kg	2.60 kg	2.84 kg	2.95	3.00	3.02

Remarks

Filing from #2

#1 blade all in.

Remarks.

Filing from #2

#2 not MT yet. Filing from #3

blade #1 above bottom

Remarks

Filing from #3

above bottom

12/1/49

EXPERIMENT 209

H/X = 52.9

MACKLIN
MOONEY HAM
PRESSEY
CALLIHAN

FIXED 10"
SINGLE 8" AL CYLINDER, TAMPED. H/X = 53.

INSTRUMENTS: TRIP POINTS - #3 - 90X100; #4: 5.7X100
SCALES - 3X10; 4X100; 5X5; 6 - out of order -

Sources = #1 - Scale - 5 cm ≡ 4 cm actual.
#2 - Dr. Pressey's bucket in attic.
Control Rod - #1 - Cd Sheet -
#2 - Not used.
#2 Cylinder = 2' from #1 -

9:45 A.	#9 M.T. @ 1.6 cm now filling from #3 x					
9:50	Ht. = 5.8 cm	8.0 / 7.0 (7.5)	15.0 / 14.5 (14.75)	← Background Counts		
10:00	7.6	9.5	16.0	.79	.92	
10:12	10.3	16.5	34.5	.45	.43	
10:18	11.0	22.0	55.5	.34	.27	
10:25	12.1	91.5	260	.082	.057	
10:40	12.35	Not CRITICAL				
10:50	12.45	" "				
10:58	12.5	CRITICAL with ROD 12 cm from bottom				

Filling from #6 from 11.0? ~~filling f~~ Goes dry at 18.4 cm.

11:00 TAMPER lowered until sol. raised 2cm. CRIT. WITH ROD 3.5 cm from bottom
11:05 " RAISED " " dropped 1 cm CRIT. WITH ROD 8.5 cm " "
11:25 " lowered " sol raised 2.9 cm SUPER CRITICAL WITH ROD IN (Tamper 2 mm below soln level)

11:40 Soln. level reduced ~~by~~ to 12.35 by draining back into #1.
TAMPER in CONTACT - Sub critical WITH ROD out.
TAMPER lowered 4mm. - soln. level 7.5 cm above free surface - CRITICAL WITH ROD 1 cm out.

11:55 Soln level reduced to 12.2 by draining back into #1
Tamper lowered in soln. 4mm. - sol. level 7.5 cm above free surface - CRITICAL with ROD 13.1 ~~14.5~~ cm out.
TAMPER " " To 5mm - " " 10.0 cm " " " - NOT " " ROD out.
" RAISED " "To 4mm = " " 7.5 cm " " " - CRITICAL " " 13.1 cm out.
" " " "to 3 mm in soln - soln. level 5.0 cm " " " Not CRIT. " " out.

Effect of tamping on Top Tamper

12:25

1:25 Soln Ht. raised To 12.35 from #1.
1:27 #3 chamber started to vibrate alarmingly so ~~was~~ to be removed from trip circuit but the dump spring was removed since #3 now behaves.

1:35. With top tamper just Touching soln. - Not crit. with rod out. (quite dead)
1:40 TAMPER submerged about 1mm. LEVEL in sight glass RAISED 2.5 cm. (14.85) - Just crit. with rod out.
1:45 " " " 2 mm " " " " RAISED TO 5.0 cm (17.35) - CRIT. WITH ROD 3.6 cm ~~4.2~~ cm out.
1:50 " " " 3.5 or 4 mm. " " " " " TO 7.5 (19.85) " " " 1.0 cm out.
1:55 " " 5 mm " " " " " TO 10.0 (22.35) " " " 3.7 cm out.
1.57 " " 6+ mm " " " " " TO 12.5 (24.9) " " " 10.3 " "

2:10 p	
2:50 p	
3:00 p	
3:05 p	
3:10 p	
3:11 p	
3:35 p	
3:40 p	
3:45	
3:55 p	
4:00	
4:05	
4:20	
4:22	
4:32	
4:42	
4:47	
4:57	
5:05	
5:12	
5:20	
5:40	
6:00	
6:20	
6:37	
6:40	
6:45	
6:50	

Effect of tamping on Top Tamper

Ht.
Top 7
ABOVE
2 c
1.3
1.0
.7
.5
.3
TAMPER H. ABOVE sol
54 c
52.8
51.7
51.5
51.4
5.85
TAMP
TAMPER
C
Filling from #2 @
Filling from #1 @ 27.
DRAI
#1
#2
#3
BEST EST

11:00

H/r - 53.

2:10 p. Ht. raised to 12.7cm from #6 with tamper up.

Effect of adjusting Top Tamper

Top Tamper Ht Above soln.	Soln level	Rod out.	
2 cm.	12.7 cm.	all the way	NOT CRITICAL
1.3 cm.	12.7 cm.	"	Not. "
1.0 cm.	12.7 cm	"	Not "
.7 cm.	"	"	Not "
.5 cm	"	"	Not "
.3 cm	"	"	Not " but close

	TAMPER Ht. ABOVE soln.	Height of (INDICATOR)	Ht. soln.	C_1	C_2	C_0/C_1	C_0/C_2
2:50 p.	54 cm	(66.7)	12.7	14	32	.53	.46
3:00 p.	52.8	66.7	13.9	25	59.5	.30	.25
3:05 p	51.7	66.7	15.0		290 (.2mi)		.051
3:10 p	51.55	66.7	15.15	NOT CRITICAL.			
3:11 p	51.4	66.7	15.30 (15.2)	CRITICAL		Rod out 8cm.	
		60.5	15.30	"		Rod out 6.8cm.	
3:35 p	5.85	19.85	14.0	"		Rod ALL out.	
3:40 p.		66.7	15.30				
3:45	TAMPER WATER DRAINED 11" or 21.8" from bott. of reactor.						TAMPER H_2O Ht. 21.8"
3:55 p		66.7	15.5 (15.4)	CRITICAL		Rod out 8cm.	
4:00	TAMPER H_2O drained 6" or 16" from bottom of REACTOR.						16.0"
4:05		66.7	15.8 (15.7)	CRITICAL		Rod 3.5 cm out.	9.0"
4:20		66.7	16.1 (16.0)	"		" 5.8 cm out.	16.0cm
4:22		66.7	16.2	Not CRITICAL			16.0cm
4:32		66.7	16.4	Not CRIT.			16 cm.
4:42		66.7	16.6	CRITICAL		Rod 10 cm. out.	8 cm.
4:47	C.	66.7	16.6	23	64.5	.33	.23	8 cm.
4:57		66.7	17.6	23.5	69.0	.33	.21 (Source not in)	8 cm
5:05	Filling from #2 @ 18.7.	66.7	18.7	34.5	86.5	.22	.17	8 cm.
5:12		"	20.0	44.0	120.0	.17	.12	8 cm
5:20		"	21.5	73.0	262	.10	.056	8 cm
5:40		"	23.7	CRITICAL				8 cm
6:00	Filling from #1 @ 27.5	"	29.0	CRITICAL				0.0
6:20		"	33.1	CRITICAL				UNTAMPED
6:37		31.8	30.9	Tamper @ 31.8	Critical	Safety rod 1cm. in.		Top tamper only
6:40		31.0	30.4		Critical	" " out		
6:45		30.0	29.7		Critical	" " "		
6:50		29.6	29.6 (contact)		Critical	" " "		Untamped except top tamper in contact

DRAIN BACK ~~SAME AS PAGE 71~~

#1 = 8.0 cm in 10" cyl.
#2 = 7.8 " " " "
#3 = 7.6 " " " "
#6 = 8.9 cm in 10" cyl.
#9 = 1.6 cm in 10" cyl. + D.V.

(*) BEST ESTIMATED CRITICAL HEIGHT

See next page for summary.

...ounts
.92
.43
.27
.057

...m
...t 18.4 cm.
...tom

...ved from trip circuit
...nes.
...ith rod out (quite dead)
...ust crit. with rod out.
...IT. WITH ROD 3.6cm 4.2cm out.
" " " 1.0 cm out.
" " " 3.7 cm out.
" " " 10.3 " "

...WITH ROD 1 cm out.

...with ROD 13.1 cm out.
" ROD out.
" " 13.1 cm out.
" " out.

11.80

2/1/49 — THINGS TO DO

2/2/49 [redacted] Wed

Fix #1 Source UNISTRUT completed 2/2/49 (jmw)
" #1 " GUIDE Tube – gets out of line with hole in Sample
" #1 " WIRE – frayed at unistrut. replaced 2/2/49 (JMW)
Put guide on #1 Sample indicator counter weight to prevent its hitting upper glass end

There is a mass of data on preceding two pages which give:
a) Total cylinder #1, single, tamped
b) " " " " untamped
c) Critical conditions at various combinations of tamper.

#2 Source is in paraffin case on top of #2 top plate.

Todo: 2 – 10" untamped
#2" single to evaluate 3" section, if we plan to make Apertures for #2 as Compensation for #1 – 3" pp.

Time	Sec
10:25 AM	2.
10:30 AM	3.8
10:33	8.8
11:10	12.9
11:20	13.7
11:30	15.7
11:40	16.9
11:45	17.4

3/4/49 DC

Experiment 209 A
#1 – 10" Al cylinder tamped.
MX = 52.9
Conc = 0.293 gm x/gm = 0.459 gm x/cc
Aff = 1.566 -
Hc = 12.5 + 0.9 = 13.4 cm
Vc = 6.79 ℓ.
Mc = 3.12

209 B
#1 – 10" Al cylinder untamped.
Hc = 33.1 + 0.9 = 34 cm
Vc = 17.2 ℓ.
Mc = 7.90 kg.

2/14/46 DC

A. I.

Conc

Drain

H/X = 52.9 75

2/2/49 Experiment #210 Two 10" Al Cylinders - Untamped H/X = ~53 Moffitt
Wed Cronin
Pressey
Mooneyham

Trip Point #4 - 6.4x100; #3 - 7.5x100

Scales #3 - x10 (bypassed on trip circuit) #4 - x100 #5 - x2 #6 - not working

	Zero	Position
#1 Source	-2.5 cm.	+3.5 cm.
#2 Source	6.3	12.3
#2 " Comp.	71.5	71.5
#1 Control rod	8.0	8.0
#2 Control rod	—	—
Separation Indicator	11.6	11.6

A. In Contact

Time	Sph. Alt.	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
10:25 AM	2.2 cm.	—	—	—	—	MT @ 1.6 cm. Filing from #9; from #1
10:30 AM	3.8	—	—	—	—	Tube jiggled, #1 dry @ 3.8 cm
10:53	8.8	49, 48 } C_0 = 48.5	68, 67 } C_2 = 67.5	—	—	Filing from #2; dry @ 8.8
11:10	12.9	94.5	130	0.514	0.519	Filing from #3; dry @ 12.9
11:20	13.7	109	152	0.456	0.444	Filing from #6
11:30	15.7	149.5	206.5	0.327	0.327	" " "
11:40	16.9	187	260	0.259	0.260	" " "
11:45	17.4	210	283	0.231	0.238	" " " dry @ 17.4

Conclusion: Not critical due to lack of room Est. H_c = -22.5 ± 1.0 cm.

Drainback: #6 - 9.0 cm in one 10" cyl.
#3 - 8.2 "
#2 - 10.6 "
#1 - 7.0 "
#9 - D.V. "

3/4/46 DC
Exp 210,
2 - 10" Al cylinders, untamped
H/X = 52.9
conc = 0.293 gm X/gm = 0.459 gm X/cc
App ρ = 1.566
Hc > 20 cm.
V_c > 10.13 l.
M_c > 4.65 kg.

H/X = 52.9

Experiment [redacted] #2 11

2/3/49 #2 Movable 10" Cylinder Aluminum Tamped @ H/X ≈ 53

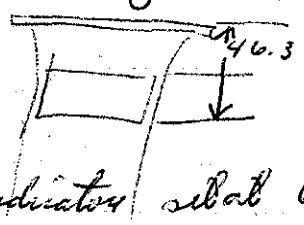
Trip Point #5 84 #4 6.5 #6 5.4 (1000 scale)

Scales: #5 "x2" #6 "x25" #3 x "10" #4 "x100"

(SEE BELOW FOR RIG*).

MORFITT
FOX
CRONIN
Callihan.

From [redacted] top of boiler plate to bottom of #2 tamper 46.3 cm

#2 tamper 

106.9
46.3
60.6 cm

tamper indicator set at 60.6 cm

#1 Source in attic

#2 Source set at 4 cm from bottom
Compensator at 71.5 cm
Indicator at 18.9
#1 Control Rod Out
#2 CRC 80.6 cm } zero setting.
#2 CR Scale 3.5 cm }

		H cm
1:12P		3.7
17		6.5
:27		8.8
:42		10.0
5✓		11.4
2:00		12.5
2:10		13.0
:16		13.5
:20		13.3
3✓		13.2
40		13.2

11:05A Filling dead volume from #9 cylinder

11:20 H = − 0.2 cm

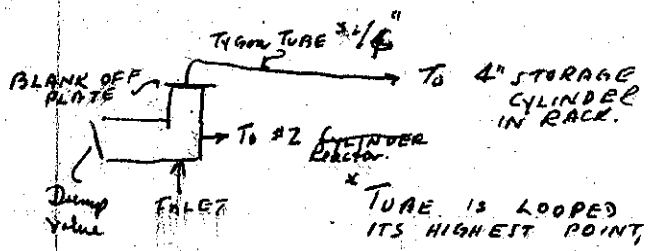
#9 almost MT: Filling from #3.

:27 ** It was necessary to try to remove air from the tygon connection to the storage cylinder. This was attempted by closing valve to #2 Reactor + draining drawing back - This was done but it was unsuccessful because impossible to empty the tygon - insufficient drop + force air bubble back.

:35 Although some solution was left in tygon, subsequent filling with solution (from #3 storage cylinder) force entrapped air through the domed tygon.

** MORE CONCISELY: FILLED REACTORS ~~CYLINDERS~~ NORMALLY TO ~ 3 cm. CLOSED VALVE BETWEEN REACTORS; TO EMPTY VENT (TYGON TO STORAGE RACK) ADDITIONAL SOLUTION WAS ADDED, SIGHT GLASS BEING CLOSED WITH A FINGER AS A PRECAUTION. THIS FORCED SOME AIR THROUGH VENT. FINALLY AIR PRESSURE WAS APPLIED THROUGH VENT CYLINDER WITH VALVE TO #2 REACTOR OPEN AND SIGHT GLASS FINGER CLOSED. THIS FORCED AIR OUT THROUGH #2 REACTOR.

* CYLINDER ARRANGEMENTS



* TUBE IS LOOPED OVER BOILER PLATE. i.e. IT IS HIGHER, AT ITS HIGHEST POINT, THAN IS TOP OF #2 CYLINDER.

CONCLU

3/7/49 DC

#2 - 16 Gal - Tamped
H/X = 52.9
Hc = 13.15 cm. = 13.2
Conc = 0.293 gm U/gm =
ρ/ρ0 = 1.566
Vc = 6.69 L
Mc = 3.07 Kg

INVEN

9

053

(1000 scale)

tamper 46.3 cm

	H cm	C_1	C_2	M_1	M_2	
1:12P	3.7					Filling from #3.
17	6.5	14.0	19.0			
		14.0	18.5			
		→ 14.0	18.7			
:27	8.8	19.0	21.0	0.74	0.89	#3 Empty; Filling from #6.
:42	10.0	24.0	23.5	0.58	0.80	
5✓	11.4	41.5	34.5	0.34	0.54	#2 Counter N.G.
2:00	12.5	103.0	73.0	0.136	0.256	
2:10	13.0	225.0	149.0	0.062	0.125	
16	13.5	SUPER CRIT WITH ALL ROD IN & TAMPER 2MM ABOVE SOL. LEVEL.				
:20	13.3	CRITICAL, TAMPER DOWN, ~~5.5~~ 7.8 cm ROD BELOW SURFACE.				#3 INIT. N.G. SHORTED OUT TRIP.
		CALL 13.2 cm = CRITICAL.				
3✓	13.2	CRITICAL, TAMPER DOWN, ROD AT 14.5 = 2.7cm BELOW SURFACE - DROPPED TWO #2 REACTOR SAFETY RODS; #6 INSTRUMENT. AT 7×25 BEFORE S. RODS DROPPED; #6 at 5 in 2 SEC, at 2 in 30 sec; to 1.3 in 60 sec.				
40	13.2	110	77	0.127	0.24	

lling from #3.
trgon
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ible to
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ed air
~ 3 cm.
T (1/GON
SIGHT GLASS
ECED SOME
VENT CYLINDER
CLOSED. THIS
2 REACTOR.
NER, AT

3/7/49 DC

#2 - 16" al - Tamped
H/X = 52.9
H_c = 13.15 cm. = 13.2
Conc = 0.293 $\frac{gm}{gm}$ × 1/gm = 0.459 $\frac{gm}{cc}$
ϕ/gm = 1.566
V_c = 6.69 ℓ
M_c = 3.07 kg.

CONCLUSIONS:

a). #2 - 10" al Cylinder, single, tamped, H/x = 53 critical at 13.15 cm.

b) Dropping #2 safety rods at criticality reduced activity by an amount corresponding to ~ 0.7 mm. of solution.

c) #1 Cylinder, alone at these conditions, was critical at 12.5 cm (See Exp. 209, pg 72, this book). Applying the usual correction for the 3" connection at bottom - (=0.9) makes the Corrected height = 12.5 + 0.9 = 13.4 cm This is to be compared with the 13.2 cm above. OR CONVERSELY CORRECTION FOR 3" BOTTOM = 13.15 - 12.5 = 0.65 cm. This is to be compared to the 0.9 cm used earlier.

INVENTORY: SAME AS THAT SHOWN PG 75.-

2/4/49

MACKLIN
CRONIN
FOX
CALLIHAN.

1. Some cleaning done in Rm 10; Shipped 2 cans conkeristable, 1-5 gal can washings. 3 gal jugs washings,

2. Emptied 3 steel cylinders from storage Rack #1, (~1/3 gal), solution badly contaminated, rinsed cylinders. Sent all for recovery (one of above jugs).

3. Instruments:
Bartkus & Carmichael here 1/2 day; #1 & 2 OK; #3 - completely out; #4 - stopper shorted - it was misbehaving no cause found - some tubes replaced. #5 & 6. OK.

4. Preparation for further experiments:
a) Removed blank off plate & tubing - stored in Rm 7.
b) Threads on remaining 2 stud, top 10" #2 cylinder, damaged by previous over tightening. Necessary to saw off stud & remove cylinder - Stud removed - ball provided for future installation.
c) Repository to 15" cylinder test - failed #2 stopper - during installation it was connected too close to its support - #2 source guide tube had not been loosened - so tube was tightly pressed into funnel base - no damage but may be noted for future. However, at this time the off center tightly rod guide tube was forced too far into its hole in stopper. Opened seam at top of tube & its junction with top of stopper. The tubes in stopper are slightly contaminated. Check de-contaminate & check before taking to shop. Removed #2 stopper, drained; removed 15" #1 cylinder
d) Decided to run 6". Found #1 stopper in #1 - 6" cylinder - removed rather easily; #2 6" stopper in its cylinder, stuck in dried UO2F2 & full of water. Forced stopper

in tig
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c) I

→

5 DATA fro

2/5/49
MOONEYHAM
FOX
SCHUSKE
CALLIHAN

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4) ~~#2~~
5) Mo
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#1 cylinder
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#2
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in tightly to minimize danger of leaving tamper
water as cylinder is tipped to slide out tamper.
tipped. No tamper or water emerged, rather ~ 50-100 cc
concentrated solution drib - on to a D.S. tray.
Apparently base of #2 - 6" cylinder had not
been drained before ~~was~~ removal - Tamper finally removed by attaching
it to the tamper support rod from #2 assembly.

→ NB (1). DO NOT STORE TAMPERS
IN CYLINDERS - WRAP IN
PAPER - PUT IN RM 7.

(2) DRAIN HOSE BEFORE REMOVING
#2 CYLINDERS.

e) Installed #2 - 6" tamper & cylinder -

→ (1) IMPOSSIBLE TO USE SOURCE, AT
LEAST IN NORMAL MANNER, WITH
#2 - 6" - HOLE IN TAMPER MISPLACED.

5. DATA from Exp 209 were plotted.

DC

2/5/49
MOONEY HAM
FOX
SCHUSKE
CALLAHAN

1) Replaced wire between sources & their counterweights with string.
2) Installed 6" cylinders - calibrated separation in detector.
3) Cut out board & painted with flagstat.
4) ~~It~~ ½" gasket on 12" flange leaks water - studs have been
tightened - may need new gasket - dripped on during pour
last today - paper on floor showed no splattering.
5) Much trouble with air lock in #2 to remote line -
unnecessarily so - line (loop) should be rotated to
remove loop - lay line flat on bottom of duct &
work air out -

H/X = 52.9

Experiment #212

5
2/4/49
Sat

#1 - 6½" #2 - 6"
Two [redacted] Al Cylinders - Tamped H/X = ~53"

Callihan
Fox
Schuske
Mooneyham

Drain

Instruments: #3 - out. #4 - T.P. = 6.1 x 100 x100 #5 - x2 #6 - T.P. = 4.8 x 1000 x25

Calibration of dolly for 6" cylinders

Position indicator (cm.)		Actual Separation Bottom	18" up	Top
2.2	(Δ=2.0)	0.2	0.1	0
4.2	(Δ=2.3)	1.9	1.85	1.8
7.2	(Δ=2.3)	4.8	4.7	4.6
26.2	(Δ=2.2)	24.0	23.6	23.5

Zero

	Scale @ Zero	Position
#1 Source	-2.0 cm.	4.0 cm.
#2 Source	out	out
#2 Source Comp.	—	—
#1 Control rod	5.5	5.5
#2 Control rod	3.5	out
#2 Control rod Comp.	88.6	88.6
Sep. Indicator	2.2	2.2

Time	Sol. Ht. (cm)		C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
4:58 PM							#2 empty at 1 cm with rev. rods not yet open.
4:30 PM	4.3	#1 TT 4.8 cm. #2 4.1 cm.	C_0 = 13.7 14.0, 13.5	C_0 = 14.5 14.0, 15.0	1.0	1.0	Filling from #1
4:38 P.M	9.5	#1 TT 9.8 #2 10.0	C = 17.0	21.5	.806	.675	empty 7.2 cm.
4:45	14.4	#1 14.7 #2 14.8	35.0	41.0	.393	.354	Filling from #3
	15.2	#2					#3 empty
5:00	16.6	#1 - 17.0 #2 - 17.0	89.5	100.5	.154	.144	Filling from #6
5:16	17.2	#1 - 17.6 #2 - 17.6	184.0	211.0	.073	.069	
5:30	17.6	#1 - 18.0 #2 - 18.1	not quite critical				
	17.7	#1 - 18.2 #2 -	Critical when control was 3.2 cm in solution				

3/7/49 DC

Coned

worse but it pays me

#1 - 6½" Separation
Hc = ~~17.65~~
Cone = 0.2
H/X = 52
Vc = #1
Mc = #1
ηk_∞ = 1.56

9

Callihan
Fox
Schuske
Mooneyham

-53

T.P. = 4.8 x 1000
#6 - x25

Drainback

#6 back to 15.2 cm.
#3 " " 7.2 cm.
#1 " " 0 cm.
#9 D.V

Solution should be same as on page 71 - (75 is more recent.)

#1 #2
6½ + 6

Conclusion: ~~Two~~ 6" Al tamped cylinders at - H/X = ~53 are critical at 17.65 + 0.05 cm.

These will probably go at various separations — would have been efficient in time & continue but it is too late + crew is tired — that is for next schedule —

Instruments — all OK but #3 — its stopper shorted out. —

Indicator	Bottom	12" up
5.2	2.9	2.9
11.0	8.9	8.8

Remarks

3/7/49 DC

#1 - 6½" & #2 - 6", Al, Tamped

#9 empty at 1 cm. with wire reflector not yet open.

Separation 0.1 cm

Filling from #1
empty 7.2 cm.

H_c = ~~17.65 + 2.90 - 18.8 cm~~ #1: 17.65 + 2.2 = 19.9; #2: 17.65 cm

Core = 0.293 gm X/gm = 0.459 gm X/cc

H/X = 52.9

Filling from #3

V_c = #1: 4.04 ℓ; #2 · 3.23 ℓ

M_c = #1 1.85 kg #2 1.48 kg

ρ_{eff} = 1.526

#3 empty
Filling from #6

82 Cronin
For
Pressy
Morfitt

One 6½" (#1) and One 6" (#2) Cylinder Interaction; Tamped; H/X = ~53

Experiment #213

H/X = 52.9

2/6/47

Trip Points #4 62x100 #6 4.8x1000

E SEPARATION

2:30p 35.8'
2:45. 37.1

	Scale Reading @ 0	Set @ (scale)
#1 Source	−2.0	4.0
#2 Source	0.0	6.0
#2 Source Comp	66.1	64.5 64.5
#1 CR	8.0	~~8.0~~ 8.0
#2 CR Comp	3.5, 88.6	3.3 87.1
~~Sep~~ Sep Indicator	2.1	0.3

10:00 A. Actual Separation 3.0 cm. (from calibration graph)

Filling D.V. from #9 M.T @ 1.2 filling from #1

Spent first 1½ hr. REMOVING OFF-CENTER SAFETY ROD, ADDING 2 MORE Thread SAVERS, ROTATING Top tamper 180° so that source NOW WORKS SMOOTHLY in #2 cylinder reactor

10:30A	Soln reacked equilibrium in 1 MIN.					
11:00A	6.6 cm.	15.0(14.0)	14.5	15.0 (14.5)	14.5	BACKGROUND
11:11 A	M.T. @ 8.5 filling from #2.					
11:17 A	11.7	22.0	22.5	.66	.65	
11:31 A	15.2	32.5	33.5	.44	.43	
11:42	17.2	46.0	46.5	.31	.31	
11:50	18.2	58.5	59.5	.25	.24	
12:10	20.0	142	149	.10	.10	
12:40	20.9	NOT CRITICAL				
1:05	21.1	CRITICAL WITH ROD JUST OUT				

A

B

1:15 #1 source 4.0cm; #2 Source 6.0cm; #2 Source comp. 62.6cm
#1 Control Rod. 8cm (0); #2 Control Rod 3.5cm (0); #2 Cont. Rod Comp. 85.1
Separation Indicator 9.3 cm. Actual Separation 7.0 cm.

1:30	21.1	37.0	36.5	.39	.40
	#2 M.T. @ 21.1 cm filling from #3				
1.45	25.1	66	65	.22	.22
2:00p	28.2	279	282	.052	.052
	FILLING FROM #6				
2:15p	29.0 +.1cm −0cm +0.1 −0.0 CRITICAL				

Separation 10.5cm

	29.0	49	48	.3	.3

C 2:35p 34.2 CRITICAL

Separation 13cm Control Rod comp. 82.1, Source Comp. 59.6, Sep. Ind. 15.4.

D 2:40	34.2	158.5	158 3	.092	.095
3:00	35.0	NOT CRITICAL			
3:12	35.4	" "			
3:22	35.8	CRITICAL			

Cyl
(loop must be m
CONCLU
separ
previo
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It,
the

3/7/49 JL
Exp 213, A
~~Separation~~ Separation 3.0 c
H_c meas 21.1
H_c #1 23.3
#2 21.1
Corr 8.29
H/X 52.
V_c #1 4.99
V_c #2 3.85
M_c #1 2.29
M_c #2 1.77
σ_{8c} = 1.566

n; Tamped; H/x = ~53

.9

E SEPARATION 20cm. CONT. ROD COMP. 78.6, SOURCE COMP. 56.0, SEP. IND. 22.5

2:30p 35.8 188.5 190 .077 .076
2:45. 37.1 CRITICAL WITH ROD 31cm from BOTTOM.

DRAINBACK — #6. SAME AS BEFORE (WHAT EVER THAT WAS) (At least 17.8 cm in single 6" cyl.
#3 — 18.8 cm in SINGLE 6" cyl.
#2 — 18.8 cm " " " "
#1 — 18.8 " " " "
#9 — D.V. for both cylinders (REACTORS)

Cylinders could not be further SEPARATED because OF CONNECTING HOSE. (loop must be reversed.)

CONCLUSIONS: (a) A SINGLE 6" cylinder should be RUN, as at 20cm separation The critical Height was only 37.1 cm against previous single cylinder height of 69.2 cm. in EXP. 132.
Twenty cm separation does not appear to be effective isolation.

It is recommended that this single cylinder be run first as the curve of separation vs. Hc appears almost flat. JP

Set @ (Scale)
4.0
6.0
64.5 64.5
~~80~~ 8.0
3.3 87.1
0.3

graph)

More Thread SAVERS, ROTATING #2 cylinder reactor

BACKGROUND

.65
.43
.31
.24
.10

. 62.6 cm
WT. Rod Comp. 85.1
ATION 7.0 cm.
.40

.22
.052

.3

ER IND. 15.4.
.085

3/1/49 Exp 213, #1 - 6½"; #2 6" Tamped, all cylinders.

	A	B	C	D	E
~~Separation~~ Separation	3.0 cm	7.0 cm	10.5 cm	13.0 cm	20.0 cm
H_c meas	21.1	29.0	34.2	35.8	37.1
Hc #1	23.3	31.2	36.4	38.0	39.3
#2	21.1	29.0	34.2	35.8	37.1

Cone 0.293 gm x/gm = 0.459 gm x/cc
H/x 52.9

Vc #1	4.99 L	6.68 L	7.79 L	8.13 L	8.41 L
Vc #2	3.85 L	5.29 L	6.24 L	6.53 L	6.77 L
Mc #1	2.29 kg	3.07 kg	3.58 kg	3.73 kg	3.86 kg
Mc #2	1.77 kg	2.43 kg	2.86 kg	3.00 kg	3.11 kg

ρ_x = 1.566

Callihan
Fox
Pressey
Macklin
Mooneyham

H/X = 52.9

7
2/6/49
Monday

Experiment #214

One #1 6½" Aluminium Cylinder - Tamped H/X = -53

Rap

Ca

Trip Points

#4 6.1×100 #6 5.0×1000

Scales

#3 - out, tripper shorted #4 - ×100 #5 - ×2 #6 - ×25

Zeros

	Zero	Position
#1 Source	-2.0 cm	10 cm.
#2 Source	0	out
#2 Source Comp.	66.1	66.1
#1 Control Rod	8.0	8.0
#2 Control Rod	—	out
#2 Control Rod Comp	—	—

3/7/49 DC Experim

He = 3
H/X = 5
Cove = 0.
Apg = 1.
Vc = 8
Mc = 3

Experiment

Time	Soln. Ht	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
10:35 AM	~~5.2~~ ~~13.0~~	12.0 11.5 } 11.7	13.0 12.5 } 12.7	1.0	1.0	from #9, dry @ 4.2
10:40	~~—~~	16.0	15.5	0.731	0.819	from #6 from #6
10:50	25.2	29.0	24.0	0.407	0.529	
11:15	31.6	52.0	40.0	0.225	0.318	#6 dry @ 31.6 cm.
11:35	36.0	222.5	~~169~~	0.053 ~~0.053~~	0.075	Filling from #3
11:50	36.95	not quite critical	~~T.T. 36.95~~		rod all the way out	T.T. = 36.95 cm.
11:59	39.4	annulus 2.5 cm. high	critical		rod out 30.0 cm.	
12:03	42.0	annulus 5.35 cm. high	critical		rod out 25.5 cm.	T.T. 36.65 cm.
12:06	44.5	" 8.35 cm. high	critical		rod out 25.0 cm.	T.T. 36.15 cm.
12:09	47.0	" 11.08 cm. "	critical		rod out 26.0 cm.	T.T. 35.95 cm.
12:15	49.5	" 13.75 cm. "	critical		rod out 28.0 cm.	T.T. 35.75 cm.
12:25	~~37.15~~ ~~37.15~~	T.T. just touching	critical		rod out ~~31~~ cm.	
12:30	39.65	annulus 2.80 cm. high	critical		rod out 25.5 cm.	T.T. = 36.85 cm.

Drainback: same as fill-up. Inventory is as on page 83.

Conclusion: A single 6½" Al. cylinder tamped at H/X = -53 is critical at 37.0±0.05 cm. Depressing the top tamper into the solution made the reactor more critical up to a point then less critical.

37.0 + 2.2 = 39.2 cm bottom annulus

2,9

7
2/6/49
Monday

2/7/49

-53

Replaced #1 - 6½" by #1 - 6" -

Calibrated separation indicator.

DC

#6 - x25

Position
10 cm. out
56.1
8.0
out
—

3/7/49 DC Experiment 214. #1 6½" al cylinder Jammed.

He = 37.0 cm. + 2.2 = 39.2 cm.
H/x = 52.9
Cave = 0.293 gm x/gm = 0.459 gm x/cc
ρ_eff = 1.576
Vc = 8.39 ℓ
Mc = 3.85 kg

Remarks

from #9, dry @ 1.2
from #6
from #6

#6 dry @ 31.6 a.
Filing from #3
way out T.T. = 36.95 cm.
.0 cm.
5 cm. T.T. 36.65 cm
0 cm. T.T. 36.15 cm
0 cm. T.T. 35.95 cm
0 cm. T.T. 35.75 cm.

m.
m. T.T = 36.85 cm.

is critical at 37.0±0.05 cm
da the reactor more

+2.2 = 39.2 cm bottom unaltered

2/8/49

EXPERIMENT #215

H/X = 52.9

CRONIN

SINGLE (#1) 6" AL. REACTOR, H/X = 53-, TAMPED. (Tuesday)

PRESSEY
MOONEYHAM
CALLIHAN.

INSTRUMENTS: TRIP POINTS: #3 - Badorde, #4 - 6.7 x100, #6 - 5.0 x1000
SCALES: #3 x0 ; #4 x100 ; #5 x 2 , #6 x 25

	Scale	Comp	Actual
#1 Source	13 cm	–	15 cm
#2 Source	~~In all~~ Raised into guide tube -		
#1 CR	8.0	–	0
#2 CR.	3.5	64.0	0
Cyl. Separtr.	51.1	–	48.9
#2 Tamper	58.2		33.3
#1 Tamper	8.75		6.7 cm

11:45

11:55

3/9/49 DC

8:55 Filling DV of both cylinders

Sol'n Ht.	C_1	C_2	c_0/c_1	c_0/c_2	
6.7					
2.3	at equilibrium in both cyl. drain balls from #1 into #6				#9 Empty fill from #6
0.2 cm	#2 cyl closed off				#2 Cyl closed off.
~~7.75~~ 7.65	tamper contacted at 8.0				From #6 cyl.
15.0	13.0	11.5			" " " "
	13.0	12.5			
C_0 =	13.0	12.0			
24.85	16.5	14.5	.778	.828	
33.5			591	.667	#6 Empty
37.8	22.0	18.0	.724	.657	Filling from #3
47.5	30.0	25	434	.480	
54.2	39.0	33	.333	.364	#3 Empty
~~57.5~~	unable to count				From #2 "
~~68.0~~ 68.15	NOT CRITICAL				
68.50	Critical				

Control = 62. cm from bottom

Critical at 68.30 ± 1 mm (±2.6 cm bottom counter = 70.9 cm H_c)

Drain back into #2 cyl

65.0	123.5	100.5	.105	.119	
	129.5	103.5	.099	.115	

TAMPED). (Tuesday)		Soln Ht	C_1	C_2	C_0/C_1	C_0/C_2
	11:45	59.9	62.5	47.5	.208	.253
- 5.0 x1000						
6 x 25						
	11:55	Inventory in 2-6" cyl				
		#1 = 22.1	11.0 cm			
		#2 = ~~20.7~~ 22.1	~~10.3~~ 11.0 cm			
		#3 = 20.7	10.3 cm			
		#6 =				
		#9 = MT				
	3/9/69 DC	Exp 2N, #1 - 6" all reactor, pumped.				
		H/X = 52.9				
		H_c = 68.3 + 2.6 = 70.9 cm				
		Apg = 1.526				
		cone = 0.293 gm U/gm = 0.459 gm U/cc.				
		V_c = 12.932				
		M_c = 5.93 kg				
#9 Empty						
Fill from #6						
Leaved diff.						
From #6 cyl.						
" " " "						
#6 Empty						
Filling from #3						
#3 Empty						
From #2						
" "						
cone constant = 70.9 cm Ht)						
into #2 cyl						

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Callihan
Mooneyhan
Cronin

Ex 216

H/X = 52.9

2/8/49

2-6" Al Cyl tamped H/X = 52.9

2/6A

	comp	Scale	Actual
Separation	—	2.7	0 (at bottom)
#1 CR	88.2	99.5	99.5
#2 Source	66.4	13.0	13.0
#1 "	—	~~13.0~~ 10	~~13.0~~ 12.0
#1 CR	—	8	0
#2 Tamper		58.3	58.3

Sol'n Ht = ~~25.20~~ 19.10 in fixed 6" cyl.
0.20 in movable 6" cyl

1:25	9.4	Valve opened between cylinders				
1:35	~~9.4~~ Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2	
	9.4	11.5	8.5			
		11.5	8.5			
1:47	12.0	15.75	11.0	.74	.762	
14:00	15.1	25.0	17.0	1460	.50	
14:10	17.9	56.5	40.5	.203	.21	#6 Empty
14:20	19.1	154.0	109.5	.075	.078	From #3
14:35	19.55	not critical				
14:45	19.80	Critical with 10cm of Rod in sol'n				

Critical at 19.65 ± 1 mm

~~19.65 + 2.59 = 22.24 cm~~
~~Corrected for~~

15:00

Ex 216 B

Sep = 2.9 cm

	Scale	Actual
~~Sep~~ Sep	5.1	2.9
#2 Source	13.0	13.0
Comp #2 Source	66.0	"
#2 C Rod		
Comp #2 " "	86.75	
#1 C Tamper	27.0	27.0
#1 Source	10	12
#1 CR	8	0
Sol'n	19.8	

Time	Sol'n
15:02	19.
15:15	21.
15:25	22.
15:35	22.
15:48	22.
	C
15:52	
16:15	
16:25	
16:25	
16:45	

2/8/49

Ex 216 B

Time	Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2
15:02	19.80	42.5	31.0	.271	.274
15:15	21.00	68.0	47.5	.169	.179
15:25	22.20	179.5	130.5	.064	.064
15:35	22.60	NOT CRITICAL			
15:48	22.80	CRITICAL			

#1 Control Rod 19.5 cm from bottom

Critical at 22.70 ± 1 mm

216 – C

Sep ↘	~~Comp~~	Scale	actual
	—	8.0	5.8
#2 CR	85.30	3.5	0
#2 Source	63.50	13.0	13.0
#2 Tamper	—	36.0	36.0
#1 CR	—	8	0
#1 Source	—	10	12.0

Pressey in

	Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2	
#6 Empty	15:52	22.8	27.5	21.0	.418	.405
From #3	16:15	26.0	46	32.5	.250	.261
	16:25	28.2			#3 MT	Mooney house out
	16:25	30.0	not Critical			From #2
65+2.59=22.24 Corrected for	16:45	30.3	Critical #2 Rod out			

#1 Rod about 28 cm from bottom

Critical at 30.2 ± 1 mm

216 – D

Seq	Comp	Scale	actual
	10.8		8.7
#2 Source	67.05	13	13
#2 CR	83.85	3.5	0
#2 tamper	—	34.6	34.6
#1 CR	—	8	0
#1 Source	—	10	12.0

3/8/49

216 D Sep - 8.7 cm

	Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2	
17:00	30.3.	34.5	22.0	.334	.387	From #2
17:20	37.0	121.	80	.0950	.106	#2 MT
17:38	39.7	Critical with 20 cm Rod from bottom #2 Rod all out				From #1
17:45	39.5	Critical #2 Rod out 14 cm of Rod #1 in sol.				
17:50	39.2	Sub critical both Rods out				

Critical at 39.4 ± 1 mm.

216 E Sep = 11 cm

		Comp	actual
Sep	13.1	—	11.0
#2 CR	3.5	82.60	0
#2 Source	13.0	60.80	13.
#1 Source	10.0	—	12
#1 CR	8.	—	0
Tamper	41	—	41

	Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2	
18:00	39.2	50.5	33.5	.228	.254	From #1
18:20	43.6	110	84.	.199	.101	
18:30	47.5	Critical with 35 cm #1 Rod in sol. #2 Rod out				#1 MT
18:40	46.9	Critical with #2 Rod out #1 Rod 21 cm in sol'n				
18:45	46.5	Critical #2 Rod out #1 Rod 8.5 cm in sol'n				
18:50	46.2	just sub critical both Rods out				

H_c = 46.3 ± 1 mm

	18:55	Sol'n 46
	19:15	48.
	19:20	
		#1
		#2
		#3
		#6
		#9
		15"
		5"
		#2 Top of
3/7/49		Two 6"
Separation		A 0 cm
Hc meas.		19.65
Hc corr (+1.3)		21.0
H/X		52.9
δ_f		1.566
Conc		0.293
Vc		3.83 ℓ
Mc		1.76 kg

3/8/49

216 F

	°	Sep = 13.0 and D
		Comp
Sep	15.1	13.0
#2 CR	3.5	81.6 0
#2 Sonne	13	59.8 0
#1 "	10	— 12
#1 CR	8	— 0
Tamper	—	— —

	Sol'n Ht	C_1	C_2	C_0/C_1	C_0/C_2
18:55	46.2	70	45.5	.164	.186
19:15	48.4	72	48.5	.160	.171
19:20		113	80.5	.102	.105

Not critical but extrapolate to 50.5 ± 10 mm

Drain back

cm in 2-6" cyl

#1 11.6 cm
#2 12.0 cm
#3 12.1 cm
#6 12.0 cm
#9 Dead Vol.

15" Tamper has been repaired and is ready for Exp. 5" assembly should be ready tomorrow.

#2 Sonne gave difficulty today may be on top of tamper, or on cylinder bottom.

3/7/49 Two 6" Al cylinder Tamped

Separation	A 0 cm	B 2.9 cm	C 5.8 cm	D 8.7 cm	E 11.0 cm	F 13.0 cm.
He meas.	19.65	22.70	30.2	39.4	46.3	50.5*
He corr (+1.3)	21.0	24.0	31.5	40.7	47.6	51.8*
H/X	52.9					
ρ_g	1.566					
Conc	0.293	gm X/gm = 0.459 gm X/cc				
Vc	3.83ℓ	4.38ℓ	5.74ℓ	7.42ℓ	8.68ℓ	9.45 kg ℓ
Mc	1.76 kg	2.01 kg	2.64 kg	3.41 kg	3.98 kg	4.34 kg.

2-15" Al cyl. water tamped.

Exp 217

H/X = 53

H/X = 52.9

2/10/49

Thursday

	scale	comp	
Sep @ 0	24.7 ~~250~~ cm		
#1 CR 0	8 cm		
#1 Source 0	1½ cm		
#2 CR 0	3.5 cm	81.1 cm	
#2 Source 0	0	58.7 cm	

Time	
Morfitt	1515
Fox	1525
Cronin	1533

Ex 217 A

	scale	comp	actual	
#2 Source	~~3~~ 2	81.1 cm	3 cm	2 cm
#1 Source	~~4.5~~ 3½	—	3 cm	2 cm
#2 Tamper	59.2	—	57.2	

Instruments #3 – not in trip circuit #5 not in trip circuit
#4 – 100× at 6.9 #6 1000 scale at 6.0

	Sol'n Ht.	C_1	C_2	C_0/C_1	C_0/C_2	
13:15	8.35	50	30	1	1	
		50	30	1	1	
1400	4.40	64	40.5	.782	.742	
	~~5.5~~	104	69	.480	.435	(5.4 cm)
1425	6.25	182	132	.275	.227	
1442	6.90	831	670	.062	.048	
1455	7.10	Critical both Rods in				
	7.00	Sub Critical				

#1 MT

From #2	1645
#2 MT	1552
From #3	
#3 MT	
From #6	

Sol

Ex.

Critical at 7.05 ± .025 cm at separation of 0 cm.

217 B

	scale	comp	actual	
Sep	27.6	—	2.9 cm	
#1 CR	25	—	0	
#2 CR	10	79.6	6.5	
#1 Source	3½	—	2 cm	
#2 Source	2	57.2	2 cm	

1600	
1615	
1630	
1640	

3 | 2/10/49

52.9 | Thursday

	Time	Sol'n Ht	C_1	C_2	C_o/C_1	C_o/C_2	
Morfitt	1515	7.00	169.5	132	295	.227	
Fox	1525	7.40	Critical with Hampers down				# 6MT 87.3
Cronin	1533	7.30	Sub Critical (barely) rods + tampers out.				

Critical at 7.35 cm ± .025 cm

2 cm
2 cm
cirmd
@ 6.0

2 17 C

	scale	comp	actual
Sep	30.5	—	5.8
#1 CR	25	—	0
#2 CR	3.5	78.1	0
#1 S	3.5	—	2
#2 S	2	55.7	2
tampers	10	—	10

#1 MT

	Sol'n Ht.	C_1	C_2	C_o/C_1	C_o/C_2
from #2 1545	7.30	228	180	.219	.168
#2 MT 1552	7.50	Critical Tampers down Rods in.			

from #3
(5.4cm) #3 MT
from #6

Critical at 7.40 ± .05 cm

Ex. 217D

			actual
Sep	~~33.4~~ 30.3	—	11.6
#2 CR	25	75.2	0
#2 S	2	52.8	2
tampers	10.0	—	10

@ cm.

	Sol'n Ht	C_1	C_2	C_o/C_1	C_o/C_2
1600	~~7.50~~ 7.40	168	136	.298	.220
1615	7.30	132	102.5	.379	.293
		86	60.5	.582	.495
1630	5.7	44	31	1.13	.97
1640	4.1	32	21		
	3.8	30.5	19		

Conclusion Critical @ 7.45 cm ± 0.5 cm

2/18/49

217 E

Mc,H

Single 15" Al Cyl. water tamped

Collibee
Cronin

Soln Inventory

			scale	actual
#1	24 cm	#1 Source	4.5	3
#2	4 cm	#1 CR	25	0
#3	4 cm			
#6	3			
#9	MT			

17:08	#9 Empty @ 4 cm.					
17:13	#6 Empty @ 3.4 Cm					
17:15	4.2	23.5, 22.5	12.0, 12.5	1.0	1.0	
	Use Background of	23.0	12.0	See No to		

17:30 At this point the source was found to be on top of Tamper after instrument did not seem to respond. This would also account for steepness of curves in point A-D. Since the critical point was known within definite limit this point below was taken as background.

17:54	5.9	77.5	52.0	1.0	1.0
17:59	6.6	110	81	.03 Empty	
				↳ 0.7	6.2
18:08	7.0	200	165	.39	.30
18:18	7.4	Not critical. EST crit 7.6 cm			
18:25	7.6 Super Critical with				

(Critical with tamper 4 mm off solution & 10 cm rod in.

∴ Conclusion Critical @ 7.5 Cm ± 0.05 cm.

[illegible] = 7.9 cm

?

Drawback in terms of single 10 in cyl.

#1	4 Cm X 9	÷ 2	= 18 (2-5" cms)
#2	4 Cm X 9	÷ 2	= 18
#3	4 cm X 9	÷ 2	= 18
#6	2.6 Cm X 9 = 23.4	÷ 2	= 11.7
#9	D.V.		

3/7/49 bc Exp 2

Separation.
He meas
He corr
Avg = 1.566
Corr 0.993
Vc
Mc

→ Exp

H/f =
He meas 7.5
He corr 7.5
Avg = 1.5
Corr = 0.
Vc = 9.
Mc = 4.

2/18/49

Mo. Hill
Callihan
Cronin

2/11/49

Macklin
Cronin
Fox
Callihan

actual
3
0

Removed & stored 15" cylinder

Installed 5" cylinders.

Installed guide tube for #1 control rod.

3/7/49 DC — Exp 217, A-Direc. Two 15" al cylinders, Tamped. H/X = 52.9.

	A	B	C	D	E
Separation	0 cm	2.9 cm	5.8 cm	11.6 cm	
He meas	7.05	7.35	7.40	7.45	
He corr'd	7.3	7.6	7.6	7.7	

Avg = 1.566

Cone 0.793 gm x/gm = 0.459 gm x/cc.

Vc	8.32 L	8.66 L	8.66 L	8.78 L
Mc	3.82 kg	3.97 kg	3.97 kg	4.03 kg.

→ Exp 217 E, Single 15", #1 al cylinder tamped.

H/X = 52.9.

He meas 7.5 cm
He corr 7.9 cm
Avg = 1.566
Cone = 0.793 gm x/gm = 0.459 gm x/cc
Vc = 9.01 L
Mc = 4.14 kg.

1.0 — 1.0 — See Ms to be on cm of clears from within background.

1.0 1.0
.23 Empty
0.7 6.2
.39 .30
7.6 cm

10 cm rod in.

e.

(2 – 5" cms)

96
3/11/49

EXPERIMENT 218

H/X = 52.9

Callahan
Cronin
Brackbill
Fox

TWO 5" Al CYLINDERS - ~~Co~~ TAMPED

H/X = 53 - ~~H+ Con~~

SEPARATION : 2mm

A

INSTRUMENTS: TRIP POINTS; #3 - 8.0; #4 - 5.6 x100; #6 5.4 x100

SCALES - #3 x10 ; #4 x100 ; #5 x2 ; #6 x25

	Scale	Compensator	Actual
#1 SOURCE	9.5 ~~0 cm~~	—	8.0 ~~0~~ [redacted] cm
#2 "	NOT USED.		
#1 CR	8cm	—	0
#2 CR	NOT USED.		
#1 Tamper	91.4 - (15.4 + 13.2) = 62.8.		
#2 Tamper	106.9 - (22.5 + 15.4) = 69.0 set.		
Dolley indicator	0	—	0.2 cm.

2:45P Filling lead volume from #9.

	SO2 Ht.	C_1	C_2	C_0/C_1	C_0/C_2	
3:32 PM	2.3 #9 empty	—	—	—	—	filling from #6
3.46	7.4	11.5	6.0	—	—	
		(11.0)	(6.0)	—	—	
3.56	11.1	15.0	8.0	.734	.750	
4 10	15.1	16.5	9.5	.667	.632	#6 Empty 13.0
4 18	17.9	19.0	10.5	.580	.572	Filling #1
4 27	24.8	34.5	19.5	.318	.308	
4 36	28.0	48.0	27.5	.228	.218	Filling #2 ↓
4 48	31.0	**82.5**	**49.0**	.133	.123	
5 06	33.2	208.0	125.5	.053	.048	
5 09	34.2	SLIGHTLY SUB-CRITICAL				
5:16	34.4	" " "				
5 24	34.6	Critical - Rod up 28cm				

Drainback same as filled
see p. 94

Conclusion: Critical at 34.5 cm

3/7/49 2-5" Al cylinder. Tamped.
Separation - 0.2 cm.
He (meas) = 34.5 cm ≡ He (corr) = 34.5 + 1.4 = 36.4 cm
H/X = 52.9; ≡ 0.293 gm H/gm ≡ 0.439 gm H/cc = ρ_{H_2} = 1.566
V_c = 4.61 ℓ
M_c = ~~2.21~~ 2.12 kg.

INSTRUMEN

#1
#2
#1
#2
#1
#2
Cylinder

9 24 AM

9 45	
10 05	
10 17	
10 32	
10 46	
11 01	
11 19	
11 30	
11 40	
11 43	

Con

Callahan
Cronin
Mracklin
Fox

EXPERIMENT 219 H/X = 52.9

2/12/44

2 - 5" Al Cylinders - H/x = 53; TAMPED.

Schuske
Cronin
Fox
Callahan

Hc vs SEPARATION

A

INSTRUMENTS: TEIP POINTS, #3 - N.6.; #4 - 5.8x100; #6 - 5.5x1000
SCALES: #3 x100; #4x100, #5x2, #6x25.

	Scale	Compensator	Actual
#1 SOURCE	9.5	—	8.0cm.
#2 SOURCE	NOT USED.		
#1 CR	8cm	—	0
#2 CR	30.0cm	96.8cm	15cm.
#1 Temp	as before -		
#2 Temp.	Read.		
Cylinder Separation	3.1 cm	—	2.9cm.

	Sol. Ht.	C_1	C_2	C_2/C_1	C_0/C_2	
9 24 AM	1.4 cm	—	—	—	—	#9 Empty at 2.5
9 45	10.0	13.5 (13.0) 13.0	7.0 (7.0) 7.0			Filling #6
10 05	17.5	19.0	10.5	.685	.667	#6 Empty @ 14.0
10 17	25.0	25.5	13.5	.510	.518	Filling #3
10 32	35.0	40.0	24.0	.325	.292	#3 Empty 31.9
10 46	42.5	70.5	44.0	.184	.159	Filling #2
11 01	48.0	199.0	136.0	.065	.051	
11 19	50.55	critical { #1 Rod OUT; #2 " 8 cm. Below surface				Filling #1
11 30	50.35	critical { #1 Rod OUT; #2 Rod 3 cm Below surface				
11 40	50.1	critical { #1 Rod at sol. surface Level; #2 Rod out				
11 43	49.9	slightly Sub-critical - Both Rods out				

Conclusion; critical at 50.0 ± .05

#6 J. H. x1000
#6 x 25
[redacted] cm
2 cm.
C_0/C_2 — filling from #6
.750
.632 #6 Empty 13.0cm
.572 Filling #1
.308
.218 Filling #2
.123
.048
ICAL
Tamped.
34.5 + 1.9 = 36.4cm
19 gm/cc = ρ_{avg} = 1.566

7/14/49

EXPT. 219 B

2-5" Al. Tamped
#/x = 5-3

Separation 3.3 cm.

	scale	comp.	actual
Separation	3.5	—	3.3 cm.
#1 source	9.5	—	8.0
#2 C.R.	30.0	96.4	15.0
#1 C.R.	8.	0	0

#2 source not used

	So2 Ht.	C_1	C_2	C_0/C_1	C_0/C_2	
12.10 PM	49.9	120.0	81.0	.108	.086	Filling #2
12 22 "	52.05	214.0	149.0	.061	.047	
12 33 "	~~54.0~~ 54.1	Slightly sub-critical				
12 45	54.4	Critical { #1 Rod - 15cm Below surface; #2 Rod - Out				

Conclusion critical at 54.3 ± .05

1 48 PM
2 00
2 14
2 26
2 30

EXPT 219 C

	scale	comp.	actual
Separation:	3.7	—	3.5
#1 source	9.5	[redacted]	8.0
#2 "	not used		
#1 CR	8.		0
#2 CR	30.0	96.3	15

		C_1	C_2	C_0/C_1	C_0/C_2
1 37	54.4	172.0	114.0	.075	.040

3 02

Did not change actually sufficiently. Decided to separate further. Indicated crit. at about 37 cm.

-5" Al. Tampad
#1 = 5-3

EXPT. 219 D

	Scale	Comp	Actual
Separation	4.0	—	3.8 cm
#1 C.R.	8.0	—	0
#2 C.R.	30.0	96.1	15.0
#1 source	9.5 —	—	8.0

		C_1	C_2	C_0/C_1	C_0/C_2	
1 48 PM	5~~4.4~~	76.5	50.5	.170	.138	Filling #2
2 00	60.0	171.0	120.0	.076	.058	#2 Subcrit at 54.5
2 14	64.1	critical	{ #2 Rod out; #1 " 17 cm Below surface			Filling #1
2 24	63.7	"	{ #2 Rod out; #1 " 9 cm " "			
2 30	63.3	slightly sub crit. with Rods out				

Conclusion 63.4 ± .1 cm.

C_0/C_2
.084 Filling #2
.047

al
Below Surface

actual
3.3 ~~5~~ cm.
8.0
15.0
0

EXPT. 219 E

	Scale	Comp.	Actual
Separation	4.4 cm.		4.2 cm
#1 C.R.	8.0	—	0
#2 C.R	30.0	95.9	15.0
#1 source	9.5 —	—	8.0

#2 source not used.

Sol. Ht.	C_1	C_2	C_0/C_1	C_0/C_2
63.3	81.0	54.5	.160	.129
68.3	140.0	100.0	.093	.070

Extrapolated to critical at 74 cm —

actual
3.5 —
8.0

0
15 —

C_0/C_2
.060

ntly Decided
zero at 37 cm.

EXPT 219 F

	Scale	Comp.	Actual
Separation	6.5 cm		4.3 cm.
#1 C.R	8.0		0
#2 C.R	~~30.0~~	94.9	~~15~~ 0 out
#1 source	9.5		8.0

Sol. Ht.	C_1	C_2	C_0/C_1	C_0/C_2
68.3	~~24.0~~	17.0	.50	.41

2/12/49

EXPT 219 G

Separation (Actual) 5.8 cm.
source & Rod as in part E

	Sol Ht.	C_1	C_2	C_0/C_1	C_0/C_2
326	6.83	30.0	19.5	.433	.359

EXPT 219 H

Actual separation 8.3 cm.

		C_1	C_2	C_0/C_1	C_0/C_2
332	same	21.0	12.0	.620	.580

EXPT 219 I

Actual separation 12.7 cm.

same	18.5	10.0	.70	.70

EXPT 219 J

Act. separation 15.2 cm

6.83	18.0	—	.722	
	17.0	9.5	.763	.738

Ex 219 K

Act. Sep. 19 cm

6.83	C_1	C_2	C_0/C_1	C_0/C_2
	17.5 ~~17.6~~	9.5	.764	.738
	17.0	10.0	~~.768~~ .763	.70

EXPT 219 L

Act. sep. 4.1

6.83 Slightly Sub. Critical

Sources destroyed

EXPT 219. M

Actual separation 4.0 cm.

6.83 Critical { #1 Rod 24 cm Below Surface; #2 Rod out

2 Copper sp Bakelite ~~guide~~ ~~bracke~~

See pg 102 for summary

2/12/49

Drainback

#1	storage cyl.		17.0 cm	(2-5" cyl. cms)
#2	"	"	17.0	"
#3	"	"	17.0	"
#6	"	"	17.0	"
#9	D.V.	~~+0.3~~ +	0.3	"

C_o/C_2
.359

C_o/C_2
.580

.70

.738

C_o/C_2
.738
.70

The above is much ado about what we are not sure — It is an attempt to observe limiting separation beyond which there is no interaction between two 5" cylinders. The following was done:

a) at given separation He was determined
b) Separation increased stepwise and further values of He obtained in the usual way until we ran out of solution at 68.3cm = H. (Actually in this series the greatest He was slightly below 68.3).
c) At this constant mass (~~He~~ H = 68.3cm) the reactors were further separated and the reciprocal multiplication measured; these separations ~~and~~ ~~(reactivities)~~ vs. M^{-1} were plotted until further separation did not reduce the $(\text{multiplication})^{-1}$
d) The value of the separation at $M^{-1} = 0$, (critically), the extrapolation of the curve of C, was checked by running in the #2 cylinder until they were critical.
e) The results are plotted.

Sources: + 1 in position — others stored
Instruments: all operated ~~normal~~ OK — except — #3 trippin shorted out; #6 — very slight aperiodic fluctuations — not enough to worry about trippin.

2 Copper space bars (1.2 cm thick) Have been painted with Bakelite varnish + oven dried today. ~~They have been given second coat and are air drying; in shop beside bare pcs. They should be oven dried~~

(Cont.)

Surface

8/14/49

2/13/49
Sunday

~~for 2 hr 250° F Sunday AM Oven is being left on~~. These are spacers for compensating 8" cylinder for 3" pipe
Revision: One cock will suffice + they are too hot to now paint.

Ex. 220A
Content

Suggestions: Investigate effect of 3" pipe #1 8" cylinder by Hom or interaction now. This requires installing ~~one~~ two 8" cylinders + running tamped up. with spacers in ~~one~~ 8" cylinder (#1) wire then be in place for mixing solution after next dilution —

Dilute to H/x = 125 - 150 —

Note: We forgot to drain rubber hose connecting the cylinder. Sorry! —

Time

12:48 PM
1:15
1:45
1:55
2:00

Soln.

7.0
9.3
11.3
11.75
11.95

3/7/49 DC

Exp 219. 2- 5" al cylinders Tamped

	A	B	C	D	E	F	G	H	I	J	K	L	M.
Separation	2.9 cm	3.3 cm	3.5 cm	3.8 cm	4.2 cm								4.0 cm
He meas	50.0	54.3	-	63.4	74* settling								68.3
He cor.	51.9	56.2	-	65.3	76*								70.2
H/x	52.9												
Cond	0.293 gmx/gm = 0.409 gm/cc												
Of g	1.376												
Vc													
Mic													

Experiment
220B

Two
No. 2
Inv
Co
Seperat

2/13/49
Sunday

Experiment # 220

H/X = 52.9

Morfitt
Fox
Pressey
Mooneyham

Two 8" Aluminum Cylinders Tamped H/X = ~53

No. 2 Cylinder 1.2 cm lower than usual (shims)

Ex. 220A
Content

Instruments: Trip points #4 - 5.8×100 #6 - 5.8×1000
Scales #3 tripper shorted #4 - ×100 #5 - ×2 #6 - ×25

	Zero	Position	
#1 Source	1.5 cm.	6.0 cm.	Δh = 4.5 cm.
#2 Source	10.7	15.2	Δh = 4.5
#2 Source Comp.	77.4	77.4	
#1 C.R.	8.0	8.0	
#2 C.R.	16.0	16.0	
#2 C.R. Comp.	95.8	95.8	
Cylinder Seperation	~~7.5~~ 7.4	7.4	

Time	Soln. Ht.	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
12:48 PM	7.0	37.0 / 35.0 } 36.0	30.0 / 32.0 } 31.0	1.0	1.0	Filling from #9; dry; Then #1; dry
1:15	9.3	63.0	56.0	0.571	0.553	From #2
1:45	11.3	~~233~~ ~~202~~	281 ~~208~~	0.0127 ~~0.0134~~	0.0110 ~~0.0149~~	" " to 11.5 cm.
1:55	11.75	not quite critical				From 3
2:00	11.95	Critical with both rods in				

Conclusion: Critical at 11.85 ± 0.05 cm.

Experiment
220B

Seperation increased ~~2.0~~ 3.5 cm.

	Position
#1 Source	6.0 cm.
#2 Source	15.2
#2 Source Comp.	75.65
#1 C.R.	8.0
#2 C.R.	16.0
#2 C.R. Comp.	94.05
#2 T.T.	14.0
Cylinder seperation	10.9

K L M.
40 cm
68.3
70.2

2/13/49

		$C_{01}=36.0$ C_1	$C_{02}=31.0$ C_2	M_1^{-1}	M_2^{-1}	Results
2:20	11.95	107	103	0.336	0.301	From #2
2:30	13.6	Supercritical with rods in and tampers down				
	13.45	Not quite critical				

Concl: Critical at 13.55 ± 0.05 cm.

Ex. 220 C
Separation = 14.7 cm.

#2 C.R. Compensator	88.7 cm.
#2 Source "	70.2
# Cylinder Separation	22.1

2:55	13.45	61	52	0.590	0.596	From #3
3:10	16.3	164	149.5	0.219	0.207	
3:30	17.75	Not critical				
	17.90	Critical with #1 rod 5 cm up; #2 C.R. in; tampers down				

Conclusion: Critical at 17.80 ± 0.05 cm.

Ex. 220 D
Separation = 7.0 cm.

Cylinder Separation	14.4 cm. on scale
#2 Source Compensator	73.9 cm.
#2 CRod "	92.3 cm.

4:00	14.60	183	171	0.197	0.181	From #3
4:15	15.55	Not critical				"
4:23	15.8	Critical #1 rod up 2 cm.; #2 rod out; tampers down				"

Conclusion: 15.70 ± 0.05 = critical height

Ex. 220 E
Actual separation
= 9.2 - 7.4 = 1.8 cm

Cylinder Separation	9.2 cm. on scale
#2 Source Comp.	75.6
#2 CR "	94.0

4:50	12.9	Supercritical	Draining into #2
5:00	12.7	Supercritical	
5:03	12.5	Critical #1 CR in.; #2 out 15 cm; tampers down	
5:07	12.4	Critical #1 CR out 10 cm; #2 out; " "	

Conclusion: Critical at 12.35 ± 0.5 cm.

2/13/49

Concl. The
effect
compe
here
down

Unc

N.

on

grou

NOTE
in
Re

3/7/49 DC

2-8"	
A	
Separation	0 cm
He meas	11.85
He corr.	13.2
$\mu f x$ =	52.9
μf_s =	1.576
Conc	0.293
V_c	4.282
M_c	1.96 Kg

2/13/49

Results

From #2

Drainback #1 6 cm. in two 8" cylinders
#2 6 cm. " " " "
#3 2-3 cm " " " " bad valve, leaking in pit
#6 6.6 cm. same as before
#9 DY.

Concl. There seems to be a small but significant difference here, with effect going thru a maximum. Δh should be carefully computed for points on exp 205 & 220. One curve here is concave upwards, Curve for 205 is concave downwards which explains large difference at close separations.

From #3

pers down

Untamped was done on 1/29/49.

N.B. #3 cylinder has leak in valve. Disconnected on drainback. We put no more in, after this cleanup.

From #3

" gross contamination only from pit. Spill ~ 3-5 cc.

ers down "

2/14/99

NOTE: After installing new valve in #3 position in pit; a leak rate on manifold was made. Result: At 15# pser. dropped ½# in 1 hr.

ing into #2

3/7/49 DC 2-8" all Cylinders stamped, #2 cylinder lowered 1.2 cm.

ers down

"

	A	B	C	D	E
Separation	0 cm	3.5 cm	14.7 cm	7.0 cm	1.8 cm
He meas	11.85	13.55	17.80	15.70	12.35
He corr.	13.2	~~14.9~~ ~~+3.5~~	~~19.1~~ ~~+9.7~~	~~17.0~~ ~~+7.6~~	~~14.3~~ 13.3 13.7
+1X =	52.9				
Pfs =	1.56				
conc	0.293 gm/gm = 0.459 gm/cc.				
Vc	4.28 L	4.83 L	6.19 L	5.57 L	4.44 L
Mc	1.96 Kg	2.22 kg	2.84 kg	2.53 kg	2.04 kg.

≡ He(mean) + $\frac{1.4+1.2}{2}$

106 2/14/49

Macalum
Fry
Chisney
Morrison
Callahan

Distribution of solution for dilutes:

~~1 2 3 4 5 6~~

	1	2	3	4 (not in use)	5	6-7	8-9
H_1	63.0	71.0	58.6	—	46.2		73.2
H_2	40.8	33.6	44.8		38.0		31.7
DH	22.2	37.4	13.8	—	28.2		41.5
ΔHx ~~2.96~~ 1.566 or 1.89	42.0	70.7	26.1	—	53.3		78.5

Sol. then filled into 8" reactor and redistributed

H_2	15.3	22.7			9.3	17.3	10.6	16.0	24.0
Drained →	68	47	6.5	—	6.7	6.7	6.7	6.7	6.7
into EACH	8.5	16.0		—	2.6	10.6	3.9	9.3	17.3
Cyl. (Cm in 8" cylinders).		(16.2)							

Cylinder # 5 had about 1½ liters of pan washing filtered into it prior to adding above sol.

Solution redistributed into manifold cylinders:

	C	B	A
	8.5		
Net →	6.7		
	1.8		
	12.0	11.6	16.9 — net manometer readings

These may be in error because of solution in vertical connection between pit and delay.

-7 - 8-9

732
31,7
41,5

78.5

distributed
10,6 16,0 24.0
6.7 6.7 6.7
3.9 9.3 17.3

pan washing
above sol.

problem:

readings
because of
ation between

Considerations of Exp 205 and 220:

1) It is to be pointed out that the sight glass readings in Exp 205 represent the amount of solution in #2 cylinder; the effective amount in #1 is sight glass plus 1.2 cm, the effective height of the 3" pipe
2) In Exp 220, the effective amount of solution in each cylinder is ~~for~~ given by the sight glass reading plus 1.2 cm.
3) There is probably some lack of ~~precision~~ accuracy in the values of cylinder separations - for instance Exp 220E was done at 1.8 cm according to data - more careful measurement with gage blocks shows it to be 1.6cm. —
4) It is believed that data should be plotted as mass (effective) vs separation -
5) It is not certain how the "bottom" corrections in #220 should be applied at wide separations except in mass considerations. (or total effective height) when the asymptote is 2x single mass.
6). It is believed that the data (205 vs 220) are not seriously discrepant -

D.C.

Decided to dilute to a volume capable of making 10", 15" & 20" critical, untamped, when two cylinders are infinitely separated. This is ~ M/k = 175. Also to procure ~ 700 gm U from Y-12 (ours recovered material) on 7/15 or 16 -

Visit by Dr Fleming of Duke:

1) Re - "Tamper Damping" Experiment (#209 x 214) Effect is due to filling holes in top tamper with solution which serves as a reflector - ~~to~~ up to certain point (ca 3" height) it (solution in holes) is more valuable as reflector than as fuel -
2) Differences observed between #1 cylinder data obtained in single cylinder exp's + in intersection exp's - probably due to temperature differences : $\frac{\partial k}{k} \simeq -10^{-4}\,\delta T = 10^{-3}$ for $\delta T = 10C^{\circ}$ -

$$\frac{\partial M}{M} \simeq 5\,\frac{\partial k}{k} = 5 \times 10^{-3} \simeq 1/2\%$$

for 6" cylinder at $H_c \simeq 70$ cm this is ca 3 mm.

(cont)

Fabr

Experimental difference ≅ 7 mm - the precisions probably overlap. This is a effect of temperature on hydrogen scattering cross-section principally -

3). Reflection of neutrons by stainless cylinders untamped - i.e. Hc for an untamped cylinder being ~~less~~ greater than Hc for stainless at same H/V + same cylinder was to be expected. Also the effect of partial tamping - Exp 209, was anticipated. -

Repl
wh
jo

Repai

To do

7/15/49

&c.

Amount of Soup in Cylinder

	B	A	5	C	6
Manometer Diff.	14.9	13.3	24.0	12.8	13.9
Ht. in 8" cm.	7.8	6.96	11.58	*6.7	*6.7
Sp. Gr.			1.455		

* MEASURED VALUES

Cylinder No.	Sp. Gr.	Gm X(?)	Gm H_2O Added	
✓ 1	1.167	1012	4700	4560
✓ 2	1.175	997	4630	4500
× 3	1.186	968	4490	4365
✓ 6	1.173	997	4170	4500
✓ 7	1.193	997	4170	4500
✓ 8	1.195	997	4170	4500
✓ 9	1.158	997	4170	4500
✓ C	1.167	997	4170	4500
✓ A	1.177	1035	3848	
✓ B	1.195	997	3471	
× E	1.187	643	2130	
✓ 5	1.200	997	3255	

avg 1.181 sp Gr. from graph = 4/x of 177 (assuming equal distribution among cylinders).

bly overlap-
mass-

interrupted
H/V +
3

URED VALVES

?good

Fabricated manifold for ~~two~~ three cylinders on wagon-

Mooneyham
Cronin
Henry
Pusey
Cauthen

Replaced valve + its connections through which samples are taken because of broken joint -

Repaired leak - #5 pit cylinder -

To do - Mix solution -
Repair leak on #big cylinder rack ✓done OK
~~main~~ manifold - at cylinder F -
now wrapped in Kleenex -
Clean flow under dump pan + top of dump pan - Wipe test > 350 c/min -
Pusey put dilution data in note book -
Replace broken flare nut + shorten P-10 tubing on manifold at cylinder #A. Done by D.F.C.
D

110
2/16/49

2/17/49
Callihan – V
Crowin – S
Fox – SG
Moffitt – CE

Solution Inventory

Batch	Mix	Sp. g.	"H in terms of 8" cylinders
1	A	1.187	19.7
2	A	1.187	19.7
3	C	1.186	[redacted] ?
5	A	1.187	19.7
6	D	1.190	19.0
7	B	1.185	17.7
8	A	1.187	19.7
9	B	1.185	17.7
A	D	1.190	19.0
B	B	1.185	17.7
C	D	~~1.180~~ 1.190	19.0
E	C	1.187	?
		ave 1.187	

Note: The above group of cylinders was divided up into batches A, B, C, D, & each batch ~~dried~~ mixed separately, and then equal amounts were drained back into the cylinders from which the solution was originally taken. The aim was to attain a sp g of 1.185. The sp g given above are based on one sample taken during the drainback of each batch.

∴ ANALYSIS ON RESULTING SOLUTION
SHOWS 0.136 g U/g sol.
= 0.127 gm U/gm.

Reg. # 710062
710063

Ave sp gr = 1.187
Conc = ~~0.161~~ 0.151 gr U/cc

Scales

Time	Trip	Drain
11:30		
12:10		
12:12		
12:25	12	
12:30	13	
12:50	22	
1:00	25	
1:17	29.	
1:23	33.5	
1:33	39.	
	43.1	
1:55	51.1	
2:15	60.4	
2:30	70.2	
	Not	
	Drain	
	#1 –	
	#2	
	#3	
	#4	
	#5	
	#6	
	#7	
	#8	
	#9	

2/17/99

H/X = 169.3

2 - 8" al Cylinders Undamped in center H/X ≈ 175

Calibration - V
Cronin - S
Fox - SG
Moffitt - CE

Experiment #221

Trip Point #4 5.5 #6 - 5.4 #

	Zero Reading	actual	Set @ (scale)
#1 Source	7.0	0	19.0
#2 Source Comp	71.5	—	71.5
#2 Source	0.0	0	12.0
#1 Control Rod	8.0	0	8.0
#2 Control Rod	3.5	0	3.5
#2 Control Rod Comp	70.1	—	70.1
Separation	7.0	0	7.0

1.2 cm spacers on #2 cyl to compensate for 3" section on #1 cyl.

Scabs #6 X25, #5 X 2 #4 X100 #3 X10

Time	Sol. Hgt.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
11:30	3.0	—	—	—	—	From #6
12:10						check list complete
12:12	4.4					#6 Empty
12:25	12.7					From #9
12:30	13.0	71.5	62.5			#9 Empty
		71.5	60.5	1	1	From in #1
Switches A, B, C, D,	12:50	22.4	151.5	148.0	.472	.415	#1 MT
& were drained	1:00	25.2	171	179.	.417	.343	From #3
			171.5	181.			
originally taken.	1:17	29.7	209.	224	.342	.274	
	1:23	33.5	~~29~~				#3 MT
	1:33	39.2	295.5	317	.242	.194	From #2
		43.1					#2 MT
	1:55	51.1	410	455	.174	.135	#7 MT
	2:15	60.4	505	561	.141	.109	#5 MT
	2:30	70.2	633	697	.113	.088	#8 MT

Not Critical - all pit cylinders MT

Drainbacks

#1 -	10.2 cm 8" cylinder
#2	9.8
#3	9.8
#4	~~10.1~~
#5	10.1
#6	10.1
#7	9.1
#8	10.1
#9 -	DV ↑?

Conclusion: 2 - 8" Cylinders in contact @ H/X ≈ 172 are

Very probably subcritical if undamped

0.127 gm/cc
k_{eff} = 1.167
0.151 gm/cc.

Proposed Exp.		H/X
10"	Untamped	175
20"	"	"
15"	"	"
15"	Tamped	"
5½"	"	"

See corrected list below

dilute to H/X 400 stoning ts in 3" cyl.

10"	untamped
20"	"
15"	"
15"	tamped

Statement of Experimental Program from present time to March 1,

As many of the following experiments as possible will be performed in the order given: [redacted]

At H/X ∞ 172 (present conc 2/16/29)

Two	6"	Cylinders	Tamped
Two	10"	"	Untamped
Two	20"	"	Untamped
Two	15"	"	Untamped
Two	15"	"	Tamped

At H/X ∞ 350 (Directions for diluting below

Two	15"	"	Tamped
Two	15"	"	Untamped
Two	20"		Untamped
Two	10"		Untamped

The
of H/x
should
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would no
of simi
ratio
great
From
Tu
(A)
(B) Wo
The
(C)

The following comments are made with regard to the choice of H/X of 350:

Experiment to date make it clear that emphasis should be on untamped data which means utilizing the larger size cylinders. Because an examination of the previous experimental results showed that an H/X of 500 would not make a 10" cylinder go critical untamped & because of similar considerations, it was decided to limit the H/X ratios to ≈ 350.

At such a concentration, the 10" cylinds requires the greatest mass, & therefore, with fixed concentration, the largest volume

From the data:

(A) At H/X ≈ 350, i.e. 0.076 gX/cc
Two 10" cylinders require 8.5 Kg X + D.V for total of 9.0 Kg X
& corresponding volume is $\frac{9000}{76}$ = 118 liters

thus requiring all 17 - four inch storage cylinders
17 x 7 = 119 liters.
& possibly 2 3"-inch cylinders for safety.

(B) We now have on hand (2/17/49)
73 liters @ spg 1.187 ≈ H/X of 172
& concentration is 0.148 gX/cc yielding 10.8 Kg X.

Therefore in order to fill mass requirements of (A) we must use

(C) $\frac{9.0}{10.8}$ x 73 = 60.8 liters of our present solution

From ©, the excess solution is

73.0 - 60.8 = 12.2 l. ~~tan~~

(D)

This excess can easily be stored in 4 - 3"-inch cylinders.

Dilution to H/X ≃ 350

From (A) & (C) our problem is to add 57.2 l. H_2O
to 60.8 l H/X ~172
yielding 118.0 l H/X ~ 350

This will be correct to the extent to which present H/X's are known & ~~#~~ assumes no volume change on mixing which at these concentrations should not be significant.

~~Final~~ Solution may be divided as follows

FINAL DISTRIBUTION {
2 Three inch cyl. @ 3.75 l each = 7.50 l
17 Four " " " 6.50 l " = 110.5 l
Total 118 l.

START WITH {
2 Three inch cylinders containing 1.93 l each = 3.86 l
17 Four inch " " 3.35 l each = 56.95 l
60.81 l

ADD WATER {
2 Three inch cylinders; add 1.82 l. each = 3.64 l
17 Four inch cylinders; add 3.15 l. each = 53.55
57.19

Installed 2-6" reactors

2-6"H
Calibra
Scale
12.3 cm
7.5 cm.
3.6
2.6
2.2
Note: 1) T
2) T
INSTRUMEN
Cylinder

H/X = 169.3

EXPERIMENT 222

2/18/49

2-6" AL CYLINDERS. TAMPED, H/X ≈ 175

MACKLIN
CRONIN
FOX
CALLIHAN.

Calibration of Cylinder Separation Indicator.
Two 6" al reactors

Scale	Bottom (Actual)	Center	Top	
12.3 cm	9.95 cm	10.05 cm	10.10 cm	
7.5 cm.		5.40		
3.6		1.45		
2.6	Contact - lump of weld rod.	0.5 cm	0.6 cm	
2.2		0.4 cm.		Forced together at bottom.

Note: 1) Two pair of spring joint inside calipers have been put in tool box.
2) Two "d" (pipe) storage cylinders brought from shop. These are not cd covered. Wrap in Cd sheet - [only 65 mil available in ~~shop~~ stores] use that in Rm 7 - after decontamination.

INSTRUMENTS: TRIP POINTS: #4 - 6x100, #3 & #6 out of order
SCALES: 3x10; 4x100, 5 x 2, 6 out of order

		Scale cm ~~≈8~~ ≈0	Compensator cm	Actual, cm. ~~≈8~~ ≈0
#1	Source		—	
#2	"	NOT USED.		
#1	Cd	0	—	~~8~~ 4
#2	Cd (Adjustable rod).	3.8	73.0	0
#1	Tamper	Set		
#2	Tamper	Set.		
Cylinder Separator.		2.2	—	0.4 cm.

82.4 cm to top #2 tamper from top of plate
106.9 - (82.4+15.4) =
106.9 - 97.8 = 9.1 cm

#1 tamper -
72.8 cm from edge cylinder & top tamper

(36.0 - 0.5) 2.54
- (72.8 + 15.4) =
90.1 - 88.2 = 1.9 cm

3" - inch

57.2 l H_2O
60.8 l H/x ≈ 172
118.0 l H/x ≈ 350

k present
ger on wiping
it.

l each = 7.50 l
l " = 110.5 l
118 l.

3 l each = 3.86 l
- l each = 56.95 l
60.81 l ✓

- l. each = 3.64 l
- l each = 53.55
57.19

Exp 222 (cont).

Note — Tue
Wa

A

9:50 A Filling dead volume from #9.

#2 Rod is in cylinder thru safety Rod guide

Ckts flow -	Scale	Comp	Actual
Separation	2.2	—	0.4 cm
#1 Source	14		7 approx
#2 Source	—	—	—
#1 Control Rod	8	—	0
#2 control Rod	3.8	73	0
#2 Tamper	re-set		

#9 MT at 4 cm

S/n	Ht	C_1	C_2	C_0/C_1	C_0/C_2	
		36,5	3,0			
7.80		76.5	3.0			from #8 cyl.
		85	3.0			
			4.0			
		8.0	4.0			
	11.8	12	4.0	.667	1	
11:15	15.8	11.5	12.5	.698	.32	
11:20	17.9	17.0	17.5	.47	.229	
11:30	21.1	21.0	28.0	.381	.143	#8 MT
		~~37.5~~				
11:40	23.9	37.5	53.5	.213	.075	From #7
11:50	25.9	95	120.5	.084	.033	
11:55	27.~~2~~	not critical				
12.05	27.~~1~~	not critical but close				
12.10	27.9	super Critical				
12.15	27.7	super Critical				

∴ Critical at 27.6 ± 0.1 cm

	#1 Counter	Sol'n
1:25		27.
1:50		30.4
1:55		31.0
2.05		31.6
2:10		30.9
2:30		31.3
2:35		31.3
2:45		~~34.65~~
2:55		
3:10		39.2
3:20		40.7
3:25		41.0

Note — Tues 22nd Feb
Water will be off.

2/18/49

Callihan C2
Cronin B
Fox SG
Macklin VR

Exp 222 B

	Scale	comp	actual
Sep	7.1	—	0.0
#2 comp.	3.8	72	0
tamper	30.9	—	30.9

#1 Counter pulse height selector moved from 14 to 15

Sol'n	C_1	C_2	$C_1/2.5$	$C_2/C_0 = 4.0$	
1:25	27.9	35	.0715	.0625	From #7 cyl
1:50	30.4	131.5	.019	.0148	
1:55	31.05	not critical			
2:05	31.60	just critical #2 Rod out #1 in			
2:10	30.9	not critical			
2:30	31.3	#2 Rod out #1 Rod 11 cm in Critical			

Critical at 31.2 ± .1 cm

222 C

	Scale	comp	actual
Sep.	6.1		4 cm
#2 CR	2.8	71	
Tamper	33.8		

Sol'N	C_1	C_2	$1/M_1$	$1/M_2$	
2:25	3:3	22.0	3.8	.113	.105	Stepped #7 from #6 cyl.
2:45	3465 3465	32.5	55.5	.077	.072	
2:55					
3:10	392	100	199.5	.045	.051	
3:20	40.7	just barely critical both rods out			
3:25	41.0	Critical with #2 Rod out #1 Rod 15 cm in			

Critical at 40.9 ± 0.1 cm

tical
0.4 cm
7 approx
—
0
o

from # 8 cyl.

8 MT

From #7

118

7/18/49

222 D

	scale	comp	actual
Sep	8.15	———	6
CR	3.8	70	——
Tamper	43.1	———	———

Bottom in to adjust Reed and #1 counter
Speedomax #6 needs worked on.

	Sol'n Ht	C_1 (G=2.5)	C_2 (G=4.0)	C_0/C_1	C_0/C_2	
3:35	41.0	21.0	32.5	.119	.123	Bottom & Top out
4:00	44.0	#7 MT				From #7 cyl
4:10	~~48.~~	25	48.0	.10	.083	From #6 cyl 4:15
4:15	47.2		48.			
4:30	54.4	56	116	.0447	.0345	
	57.0					#6 MT; Filling from #5
4:50	60.1	CRITICAL WITH #2 Rod out #1 Rod ~~21 cm~~ 22 cm ~~Rod~~ in.				
:58	59.7	CRITICAL WITH #2 Rod out. #1 Rod 6 cm in.				

Estimated CRITICAL at 59.5 ±0.1 cm =

222 E

	Scale	Comp	actual
Separator	10.2 cm	—	8 cm ←
Tamper	60.5		
#7 CR.		~~#~~ 69 cm	

5:10P	59.7	18.5	30.5	0.135	0.131	Filling from #5
:18	64.1	19.5	34.5	0.128	0.116	
35	69.2	23.0	39.0	0.109	0.103	

Two 6" Al Cylinders ~~8~~ 8 cm separated in H$_2$O - HX appear infinitely Dense

6:20P INV

Bottom & Top out 4:15

Conclus

TOOK Tamper penetra

3/7/49 Exp 22

A

Separation 0.4 c

He meas 27.6

He cal. 289

HX = 169.3

Core 0.127 g

A_{fg} = 1.187

Vc = 5.27 ℓ

Mc = 0.80 kg

7/18/49

Barthan in
5 adjust Reed
Reed #1 counter
Reed on box #6
needs worked on

6:20 P

INVENTORY

1	10.V	cm	in two 8" cylinders
2	9.8		
3	9.8		
4	- M.T.		
5	- 10.1		
6	- 18	cm	in two 6" cylinders
7	- 18	"	"
8	- 18	"	"
9	- Dr+3	"	"

from pg 111

Barthan + Tot and 4:15
From #7 cyl
From #6 cyl

#6 M.T. Fillings from #5

Sad in.

Conclusion - H/X ≅ 175
Two - 6" al cylinders. Tamped -

Hc -	Separation between edges
27.6 cm	0.4 cm
~~30.9~~ 31.2	2.0
40.9	4.0
59.5	6.0
∞	8.0.

FC
DC

Took two water samples for analyses - one from tamper tank at end of experiment - the other from sanitary water supply.

~~Sam A from supply~~
Sample 222 C from supply
" 222 D " tamper.

Fillings from #5

3/7/49 Exp 222; 2-6" al cylinders tamped.

	A	B	C	D	E
Separation	0.4 cm	2.0 cm	4.0 cm	6.0 cm	8.0
Hc meas	27.6	31.2	40.9	59.5	∞
Hc cal.	289	32.5	42.2	60.8	∞

H/X = 169.3
Conc 0.127 gm X/gm = 0.151 gm X/cc
Sp g = 1.187
Vc = 5.27 L 5.93 L 7.70 L 10.90 L ∞
Mc = 0.80 kg 0.90 kg 1.16 kg 1.65 kg ∞

Dc

H/X ≅ 175

120
7/19/49

CRONIN

SCHUSKE
CALLIHAN.

1) Removed 6" cylinder, stored
2) Installed 20" cylinder – for unstamped experiment – note that water flange nuts are in position but only every other one is tightened.
3) Decontaminated top of dumper pan, floor underneath adjacent to Vertex, area around pit and edges of pit.
4) Replaced flexible lines on #1 source + #2 control rod.
5) Took two samples for H/X – done by filling dead volume from #9, then sampling.
6) Sp gr of these samples (222A & 222B) was 1.192 at 16° C.

7) Installed #2 sources –

8) Zero values (i.e. source on bottom of reactor or bottom of control rod on bottom of reactor):

	scale	compensator	actual Zero
#1 Source	7.0 cm	–	0 cm
#2 Source	0	47.7 cm	0
#1 C.R.	8.0	–	0
#2 C.R.*	3.5	55.7 cm	0

* #2 C.R. runs hard because of angulation of wire + #2 C.R. guide tube. suggest lowering #2 tamper support plate or putting pulley in place of screw eye.

#9) Instruments – #6 Speedomax out of order – all others have either been just worked on or have been OK –

#3 Trigger is being put back in. ✓ has to be set.

P.S. Trip circuit seems over-sensitive. is shorted out now –

#6 Trigger is in – ~~note~~ use meter on Trigger instead of Speedomax

2/19/49

NOTE – Apparently we sent a Zuto to be repaired which had its screen broken & which carried large deposits of UO2F2 (50 x 10³ CO α/min) – had been used in cleaning up a spill & then itself not cleaned & checked –.

→ It is imperative that all items of Lab property be monitored as they are taken from this Bldg & tagged stating condition so far as contamination is concerned. Individuals will be responsible for their own personal property –

DC

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1 222B)

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– 0 cm
7 cm 0
– 0
.7 cm 0

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ur –

: meter on Hoppler visited
of specimens

Experiment #223

H/X = 169.3

H/X = ~175

Callihan
Morfitt
Fox
Pressey
Mooneyham

Three 20" ~~Aluminum~~ Stainless Steel Cylinders

Untamped

2/20/49

Trip points #4 – 5.3 x 100 #6 – 0.75 on meter

Instruments #3 – x10 #4 – x100 #5 – x10 #6 – recorder out on.

Dolly

Separation	Scale
0 cm.	38.5 cm.
1.5	40.0
3	41.5
8	46.5

Apparently linear

Zeros

	Zero	Position
#1 Source	7.0 cm.	~~12.0~~ 11.0
#2 Source	0	~~5.0~~ 4.0
#2 Source	47.7	47.7
#1 CR	8.0	8.0
#2 CR	3.5	3.5
#2 CR Comp.	55.2	55.2
Separation	~~38.5~~ 0	38.5

Ex. 223 A

Time	Height (cm.)	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
9:25 AM	1.5 (single cyl.)	—	—	—	—	From #1 ; #1 dry
9:35	4.8 (single cyl.)	—	—	—	—	From #2; #2 dry
"	or 2.0 (both cylinders)	—	—	—	—	From C
9:55	2.2	valve closed ∴ 0.2 cm in 120" cyl. from C				C plugged
10:00	4.0 (both cylinders)	— not in equilibrium				From B
10:30	5.1 "	43.0 } 42.5 42.7	36.0 } 34.0 35.0	1.0	1.0	B empty; from A; A empty
10:45	7.1	~~52.5~~	~~44.0~~			From 3; 3 empty
10:55	7.4	52.5	44.0	0.814	0.796	From 5
11:00	8.3	far from equilibrium				#5 empty
11:05	9.2	76.0	64.0	0.562	0.547	From #6
11:20	10.0	far from equilibrium				#6 empty
11:35	10.3	106.5	90.5	0.401	0.387	From #7
11:40	12.0					#7 empty ; From #8
12:00	11.8	173.5	153	0.246	0.229	"
12:30 PM	12.6	247	232.5	0.173	0.151	#6 by-passed "
1:00	13.5	508	508	0.084	0.069	#8 dry ; from C
1:30	~~14.2~~ 14.1	Sub-critical				Callihan out
1:43	14.2	Not quite critical				
2:00	14.3	Critical	with #1 rod; #2 rod at 10.8 cm on scale			

Ex. 223 B
Separation (Actual) = 5.0 cm

Ex. 223 C
Actual Separation = 20.0 cm

Comments:
The (stainless
& 14.8
varia
(223 B)
run.

the
#9 & dr
mate
held
then c
#7 wh
filled

#1
#2
#3
#4 #
#5
#6
#7
#8
#9
A
B
C –
D
E –

9.3

175 2/20/49

ater

#6 – recorder not on.

tly linear

Conclusion @ 14.25 ± 0.05 cm. + 0.3 cm for sight glass correction = 14.55 + 0.05

Ex. 223B
Separation (actual) = 5.0 cm

Separation Indicator 43.5 cm

14.3 Not Critical

14.4 Critical with #1 CR out and #2 CR at 11.5 cm

Conclusion: Critical @ 14.35 + 0.3 cm for sight glass correction = 14.65 ± .05 cm

Ex. 223C
Actual Separation = 20.0 cm

#2 CR Comp. 45.2 cm
#2 Source Comp. 37.7
Separation Ind 58.5

14.4. Critical with both rods out

Conclusion Critical @ 14.40 + 0.3 cm for sight glass corr. = 14.70 ± .05 cm

Comments:

The critical height of an isolated untamped cylinder @ 4/1x1x4 (stainless) was estimated by two methods as 14.6 cm & 14.8 cm respectively. For this reason & because of the slow variation in critical height with separation, [Compare 5.0 cm sep. (223B) with 20 cm sep 223C)] no further experiments were run.

In draining back the method used was to open cylinder #9 & drain into it until the probe of Beta-Gamma survey meter #18-A read off scale (on the most sensitive scale) when held two inches below the top of the cylinder. Valve was then closed. By starting cylinder #8 slightly behind #9, & opening #7 when #9 was full, two cylinders at a time could be filled; drainback taking about ½ time usually required

Remarks

From #1 ; #1 dry
From #2; #2 dry
From C
C plugged
From B
B empty; from A; A empty
From 3 ; 3 empty
From 5
#5 empty
From #6
#6 empty
From #7
#7 empty ; From #8
"
#6 by-passed "
#8 dry ; from C
Calibration out

	~ Cm in one 20" cyl.
#1	~ 1.6 (Small cont. draining)
#2	~ 3.4
#3	~ 3.4
#4 MT	M.T.
#5	~ 3.4
#6	~ 3.4
#7	~ 3.4
#8	~ 3.4
#9	~ 3.4
A	~ 3.4
B	~ 3.4
C	1.0
[illegible]	[illegible]
2	3.0

3/7/49 2 - 20" S.S. Cylinders untamped.

	A	B	C
Separation	0 cm	5.0 cm	20.0 cm
He meas	14.55	14.65 ~~14.70~~	14.70
He corr.	14.7	14.8	14.8

Mk = 169.3 = 0.127 gm U/gm = 0.151 gm U/cc = 6 gc = 1.187

Vc =	29.78 L	29.98 L	29.98 L
Mc =	4.50 kg	4.53 kg	4.53 kg

Valve on cylinder #C extremely slow. do not add more solution to this cylinder.

scale

2/21 Replaced 20" cylinders with 10" Samples 222 taken & Lab

H/X = 169.3

FOX V
MACKLIN S
PRESSEY D
CALLIHAN CE

EXPERIMENT 224

2-21-49

2 - 10" Al cylinders UNTAMPED

H/X ~ 175

TRIP POINTS #4. 5.6 x100; #6 - 5.5 x1000
#1 SOURCE zero's @ 2.2 cm
#2 " " @ 0.0 cm
" COMPENSATOR @ 59.7 cm.
#1 CONTROL ROD ZERO @ 8.0 cm
#2 CONTROL ROD ZERO @ 3.5 cm
" " COMPENSATOR @ 65.6cm.
SOURCES 8cm from bottom

CALIBRATION OF SEPARATION INDICATOR
ACTUALLY 0.0 INDICATOR = 12.2
" 1.9cm " = 14.05
" 9.95cm " = 22.1
" 20.0 " = 32.1

	#3 on 10X	#4 on 100X	#6 on 25X		Cyl's. MT	
10:50 A	Filling from #1				1, 2,	
11:10 A	BACKGND COUNTS.	#1 - 57, 57.5 (57)*	#2 - 46.5, 47.5 (47)*			
	Soln. Ht. 7.8cm.					
11:30	Soln. Ht. 9.8	60.5	46			
11:40	13.0	100	83.5	.57*	.55*	3
11:50	14.8	127.5	107.5	.45	.44	
12:05 pm	18.3	199	183	.29	.26	5
1:00	21.6	316	313.5	.18	.15	
1:30	23.6	475	487	.12	.095	
1:55 p	26.7	NOT CRITICAL				6 Almost @ 25.6
2:05 p	27.1	" "				6 MT
2:15 p	27.4	" "				
2:20 p	27.7	" "				
2:30 p	28.0	" "				
2:37 p	28.3	CRITICAL WITH 7cm of ROD IN.				

A CRITICAL @ 28.2 ± 0.1 cm. at ZERO SEP.

3:35 p B Cylinders SEPARATED 20 cm. and 2.0 cm of soln. added. Cylinders moved together with control rods out until critical. soln Ht. 30.15 CRITICAL at 2.0 cm SEPARATION.

3:45. Separating cylinders 6 cm. added 2.15 cm soln. 7 MT

3:57 p. C CRITICAL @ 32.3 cm and 5.8 cm separation.

4:00 D Separated cylinders 10 cm. added 1.5cm soln.
CRITICAL @ 33.8 cm & 9.55 cm separation.

	4:20 p.	E
	4:45 p.	F
	5:00 P	
	5:15	
	20	
	25	G

3/7/49 DC Exp 224

Separation	0 cm
Hc meas	28.2
Hc corr	28.7
Vc	+1 14.
Mc	2.20

2-21-49

H/X ~ 175

5 x 1000

Cyl's. MT

1, 2, 3

(47)

.57 .55

.45 .44

.29 .26 5

.18 .15

.12 .095

6 Almost @ 256

6 MT

4:20p. Separated 16 cm. added 1.5 cm. soln.
E Critical 35.3 cm @ 15.6 cm Sep.

4:45p. Separated 30 cm added. 1.4 cm soln.
F Critical 36.7 cm. & 24.65 cm.

5:00 P Separator Indicator 47.15
" Zero 12.15
Separation - 30.00 cm

H = 37.0 cm Not Critical.
= 37.4 " "
= 37.4 " " at 32 cm separation

5:15
20 = 37.7
25 G = 37.7 Critical with Not Critical at 35 cm sep. → Filling from 9.
Separator indicator = 46.0
" Zero = 12.1
Separation = 33.9 cm

Because of long solution level equilibration time it was found expedient to fix the separation vs height points in the following manner: After Criticality at contact had been achieved the cylinders were separated 30 cm and 2 cm solution were added; then with CR's out cylinders were brought together to critical as shown by count rate. Cylinders then separated 6 cm & 2+ cm added with CR's in. (These numbers derived from preceding data). CR removed slowly then Cylinders brought together & critical, etc. This worked satisfactorily. -

DC 2-21-49

Sight glass Zero ck'd ± 0.1 cm.

DRAIN BACK AS ON pg 123.

2/7/49 DC Exp 224 2 - 10" ac cylinders untamped. N/V = 169.3, = 0.127 gm U/gm = 0.151 gm U/cc; ρ_g = 1.187

	A	B	C	D	E	F	G
Separation	0 cm	2.0 cm	5.8 cm	9.55 cm	15.6 cm	24.65 cm	33.9 cm
Hc meas	28.2	30.15	32.3	33.8	35.3	36.7	37.7
Hc corr	28.7	30.7	32.8	34.3	35.8	37.2	38.2
Vc	± 14.34 L	15.55 L	16.62 L	17.38 L	18.14 L	18.85 L	19.35 L
Mc	2.20 kg	2.35 kg	2.51 kg	2.62 kg	2.74 kg	2.85 kg	2.92 kg

N.
ZERO SEP.
soln. added.
critical.
SEPARATION.
m Soln. 7 MT
nation.
Soln
ration

126

2/22/49

H/X = 169.3

EXPERIMENT 225

PRESSEY
CRONIN
CALLIHAN.
MOONEY/HAM.

#1 - 10" AL CYLINDER, UNTAMPED H/X = 175

#1 - Source Zero = 3.5 cm.
Set at 11.5 cm (8.0 cm from bottom).
#1 - CR - Zero = 8 cm.

INSTRUMENTS: TRIP POINTS: #4 - 5.2 x 100; #6, 5.5 x 1000
SCALES #3 x 10; 4 x 100, 5 x 2, 6 x 25 -

8:27A Fill dial volume from #1 -
#1 Empty at 0.6 cm.

	Soln. Ht. (cm)	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
8:40	13.7	75.0 / 73.5 } 74.2	48.0 / 46.5 } 47.2	1.0	1.0	#2 dry
8:55	26.5	216	180	0.344	0.262	From #3; #3 dry
9:05	29.05	275	236.5	0.270	0.200	From #5
9:15	34.0	494	461	0.150	0.102	From #5
9:27	36.65	854	794	0.087	0.059	From #5 - not dry
9:37	39.8	Not quite critical				From #6
9:40	40.1	" " "				" "
9:45	40.2	" " "				" "
~~9:50~~	40.4	Critical with 4 cm of CR in the soln.				

Conclusion: Critical at 40.3 cm.

3/7/49 JC

#1 - 10" AL cylinder untamped.
H_c = 40.3 + 0.9 = 41.2 cm.
Hx - 169.3
Conc = ~~0.0~~ 0.127 gm X/gm = 0.151 gm X/cc
A_{fg} = 1.187
V_c = 20.87 ℓ
M_c = 3.15 kg.

2/22/49

Separation (cathal) = 5

Time	Soln. Ht.
11:00 AM	11.6
11:10	24.2
11:35	37.1
12:10	38.5
12:15	38.7

Sep
Hc
H1x
Con
Sp
Vc
M

H/X = 169.3

2/22/49

Experiment 226

Collidan
Prasey
Cronin
Henry
Mooneyham

Two 10" Aluminum Cylinders, Untamped H/X = ~175

Seperation (eatdal) = 50.0 cm.

Scales & Trip points same as in Ex. 225
Sources up 12.0 cm. from bottom
#2 CR at 0 #2 CR Comp. [redacted] 39.5 cm. #2 Source Comp. 35.0 cm. #2 Source at 12.0 cm
Cylinder Seperation = 50.0 cm - actual 62.1 cm on scale

Time	Soln. Ht. (cm)	C_{g1}	C_2	M_1^{-1}	M_2^{-1}	Remarks
11:00 AM	11.6	62.5	50.5	1.0	1.0	#1, 2, 3 dry, from #5
11:10	24.2	not near equilibrium				from #5, #5 dry
						#6 dry, #7 dry
11:35	37.1	Far from critical				from #8
12:10	38.5	Not quite critical				
12:15	38.7	Critical with 3 cm. of #2 CR in.				

Conclusion: Critical at 38.6 cm.

Exp 226 – 2 – 10" al cylinder, untamped.

Seperation – 50.0 cm.
Hc = 38.6 + 0.5 = 39.1 Cm.
H/x = 169.3
Conc = 0.127 gm x / gm = 0.151 gm x / cc
Sp gr = 1.187
Vc = 19.81 ℓ
Mc = 2.99 kg.

175

from J.

5.5 x 1000

Remarks
#2 dry
from #3; #3 dry
from #5
from #5
from #5 – not dry
from #6
" "
" "

128
2/22/49

H/X = 169.3

Ex 227

Calibron

2-15" Al Cyl Untamped

Calibron

Primary
Henry
Moonshine
Cronin

	Scale	Comp	Actual
Sep.	25.0	—	0.3
#1 CR	7.6	—	0
#2 CR	5.7	60.0	0
#1 Source	8.0	—	5 cm
#2 Source	05.0	52.6	5 cm
no Tamper	—	—	—

Henry
Moonshine
Cronin

5:45
5:50

Sol'n
17.4
17.7

Instrument	Trip Point.	
# 4	6.0	on ×100
# 6	5.5	on ×1000
# 3	[illegible]	on ×10
# 5	no trip	on ×2

3:00 PM
3:10

Valve closed between cylinders
Solution zero is about −2 mm on sight glass

	Sol'n Ht.	C_1	C_2	C_0/C_1	C_0/C_2	
	3					from #1
3:30	5.3					from #2
	1.35 (in 2 cyl)					from #3
3:40	5.4	$C_0 = 43$	$C_0 = 32$			#2 MT
	5.9	114	32.2			#1 control moved,
		44.5	81.5			
		42.5	32.5			
						#5 MT
4:10	10.1	78.5	50.5	.535	.580	#6 MT #7 MT
						~~from #6~~
4:30	14.0	112.5	154.	.198	.202	Primary out.
4:45	15.1	332.	257.5	.126	.120	from Cyl A
4:57	15.9	570	460	.075	.070	from Cyl B
5:15	16.9	not critical both rods out				from Cyl C
5:30	17.15	Critical #1 Rod out				
		#2 Rod 7.5 cm in				

Critical at 17.10 cm

6:00	Sol'n
6:10	18.
6:20	17.
6:23	17.
6:26	17.

3/7/49 Exp 227

Ignition
He manom
He cond
H/X =
Core =
Apg =
Vc =
1/Mc =

Ex 227 B

Callahan
Henry
Moonerham
Orowitz

5 cm Sep

	Scale	Comp	Actual
Sep.	80		5
#2 CR	3.5	56.4	0
#2 Source	5.0	57.1	5 cm

Sol'n Ht	C1	C2	Co/c1	Co/c2	
5.45	17.45	NOT CRITICAL	RODS OUT		From Cyl A
5.50	17.70	CRITICAL.	1 Rod in	1 Rod 8 cm in	From Cyl 9

17.60 ± 1mm critical Ht.

Ex 227 C 15 Cm Sep.

	Scale	Comp	Actual
Sep	40	—	15
#2 CR	3.5	51.4	0
#2 Source	5.0	46.1	5 cm

Co/c2

From #1
From #2
From #3
#2 MT
#1 Counter moved,

Sol'n Ht		
6:00	18.05	Critical #2 Rod in #1 Rod 10 cm in. From Cyl A
6:10	17.90	" " " 5 cm in into #9
6:20	17.85	" " 2 Rod 11 cm in #1 Rod out. into #9
6:23	17.75	" Both Rods out.
6:26		

Critical 17.80 ± .05 cm.

#5 MT
.580 # 6 MT #7
~~From #6~~ MT
.202 Privacy out.
.120 From Cyl A
.070 From Cyl 8
From Cyl 9

3/7/49 Exp 227 – 2 – 15" aluminides unstamped

	A	B	C	D
Separation	0.3 cm	5.0 cm	15.0 cm	50.0
He meas	17.1	17.6 cm	17.80	18.1 cm
He corr	17.3	17.8	18.0	18.3
H/X =	169.3			
core =	0.127 gm x/gm = 0.151 gm x/cc			
Apt =	1.167			
Vc =	19.72 L	20.29 L	20.52 L	20.86 L
Mc =	2.98 kg	3.06 kg	3.10 kg	3.15 kg.

2/23/49

Cronin
Monaghan
Moffitt
PRESSEY

Ex 227. D

	Sep	Scale	Comp	Actual
	#2 CR	3.5	33.9	0
	#2 Source	5.0	28.6	5.0
6:45	Sol'n			From
6:47	18.05	NOT CRITICAL		#8
6:52	18.15	CRITICAL #1 Rod 5.5 cm in.		
		#2 Rod all in		

8:30
8:40
8:50
9:05 A
9:15 A
9:30
9:42
9:52

Critical at 18.10 ± .05 cm

Drain back into cyl using 263 to ck when solution was within 2" of top.

15" single unstamped cyl should be kept to determine asymptote for separation curve.

Ex.	Sep.	Hc
227A	0.3	17.10
227B	5.0	17.60
227C	15.0	17.80
227D	50.0	18.10

DRAIN BACK by Method of 7/20/49 -
#1 has less than other.

Suggest doing Single 15" unstamped -

Note - a stud in water flange flexible tubing connection @ 15" #2 cylinder needs to be replaced by bolt before doing stamped exp.

Sing
Trip P

PM

In.

7.
14.
15.
17.
17
18

Concl

#1 -

Hc = 1
H/x = 1
conc =
Vc =
Mc =

2/23/49

H/X = 169.3

Experiment 228

Cronan
Monaghan
McGriff
PRESSEY

Single 15" Al Cylinder Unreflected H/X ≈ 175 (#1 Fixed)

Trip Points #4 - 6.2 #6 5.5 #3 Out. #3 x 10 #5 x 2
Source set @ 5.0 cm off bottom (8.5 on Scale)

PM used as barrier in doorway.

	H	C_1	C_2	$1/M_1$	$1/M_2$	
8:30	in. D.V.	—	—	—	—	Filling from #1 MT
8:40	—	—	—	—	—	#2 MT @ 2.5 cm.
8:50	7.1	47, 42, 51, 49 (46)	39, 31, 31, 32 (32)	1.0 x	1.0	#3 MT @ 11.5
9:05 A	14.15	155	103	.30	.31	#5 MT
9:15 A	15.95	286	203	.16	.157	
9:30	17.0	580	445	.079	.072	Filling from #8 @ 17.7
9:42	17.85	NOT CRITICAL				
9:52	18.1	CRITICAL WITH 5cm of ROD IN soln.				
	CONCLUSION	CRITICAL	18.05 ± .05 cm			

Drawback

#	#5	#4	#3	#2	#1
	5 cm	MT	5 cm	MT	MT

#1 - 15" Al Cylinder - Single - unreflected.

$H_c = 18.05 \equiv \frac{18.5}{18.5}$ cm - corrected
$H/X = 169.3$
conc = 0.127 gm x/gm = 0.151 gm +/gm
$\rho_{fgn} = 1.187$
$V_c = 21.09$ ℓ
$M_c = 3.18$ kg.

132 2/23/49

Cronin
Monaghan
Morfitt
Preasy

2-15" Al Reactors Tamper

Experiment 229

H/X = 169.3

~~H/X = 175~~ ~~169.6~~

Cronin
Morfitt

		Scale	Comp	Actual	
	Separation	24.4 cm.	—	0 (less than 1mm @ all pts)	
	#2 CR	3.5	87.2	0	
	#2 Source	0	52.5	3cm.	
	#1 Source	6.5	—	3cm.	
	#1 CR	23.0 cm	—	0	

TRIP POINTS SAME AS Exp. 228 also instrument scales.

1:25p	BACKGROUND	14, (14)	7, (7)	with Soln. Level @ 8.3 cm.		
	Soln. Ht.					
1:42 p	5.2	19.5	9	.72	.78	#3 MT@5.3
1.50 p	6.95	32.5	17	.43	.41	
2:04 pm	7.9	61	37	.23	.19	#5 M @ 7.8
2:30 p	8.5	152	104	.092	.067	
2:42 p	8.7	NOT CRITICAL				
3:05 pm	8.90	CRITICAL WITH ROD IN AND #2 Top Tamper 1cm up.				

A CONCLUSION: CRITICAL AT 8.8 ±.1cm IN CONTACT

SEPARATING cylinders 3cm

	New Reading
Separation	27.4
#2 CR Comp	85.7
#2 Source Comp	51.0

3:25 p	8.9	223	154	.063	.045
3:35 p	9.15	CRITICAL WITH #1 ROD OUT #2 ROD IN.			

B CONCLUSION: CRITICAL 9.1 ± .05 cm. @ 3cm SEPAR.

SEPARATION INDICATOR 46.4 actual Sep. 22 cm.

	#2 CR Comp	76.2			
	#2 Source comp.	41.5			
3:47 p	9.15	146	88	.096	.08
	9.55	SUPER CRITICAL WITH RODS IN			
	9.4	NOT CRITICAL			

C CONCLUSION: H_c = 9.47 ± .05 cm @ 22cm SEP.

DRAIN BACK BY SGM-18-A

3/7/49 DC 2-15" Al Reactor Tamped, MX = 169.3, ≡ 0.127 gm X/gm = 0.151 gm/cc = δ_{gm} = 1.187

	A	B	C
Separation	0 cm	3.0 cm	22.0 cm
H_c obs	8.8	9.1	9.47
H_c corr	~~9.1~~ 9.0	9.3	9.7
V_c =	~~9.2~~ 10.26 ℓ	10.60 ℓ	11.06 ℓ
M_c =	1.55 kg	1.60 kg	1.67 kg.

The c
the
S
the a

Emptied

6:30 –
Let #1
Final R

Empt

Empt

Empt

MPER
.3

~~#1/x = 175~~
~~#696~~

Interview 229-230 Deletion of ∞ #1/x 350

Cronin
Mort. IT

eal
(less than 1mm @ all pts.
)
m.
cm.
)
nstrument scales.
1. LEVEL @ 3.3 cm.

78 #3 MT @ 5.3
11
19 #5 M @ 7.8
067

o TAMPER 1cm up.
IN CONTACT

-5
o IN.
cm. @ 3cm SEPAR.

22 cm.

8

cm @ 22cm SEP.

= 0.151 gm/cc = Sp gr = 1.187

Area of 15" cyl. 1140 sq. cm
Area of 4" cyl. 81.1 sq cm.

The analysis received of 0.136 g #1/g checks closely with the assumed .148 g X/cc on p 133 ∴

$$.148\ g\,X/cc = \frac{.199 \times .[redacted]}{1.187 \times .934} = 0.1335\ g\ \#1/g\ soln$$

Since the actual analysis is "heavier" than predicted the data on p 113 were used.

We want 3350 cc in each 4" cyl.
This is $\frac{3350}{1140} = 2.95$ cm in terms of 15" cyl.

We want 1930 cc in each 3" cyl.
This is $\frac{1930}{1140} = 1.70$ cm in terms of 15" cyl.

Emptied Cyl. #1 & #2 in 15" #1 Cyl into Untamped

6:30 – H: ~~5.70~~
Cyls #1 ~~2.95~~
Final Reading 5.75

Height Glass Blown back
Cylinders blown dry
Zero full before deionbar

in #2 H = 7.85
2.95 ← in #1
4.90
2.95 ← #2
1.95

Emptied Cyl #3 & #5

H = 10.55
into #3 2.95
[redacted] 7.60
into #5 2.95
4.65

Emptied Cyl #6 & part of #8

H = 14.70
into #6 2.95
11.75
into #4 [redacted] 5.60
6.15

#4 Removed to Storage
Replaced Cyl #4 with New One

Emptied #7, rest of #8

H = 14.00
into #7 2.95
11.05

H = 11.05

	into #8	2.95
		8.10
Emptied #9		13.85
	into #9	2.95
		10.90
J & D checked & make sure they were empty.	Drain & clean line	.10
		10.80
	into #F	2.95
		7.85
	into #D	2.95
		4.90
Emptied #E		8.40
	into #E	2.95
		5.45
	into #G	2.95
		2.50

NB
for vacu
Every
in eff
drain
die
in
hod
diffe
valve on #4.

→ Solution Inventory - Cm in one 15" cylinder ←

All H/x 169 No water has been added

? where from?

Cyl #	11	12	13	H	15	16	17	18	19
	1	2	3	4	5	6	7	8	9
Cm	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95

Cyl #	A	B	C	D	E	F	G
Cm	?	?	?	2.95	2.95	2.95	2.95

Need to be determined.

Cm dilute as per page 113

#7 3" cylinder contains dead volume ~3.5 l @ H/x 169

Removed from system: One four inch cylinder in pit, tagged with yellow tag. 5.60 cm from 15" cyl were removed from system & put into this cylinder, "#14"

1) Filled
2) Empt
3) "
4) Put
5) "
6) Empt
7) Put
9) Empt
dra
in
#
fo
Sa

1.05
1.95
.10
.85
.95
90
10
0
5
5
5
10
)

cylinder ←

18 19
8 9
2.95 2.95

≈3.5 l @ H/X 169

pit, togged
moved from

NB. There is some liquid in pit. Was used for various cooling & leak testing operations. Is not Uran

Every effort was made to read sight glass within 0.5 mm in effort to keep error to $\frac{.5}{2 \times 95} = 1/60$ <2% manifolds, drainbacks, etc. were carefully regulated to avoid discrepancies. Some (old) cylinders have < ½ cm sol. in them because fed tube off bottom. New cylinders had no such solution. This could make small difference. Also washed out & degreased two new 4' cyl. & replaced valve on #4.

Hope everything is OK

Cerni & Mayfield

3/24/49
McLENDON
FOX
CALLIHAN.

	Sight Glass
1) Filled dead volume from #7 - 3" cylinder	-0.5 cm
2) Emptied cylinder H (#4 position) into 15" reactor	2.4 cm
3) " " A " " " "	7.65 cm.
	2.95
	4.70
4) Put 2.95 cm into H.	2.95
	1.75
5) " 2.95 " " A	
Replaced valve - cylinder C	
6) Emptied #C & #B	
7) Put 2.95 cm into B & into C	
8) Emptied #14 in to reactor - evidence that this sol. more dense that H/X=169 - may be due to #14 not being empty 3/23 when 5.6 cm of Al. was added - Emptying #14 raised sight glass from 3.4 to 10.9 (7.5 cm) blow back brought this to a steady 9.65 cm.	This indicates #14 had 0.742 l of sol on 3/23.
9) At this point the solution was inventoried & found to be 67.6 l* ≡ 10.1 Kg X instead of that (73.2) on pg 113 - reason for difference unknown.	See pg 136
Since 9 Kg X are required for next exp't at H/X = 350 -	
$\frac{9}{10.1} \times 67.6 = 60.2$ l of present sol are required -	

* plus what was in #14 on 3/23

over

67.6 − 60.2 = 7.4 ℓ to be stored. (plus what was in #14 on 2/23 −

Into 17 4" cylinders, 11, 12, 13, 14, 15, 16, 17, 18, 19, A, B, C, D, E, F, G, H put

(2.95 cm in 15" cylinder put

= 17 × 2.95 × 1.14 = ~~53.8~~ 57.2 ℓ

Into 3" cylinders #3 + #7

(1.32 cm in 15" cylinder in use)

2 × 1.32 × 1.14 = 3.01 ℓ

Total 60.2 ℓ.

From pg 114 − 118 ℓ total required

118 − 60.2 = 57.8 ℓ H_2O

or 0.96 ℓ H_2O / ℓ sol.

∴ Into each 4" cylinder put

= 2.95 × 1.14 × 0.96 = 3.23 ℓ H_2O

Into each 3" cylinder put

1.32 × 1.14 × 0.96 = 1.44 ℓ H_2O

~~10) Copper~~

10). Put 2.95 − 15" cm. in #14 −

11) " 1.3 − 15" cm in #3 + #7 − 3" cylinder

12) " 1.3 − 15" cm " #4 (bad value for storage).

~~Continued~~ NOTE on Inventory − Item 8, pg 135

9 cylinders attached to manifold

1 loaded in pit

6 on rack

16 filled with 2.95 − 15" cm

= 16 × 2.95 × 1.14 = 53.8 ℓ

#14 1 × 5.6 × 1.14 = 6.4 ℓ

Dead volume 3.5 ℓ

in 15" reactor:

3.4 × 1.14 3.9 ℓ

Σ = 67.6 ℓ

0.136 $\frac{gm\ I}{gm\ sol}$ 1.18 $\frac{gm\ sol}{cc}$ × 0.934 × 67.6 = 10.12 Eq X.

In Rack #3

Rack #2

Rack #1

loaded in pit

loaded in pit

CYL. #

3
4
7
2
1
C
B
A
E
F
D
14
~~H~~ G
11
12
13
~~H~~
15
16
17
18
19

− Th...

plus what was
in #14 on 2/23 –

18, 19,

L
L.

L

L.

120

0

" cylinder.
storage).

7.6 = 10.12 kg X.

	Cyl. #	Cyl. Size	Vol. Soln (l.) H/L=169	Vol. H_2O Added (l.)	Sp. G.	H/L	Remarks	Total Vol. L H/L=350
In Rack #3	3	3"	1.50	1.44	1.111			2.94
	4	3"	1.50	None 1.88 (mm) ~~1.44~~	~~1100~~	169	To STORAGE.	–
	7	3"	1.50		1.160			3.38
	2	3"	2.8 x 1.14 = 3.19	None	–	169	Tool Box Lock To STORAGE	
	1	3"	DV = 3.5	None	–	169	To STORAGE	
Rack #2	C	4" –	2.95 x 1.14 = 3.40	3.23	1.103			8.63
	B	4" –	= 3.40	3.23	1.100		Tool Box Lock	8.63
	A	4"	= 3.40	3.23	1.103		PID on manifold + hose replaced.	6.63 ~~7.63~~
Rack #1	E	4" –	3.40	3.23	1.098			6.63
	F	4" –	3.40	3.23	1.099			6.63
	D	4" –	3.40	3.23	1.099			6.63
	14	4"	3.40	3.23	1.120			6.63
	#G	4"	3.40	3.23	1.103			6.63
	11	4" –	3.40	3.23	1.100			6.63
	12	4" –	3.40	3.23	1.100			6.63
	13	4" –	3.40	3.23	1.093			6.63
	H	4" –	3.40	3.23	1.096		SLOW VALVE	6.63
	15	4" –	3.40	3.23	1.101			6.63
	16	4" –	3.40	3.23	1.099			6.63
	17	4" –	3.40	3.23	1.099			6.63
	18	4" –	3.40	3.23	1.095			6.63
	19	4" –	3.40	3.23	1.101			6.63
			68.99					127.2 L.

× 1.185

81.75315

951 1

76.3 55

10.38 49 kg

– [illegible]

138 7/25/49

Gowin
Morfitt

Experiment 230 A

H/X = 328.7

Two Al/15" ~~Cylinders~~ Cylinders in Contact ~~H/X = 350~~ Tamped.

Trip Points #4 - 5.6 #6 - 5.6 #3 out

Scale #3 X 10 #4 X 100 #5 X 2 #6 X 25

Source @ 3 cm actual. For zeros, see exp #229

9:15	START			
9:20	2.8	ok on equilibration & sight glass	#1 MT	
10:00	3.0		#2 MT	3:20 P 12.15 cm.
10:18	5.8		#3 MT	3:45 P 12.30"
				4:05 12.40

Drawbar to 4.5 filled tamper etc. at #2 & #3

Background 28, 44 62, 17.5, 17.25, 17.5, 18.0

Volt. adj on #1 — 20, 19.5

	A leak found in #5 cylinder at this point. Leak on cylinder side of valve. Spill of 50 cc cleaned up & flooded Na_2CO_3 added to region around spill in case further leaks developed. Since leak was small, & but cylinder leaked when air was on, it was decided to empty #5 next.					
10:50	4.5	19.5	17.5	1.0	1.0	
10:59	7.40	26.0	25.0	.75	.70	#5 MT.
11:12	8.70	36,0	37.0	.54	.47	#2 #3 MT
11:42	10.40	90.0, 87.0	121.0, 12.3	.22	.145	Stepped #4 from #8.
12:00	11.0	215	381	.091	.046	
12:15	11.3	Not critical.				
12:20	11.4	Critical with #1 Tamper #2 1 cm high				

11.3 + 0.05 cm.

Conclusion. Estimated Criticality ~~13.5~~ ~~± .025~~ cm.

230 B.

Actual Separation 5.0 cm. Scale Reading 29.5.

#2 SC 39.0

#2 CR 73.7

2:20	11.4	110	174	.177	.100
~~2:38~~	11.7	187	327	.104	.054
2:57	12.05	Not critical but close.			
	Mackin T.	Morfitt out			
3:15	12.15	Critical with tampers down & both controls in -			

Conclusion: Critical at 12.10 cm. Separation = 5.0 cm

BIZAM17

Actual

#

CONCLUSIO

3/9/49 TWO

Separation

He meas.

He corr.

H/x = ~~Hof~~

corr

Of Sr =

Vc =

Mc =

= 328.7

~~350~~ Tamped.

r 25

#1 MT
#2 MT.
#3 MT
2 & #3

5, 18.0

k on cylinder
bed Na_2CO_3
veloped. Since
it was decided

1.0
.70 #5 MT.
.97 #2 & #3 MT
.145 } Stopped #4
.096 } from #8.

, kyc

5.

.100
.054

Actual Separation - 20 cm - Indication : 44.5 cm.

#2 S. Cong. 31.5
#1 & ER Corp 61.2

3:20 P	12.15 cm.	NOT QUITE CRITICAL.
3:45 P	12.30"	" " "
4:05	12.40	With both tampers down + both rods in.

CONCLUSION: CRITICAL AT 12.35 cm. at 20 cm Separation -

3/9/49 Two 15" Al Cylinders, Tamped.

Separation	A 0 cm	B 5.0 cm	C 20.0 cm
Hc meas.	11.3	12.1	12.35
Hc corr.	11.5	12.3	12.6

Hx = ~~Hc+3~~ 328.7

Conc $\frac{0.0715}{0.127}$ gmx / gm = $\frac{0.0787}{0.151}$ gmx / cc

ρ_{fg} = ~~1.187~~ 1.101

Vc =	13.11 ℓ	14.02 ℓ	14.36 ℓ
Mc =	1.03 kg	1.10 kg	1.13 kg ~~1.13~~

2/25/49

H/x = 328.7

~~H/x = 320~~

Exp 231

Single (#1) 15" al Cylinder

Untamped

	Scale	Comp	Actual.	
#1 Source	10.7	—	7 cm	
#2 "	0	53.3	0	(place boxes at ∞ for this exp.)
#1 CR	87.5	—	0	
#2 CR	03.5	59.3	0	
Separation	24.9	—	0.2 cm.	

NOTE → #2 Cylinder in contact containing approx. 0.5 cm Sol.

Trig pts - same as 230

Scales : #3 x 10, #4 x 100, 5 x 2, #6 x 25.

5:32P H = 0.5 cm. Filling from #1 Empty at 5.4 cm

		#1 counter	#2 counter	c/c		
5:43	8.15	31 (31)	26 (26.5)		#2 Empty at 8.2 Filling # 5	
		31	27			
		32	26			
5:56	14.3	86	70	~~.277~~ .360	~~.204~~ .378	#5 Empty 19.35
6:03	16.0	123.5	101.5	.252	.261	Filling #3
6:14	18.65	269	235	.115	.113	#3 Empty @ 17.5 Filling #4
6:22	19.9	533	477	.058	.056	
6:30	20.8	NOT CRITICAL				
6:31	21.15	" "				
6:38	21.4+ ~~21.30~~	CRIT. with Rod in ~8 cm				
		" " " out.				

Conclusion: Critical @ 21.3 ± .1

see note on p ~~115~~ 143 for zero of solution level.

3/7/49 JC

Single #1 15" Cylinder, Untamped.

Hc = 21.3 + 0.4 = 21.7 cm corrected

H/x = ~~167.3~~ 328.7

Conc = ~~0.127~~ 0.0715 gm x/gm = ~~0.1351~~ 0.0787 gm x/cc

~~Af~~ = ~~1.187~~ 1.101.

Vc = 24.73 ℓ

Mc = 1.95 kg.

2/25/49

Cronin

Mackin

Callihan

Fox

PM

7:30

8:00

8:05

8:15

8:28

8:45

8:50

9:00

9.05

3/7/49 JC

Two 15

Separation

Hc meas

Nc calc

H/x =

Conc

Af

Vc

Mc

H/x = 328.7

x = 328.7 / ~~x = 320~~

2/25/49

Cronin
Macklin
Callihan
Fox

EXPT. 232 ~~#x = 320~~

Two 15" Al. cylinders Untamped

Part A - in contact

	scale	comp.	actual
#1 Source	10.7	—	7 cm
#2	~~0~~ 7	53.3	7 11
#1 C.R.	7.5	—	0
#2 C.R.	3.5	59.3	0
Separation	24.9	—	.2 cm.

Trip Points: Same as Expt. 280
Scale 0: #3 - 10, #4 - 100, #5 x 2, #6 x 2 —

	PM		C_1	C_2			
	7 30	10.85	56.5 54.5 (55) 55.0	48.5 49.0 (47) 46.5			#6 MT
Empty at 8.2 Filling # 5	8:00	14.10	100	86.5	C_0/C_1 .55	C_0/C_2 .538	From #8
~~4~~ 378 #5 Empty 19.35	8:05	15.0					#8 MT
Filling #3	8:15	15.85	161.5	182.5	.340	.33	From #9
261 #3 Empty @ 17.5	8:28	18.00	377	352.5	.145	.133	#9 ~~MT~~ MT
Filling #4	8.45	18.80	685	666.5	.0790	.0708	From No 7.
13	8:50	19.60	NOT CRITICAL RODS OUT				
56	9 00	19.80	NOT CRITICAL RODS OUT				
	9.05	20.00	#1 Rod out #2 Rod 8 cm in } CRITICAL				

Critical at 19.90 ± 1 mm

2/7/49 JC

Two 15" al cylinders. Untamped.

	A	B	~~D~~	C	D
Separation	0.2 cm	~~5.0~~ 9.7 cm	5.0 cm	50.0 cm	31.3 cm
H_c meas	19.90	20.15	20.6	21.25	21.10
H_c corr	20.1	21.0	20.8	21.5	21.3
H_X =	328.7				
conc	0.0715 gmx/gm = 0.0787 gmx/cc				
ρ_{Sr}	1.101				
V_c	22.91 ℓ	23.94 ℓ	23.71 ℓ	24.51 ℓ	24.28 ℓ
M_c	1.80 kg	1.88 kg	~~1.5~~ 1.87 kg	1.93 kg	1.91 kg.

place Sources at ∞ for this exp.).

prox. 0.5 cm sol.

at 5.9 cm

Empty at 8.2
lling # 5

m.

±.1

lution level.

Ex 232 B

5 cm Separation

		Scale	actual
Sep	~~29.7~~	29.7	5 cm
#2 Source	50.8	7.0	7 cm
#2 C.R.	56.8	3.5	~~8~~ 0

T

Sol'n Ht	C_1	C_2	e_0/c_1	c_0/c_2

9:10 20.00 From #~~3~~7

9:15 20.45 Not CRITICAL From #4

20.75 Critical about 4 cm Rod in
#2 Rod all in

Moving cyl apart until just critical

Separation Scale 34.4 cm
24.7

B Critical at 20.75 ± .05 cm at 9.7 cm Separation

B' Critical at 20.60 ± 1 mm at 5 cm Separation

Ex 232 C 50 cm Sep

	Comp	scale	actual
Sep.	74.7	74.7	50
#2 Source	28.3	7	7
#2 CR	34.3	3.5	0

9:35 20.75

9:40 21.~~2~~5 21.15 not critical

21.25 ± .05 estimated critical -?

Ex 232 D

~~Sep 5 7/16~~ ~~32.9 cm sep~~

Critical Height 21.10 cm at 31.3 cm Sep.

10:30 to 11:00

#1-
#2-
#3-
#4-
#5-
#6-
#7-
#8-
#9-

For
Table

20"
other
mirr

Sep.	
	0
A	0.2 cm
B	5 cm
B'	9.7 cm
D	31.3
C	50
	∞

points
at 5 cm
to regu
was m

~~Note~~

The zero o

10[30] to 11[00]

Drainback

#1 - filled by using γ meter
#2 - 6. cm as measured
#3 - 6 cm as measured
#4 - filled to within 1" of top by use of γ meter - ca. 6.6 Liters
#5 - 6.0 cm measured.
#6 - 6.0 cm as measured.
#7 - 4.4 cm (15" cm) + extras, full up to P-10 tube.
#8 - 6.0 cm (15" measured
#9 - filled by using γ meter.

} single 15" cm

From #7
From #4

For Saturday: Sample solution in Pit for H/X taking Sp. Gr.

2. Repair Manifold (air) on dolly. [replace P-10 tube]

3. Remove 15" Al Cyl.

4. Install 20" SS Cyl.

20" SS Cyl (untamped) should require less solution than 10" (from previous data) and therefore some piping effects can be avoided. [solution in pit is fairly homogeneous]

15" Al Cyl

	Sep.	Hc
	0	
A	0.2 cm	14.90
B_1	5 cm	20.60
B_2	9.7 cm	20.75
D	31.3	~~21.3~~ 21.10
C	50	21.25
	∞	21.3 (single cylinder data)

points B_2 + D were obtained by moving #2 cyl supercritical at 5 cm away from #1 until just critical at 9.7 cm, & using control rods to regulate reactivity. At 50 cm using servo #2 cyl was moved closer to #1 until just critical at 31.3

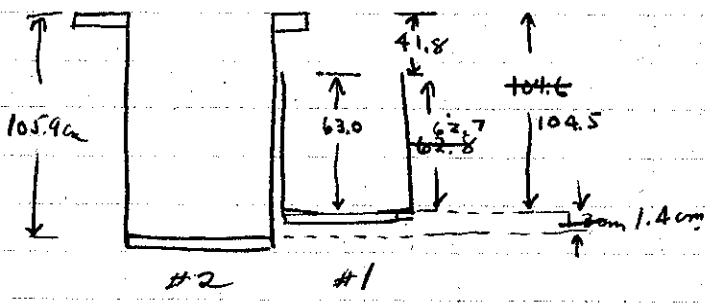
Note The zero of fixed cylinder was checked as -0.3 cm

144

2/26/49

MOONEYHAM
FOX
SCHUSKE
CALLIHAN-

REMOVED 15" CYLINDERS.
INSTALLED 30" "
After installation it was observed that the bottom of #2 cylinder was lower than that of #1 Cylinder.



1.9 - 1.2 + 1.2 - 1.8

It is believed that this difference will not affect the extension but should be considered in calculating the total mass. —

Does this affect results of 2/24/49?

Based on dimensions taken at center - because of cupping of #1 Cylinder for drainage: Difference in elevation of bottoms = 1.1 cm.

This bottom correction - 1.1 cm is to be used in the following manner: It is applied to #2 + the usual #1 bottom correction of 0.2 cm to #1 — The average of these is applied to each cylinder in Exp 234.
$\frac{1.1+0.2}{2} = 0.7$

Time	
10:15 A	
10:30	
11:00	
11:15	
11:30	
11:45	
11:53	
12:00	
12:05	
12:10	
12:13	
12:16	
12:19	
12:22	

2/26/49
2

INSTR
Source
"
CR
CR
Separ
Cla
to ze
#1's z
cylinde
variou
Remov
Solen
Filled
4.0 c
6.2
6.4
9.9
14.1
15.5
16.15
16.8
17.1
17.3
17.55
17.4
17.35

The #2
critical

Single
Hx = 32
He = 1
Vc = 3
Mc = 2

7/26/49

H/X = 328.7

One S.S.

Experiment 233- 20" Cylinders -

~~H/X = 330~~

UNTAMPED

Calliham
Fox
Schuske

INSTRUMENTS: TRIP PTS #4 - 5.7 X 100; #6, 5.4 X 1000

SCALES #3 X 10, #4 X 100, #5 X 2, #6 X 25

		Scale cm	Comp cm	actual cm
~~Source~~	#1	9.8	–	5.0
"	#2	0	49.7	0
CR	#1	7.8	–	0
CR	#2	3.5	53.8	0
~~Reactor~~		37.5	–	0

Planned to fill dead volume of both cylinders, drain to zero in #2 (which may be 1.5 cm lower than eight glass jars or #1's jars). Then close valve between reactor & do single cylinder experiment with reactor reported. Then bring reactor together and open valve between them for critical up. Removed #2 source to highest point possible.

Time	Solu. Ht (cm)	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
	Filled dead volume in #1	Zero in #1 at 2 mm. on SG.				
10:15A	4.0 cm.	#2 Cylinder		–	–	#1 MT
10:30	6.2	29.5 } 29.5	30.5 } 31.0	1.0	1.0	#9 MT
11:00	6.4	~~41.5~~	~~46.5~~			~~From #2~~ #2 dry
11:15	9.9	41.5	46.5	0.711	0.667	From #4 #4 dry
11:30	14.1	116.5	132.5	0.253	0.234	From #7 MT; From #8 "
11:45	15.5	218	271.5	0.135	0.114	"
11:53	16.15	350.5	458	0.084	0.068	"
12:00	16.8	Not critical				From #3
12:05	17.1	Not critical				"
12:10	17.3	Not critical				"
12:13	17.55	Critical with rod out 8 cm.				
12:16	17.4	Critical with " " 10 cm.				
12:19	17.35	Not quite critical				
12:22						

Conclusion: Critical at 17.4 cm - 0.2 = 17.2 cm. (corrected for S.G. jars)

The #2 cylinder was moved flush with #1 cylinder and the reactor was critical with #1 CR out 13.0 cm.

7/27/49 Single 20" #1 SS cylinder untamped.

H/X = 328.7 ≡ 0.0715 gm X/gm = 0.0787 gm X/cc ≡ ρ gr = 1.101

Hc = 17.2 + 0.2 = 17.4 cm corrected for bottom.

Vc = 35.25 ℓ

Mc = 2.77 kg.

2/26/49

Experiment #234 — H/X = 328.7

Two 20" Stainless Steel Cylinders Untamped

~~H/X = 350~~

Gallibon
Frost
Salvage
Morrison

Ex-234 C
Separation (Actual)
= 25.0 cm.

Instruments, trip points, zeros, and indicator positions same as in Ex. #234, both sources 5 cm. off bottom. Solution disposition same as at end of Ex. #234

Zero in #1 reactor at 2 mm. on S.G

Ex #234 A
(Actual Separation = 0 cm)

#	S.G.	C_1	C_2	M_1^{-1}	M_2^{-1}	Remarks
1:55 PM	~~8.0~~ ~~11.35~~	10.0 } 10.2	48.0 } 47.2	1.0	1.0	~~1F~~
		~~100~~	~~79~~	~~0.402~~	~~0.597~~	M.T. 8, 3, E
2:45	11.7	80	100	0.503	0.472	
3:15	13.6	136	171	0.295	0.267	M.T. F
3:45	15.7	370	513	0.109	0.092	M.T. D
3:58	15.2					
4:03	15.7	Not critical				From #5
4:07	16.1	Not critical				
4:10	16.3	" "				
4:15	16.5	" "				
4:22	16.7	" "				
4:27	16.8	" *				
4:38	16.4	Critical with ~~both rods almost out~~ #1 rod in + #2 rod out				Not yet in equilibrium
4:52	16.2	" " " " " " " " " 13 cm.				
5:00	16.10	Drained back 1 mm.				
5:01	16.0*	" " "				
5:03	16.05	" "				
5:04	16.05+	" "				
5:06	16.2	Had about 1 m. Critical and equilibrated ~~with~~ both control rods out				

Cylinder not equilibrated

Conclusion: Critical at ~~16.1~~ 16.0 (corrected for S.G. zero).

Ex. #234 B
(Act. Separation = 10.0 cm)

New positions
#2 CR Comp. 48.8 cm.
#2 Source Comp. 44.7.
∴ Cylinder Separation 47.5

5:22	16.2	Not Critical In Equilibrium
5:32	16.4	" " Not in equilibrium
5:34	16.35	" " " " "
5:35	16.65	" " " " "
5:36	16.6	" " " " "
5:38	16.5+	Critical; both rods out; Within ½ mm. of equilibrium

Conclusion: Critical at ~~16.1~~ 16.3 cm. (corrected for S.G. zero)

Ex-234 C Separation (Actual) = 25.0 cm.	
5:55	16.5+
6:00	16.7
6:07	16.85
6:12	16.8

Specifi

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To

Solu
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T

3/4/49 ANALYS

3/7/49 2 - 20" S

Separation	A
Hc meas	16.3
Hc corr	17.0
Vc	33.83
Mc	2.6

Gilliland
Frost
Salvage
Mornyhow

Ex. 234 C

Separation (actual)
= 25.0 cm.

New positions

#2 CR Comp	~~41.3~~ cm.
#2 Source Comp.	37.2
Cylinder Separation	62.5

same as in Ex. #234,
as at end of Ex. #234

	5:55	16.5+	Not quite critical In Equilibrium
	6:00	16.7	" " " Not quite in " #5 dry
Remarks	6:07	16.85	Critical with #1 rod out; #2 rod part way out; not quite in equilibrium
#	6:12	16.8	Critical " " " " ; " " " out 9 cm.; In equilibrium

(M.T. 8, 3, E

Conclusion: Critical at ~~16.55~~ cm (corrected for S.G. zero)

M.T. F
M.T. D

Specific Gravity taken for solution used in Ex. 233, Ex. 234 A, B, and C

From #5 →

Sp. Grav. = 1.101 by John Hoe

* Two samples prepared for lab analysis 234 A & 234 B

et in equilibrium

To be done —
Remove 20" cylinder
Replace 10" "
Repair leak in R10 connection to Cylinder A.

ith both control

; G. zero).

Solution put back in to storage using
dilector —
All storage cylinders practically full except #9 which has
only small amount. —
Tube between cylinders has been drained.

uilibrium

3/4/49 ANALYSES: 234A: 0.0765 gm U/gm
0.0767
0.0766 gm U/gm = 0.0715 gm X/gm Sol'n

for S.G. zero)

This corresponds to H/X ≡ 328.74. Sp gr = 1.101
and to 0.0787 gm X/cc.

3/7/49 2 - 20" S.S. cylinders untamped -

Separation	A 0 cm.	B 10.0 cm	C 25.0 cm
Hc meas	~~16.3~~ 16.0	16.3	16.55
Hc corr	~~17.0~~ 16.7	17.0	17.3
Vc	33.83 ℓ	34.44 ℓ	35.05 ℓ
Mc	2.66	2.71 Kg	2.76 Kg.

CHECK LIST

	194	195	196	197	198	199	200	201	202	203	204	204A	205	205 (cont.)	206	207	208	209	210	211	212	213	214	215	216	217
1. INSTRUMENTS - ON - CHECKED WITH SOURCE. TRIP POINTS RECORDED.	✓	✓	✓	✓	JM	DC	DFC	✓	JF	DC	JM	FC	JM	JF	FC	FP	JP	DC	JM FP	JP	BM	FP	FC	BM	JF	BM	DC
	✓			✓	FC	DC	JM	JF	JM	ADM	DC	FC	DC	JF	DC	JM	JP	DC	JF FP	JP	BM	JM	FC	BM	JM	BM	DC
2. SOURCES - IN POSITION, EXTRAS PUT AWAY	✓	✓	✓	✓	FC	DC	J DFC	JF	DC	DC	FC	DC	JF JM		FP JM	FP	FC	JM	JP	BM	JM	JF	JF	JF	JE	DC	JF
3. VALVES - CYLINDERS, FEED LINE, MANOMETER, DUMP PAN, MOVABLE REACTOR, AUX. MANIFOLD, TAMPER WATER IN & OUT, SIGHT GLASS.	✓	✓	✓	✓	DC JM JF DC DC JM		✓	–	DC	JF DC	FC	JF	JF	FP 3C	FP	JM	JP	DM	FP	FC	DC					
	✓	✓	✓	✓			DC DFC	–							–	–	JP	–	–			FP	FP	FP	✓	BM
	✓	–	✓	✓			DC JM	JF DFC	–						–	–		–	JF							
4. SAFETY RODS TESTED & SET	✓	✓	✓		JP	FC	JM ADC	DFC JF	AM	DC	JF	FC	DC	JM	FP	FP	JP	FC	JM JF	FP	FP	FP	FC	DC	DC	JF	FP	✓	JF
5. DUMP VALVE SET, CONTROL RODS	✓	✓	✓		JP	FC	DC	DC JF	AM	DC	FC DC	FC	JM	JM	FC	FP JM	FP	FC	JM	FP	FP	JA	FC	DC	DC	JF	FP	BM	✓	BM
6. SPRING ON DUMP VALVE	✓	✓	✓	J.M	JM	JF	DFC		DC	JM	FC	JM	JF		FP	FP JM	FP	FC		FP	FP	BM	FC	DC		FP	FP	✓	JF
7. TOP TAMPER limit SWITCHES SET. " " SMOOTH ACTION.		✓	✓	J.M	JM	DC	DFC	JM	DC	FC	–		–	JM	FC	FP	JP	–	JM	JP	FP	–	JM	DC	DC	BM	FC	✓	JM
		✓	✓	D.C.	FC	DC	JF	DC	JM	DC	JM	–		–	JM	FC	JM	JP	–	JM	JP	FP	–	FC	BM	DC	BM	JF	✓	JM
8. SET POSITION INDICATOR ON MOVABLE TOP TAMPER		–	–	JP	JM	JF FC DC JM	DC	AM	ADC	JF	–		–	D.C JF	DC	FP	–	–	JF	–	–	F	C	DC	FP	–	FC	✓	DFC
9. Coupling ON DRIVE SHAFT IN PLACE & SET.		–	–	JP	FC	DC	DFC	AM	DC	JF	–		–	JF	FP	FP	JP	FC	FP	JP	–	FP	JF	UF	JF	JF	DC	✓	JM
10 ACCOUNT FOR ALL PERSONNEL	✓	✓	✓	JM	JM	DC	JF	AM	DC	DC	DC		DC	JM	DC	JM	DC	DC	JM	DC	DU	BM	JM	DC	JM	DC	BM	✓	JM
11. NOTIFY GUARDS	✓	–	✓	J.M	JM	DC	JF	AM	DC	DC	DC		DC	DC JM	DC	JM	DC	DC	JM	DC	DU	BM	FC JM	DC	JM	DC	BM	DC	JM
12. TURN ON RED LIGHT	✓	✓	✓	JM.	JM	DC	DC	AM	DC	JM	DC		DC	JM	DC	JM	DC	DC	JM	DC	DC	BM	JM	DC	JM	DC	BM	D C	DC
13. DOSIMETERS & FILM BADGES. + Catastrophe film	✓	✓	✓	J.M.	BM	JM	JF	JF	ADM	JF	JF	DC	JM	FC	FP	JF	JF	JF	DC	BM		FC	BM	JM	DC	DC	✓	JM
14 Attic FAN ON	✓	✓	✓	JM	DC	JM	DC	JM	DC	FC	FC	DC	JM	FP	JM	DC	–	–	–	–	–	–	–	–	–	–	–	–	–
15. LOOK FOR WATER LEAKS.		✓	✓	JP	JM		DC		DC	–	–	JF	DC	JM			–	JM	DC			–	JM	DC	JF	FP	DC	–	
16. AIR PRESSURE OK.	✓	–	–	JP	FC	JM	DC	JM	DC	FC	RM	DC	JM	FP	JM	JP	FC	JM	DC	BM		JM	FC	DC	JM	FP	FC	✓	RM
17. BARRIER IN POSITION		✓	✓	JM	DC	DC		JM	BM	JM	–	–	JM	DC	JM	–							–	–			–	✓	✓
18. CHECK FOR SOLN LEAKS		✓	✓		JM	DC	ADC		DC	JM	FC		DFC	DC	JM			DC					DF FC	DC	JM		FC	✓	
19. PINS IN cylINDER VALVES		✓	✓	JP	DC	JF	DC	JF	AM	DC	FC	DC	JF	FP	FP	JP	DC	JF	JP	JM		JM	JM	DC	JM	RM	FP	✓	JM
20. Air pressure check on double Tube for leaks				JM	JM		ADC	JM	DC	JM	–	–	JM	DC	JM	–	–	JM	DC	–		–	JM	DC	JM		JC	✓	JM
21 Bring V-263 to Control Room				VM	DC	DC	DC	JM	DC	JM	JF	DC	JM	BM	JM	DC	DC	JM	DC	DC		JM	FC	DC	DC	BM	DC	✓	JM
22. Be sure tube is unkinked in connection.				JM	DC	DC	JM	DC	JM		–	–	JM	DC	FP	JP		JM	DC	–		JM	JM	BM	JM	–	FC	✓	FC
23. Put Experiment No. on charts				BM	DC	DFC	AM	DC	FC	–		JM	FC	JM				FD	FP			FP	FC	BM	DC	DC	BM	✓	JM
24. Ck free flow by a) Noting when bub. appears in #2 cylinder b) measure equal time starting with 0.5 cm in #1				ADC	–	–		JM		–	JM FC	DC	JM	–				JF	·				JM	JF	JM		BM	—	JM
25. Check Tape on Dump Pan							AM		FC JM	FC	DC	JF	FC	JM FD	FP	FC	JM	FD	BM			JM	JM	VM	JM	FD	FC	✓	BM

~~Check List~~

~~1. Sources = Extra sources put away = Cylinder sources in place~~
~~2. Instruments on — checked for response = Trip points recorded~~
~~3. Valves — Cylinders, feed line, manometer, dump pan, movable reactor~~
~~Auxil. manifold, Tamper water inlet & outlet, overflow, water sight gla~~

Catastrophy Badges

✓ 1.	Personnel		269 ✓
✓ 2.	Control Room	S. wall	273 ✓
✓ 3	" "	N wall	272 ✓
✓ 4	Reactor room	Reactor	263 ✓
✓ 5.	" "	W wall	276 ✓
✓ 6.		E "	270 ✓
✓ 7.	Office	W wall	268 ✓
✓ 8.	Post 50		271 ✓
9	Post 49		274 ✓
✓ 10.	Room 10	W wall	275 ✓
11	Vestibule		260 ✓
12	Film badge rack		267 ✓

Badges read & McLendon, Y-12, 3/1/49 - dc