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AEC RESEARCH AND DEVELOPMENT REPORT

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Technology - Hanford

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THE TREND OF CONTAMINATION IN THE AIR, COLUMBIA RIVER, RAIN, SANITARY WATER, VEGETATION, AND WATER, AT HANFORD WORKS AND VICINITY FOR THE PERIOD OCTOBER, NOVEMBER,

APPROVED FOR
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Table of Contents
(Page 8a,

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By: W. Singlevich

Date: March 20, 1956

Health Instrument Department

General Electric Company

Hanford Works

[redacted]

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THE TREND OF CONTAMINATION IN THE AIR, COLUMBIA RIVER, [illegible] SANITARY WATER, VEGETATION, AND WASTES, AT THE HANFORD WORKS AND VICINITY FOR THE PERIOD OCTOBER, [illegible]

INTRODUCTION:

This report summarizes the contamination observed at the Hanford Works and vicinity for the period October, November, and December, 1947.

Trend charts showing trend of contamination for the various sampling locations are only included where a true trend can be established for the three month period; a thorough analysis of all trends will be considered in detail in the annual report from this section.

The report is divided into the following topic sections:

SECTIONS:

Section I	Meteorological - Dissolving Data
Section II	Beta Contamination in the air and the radiation levels [illegible]
Section III	Alpha and Beta Contamination in the Columbia River
Section IV	Beta Contamination in the Rain and Snow
Section V	Alpha and Beta Contamination in Drinking Water
Section VI	Beta Contamination on Vegetation
Section VII	Alpha and Beta Contamination in Hanford Wastes

An appraisal and review of all the results is considered in detail for each section. Statistical analysis is used whenever possible to determine significant values and differences in levels of contamination measured.

Maps 1 thru 6 show the sampling and instrument locations from which all the data included in this report were gathered. The frequency of sampling for each type of analysis is considered in the respective sections of the report.

The methods of evaluation remain essentially the same as reported in the last quarterly report from this section (1) (subsequent reference to period July, August, and September, 1947).

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(1) HW-8549 "The Trend of Contamination in the Air, Columbia River, etc. [illegible] the period - July - August, 1947" by W. Singlevich, Dec. [illegible]

SECTION I

Meteorological - Dissolving Data

A summary of the meteorological conditions as observed and measured at the Meteorology Station, 622 Building, 200 West Area, is graphically represented in Figures 1, 2, and 3.

Figure 1 summarizes the monthly average wind directions observed on an eight point compass for the months, October, November, and December, 1947. The wind direction prevailed 34% of the time from the NW this quarter as compared to [illegible] of the time for WNW last quarter (July, August, September). The prevailing quadrant for the wind direction was still from the west for this quarter as it was for last quarter. Figure 3 is a "wind rose" type graph portraying the average wind direction for the overall three month period.

Figure 2 shows the average wind dilutions observed for the dissolving period only and for the overall twenty-four hour daily period. The dilution factor ratio of less than 500:1 was relatively normal for October and November but was observed to be high in December by a factor of about twenty when compared to the dissolving period for the quarter of July, August, and September, 1947.

Figure 4 is a daily tabulation of the total calculated quantity of [illegible]-day radio-iodine present in the uranium dissolved in the 200 East and 200 West Areas for this period.

DISCLAIMER

SECTION II

Air-borne Contamination and Air Radiation Level

Radiation levels in the air and airborne contamination have been [redacted] using detachable ionization chambers and filters, respectively. Map 1 is [redacted] cation map for the "M", "S", and "C" type detachable chamber; the [redacted] locations are also shown on this map. Map 2 is a location map for the [redacted] iodine monitors and for the filter sampling units.

Table I is a tabulated summary of the radiation levels measured [redacted] C", "M", and "S" type detachable chambers. The "C" chamber [redacted] 1.21 mrep per 24 hours at 100-B Area to 0.69 mrep per 24 hours at [redacted] The overall average readings for this quarter are essentially the same [redacted] observed last quarter.

Table II shows the average beta activity detected in the air by [redacted] ters. A review of this data indicates a continued decrease in the [redacted] of activity found on the filters. Average levels observed at [redacted] dropped by a factor of about 4 when compared to last quarter's data. [redacted] drop in activity was also noted in the 200 West Area. Average levels [redacted] lying areas such as Pasco, Richland, Benton City, and Hanford [redacted] the same.

Figure 5 is a bar graph of the beta activity measured on filters [redacted] listed locations. A statistical analysis of these data (each [redacted] was based on twelve to thirteen samples spread over a period of three [redacted] the filters indicated that there was no significant difference in the beta [redacted] vity levels between Richland (700 Area) and Hanford, Richland and 300 Area, Pasco and Richland. Benton City was again found to be significantly higher [redacted] Richland (700 Area). The overall three month average beta activity measured [redacted] this period on air filters is slightly lower than the average level [redacted] the same locations last period.

SECTION III

Alpha and Beta Contamination in the Columbia River

The Columbia River rate of flow has dropped from about 2,000,000 [illegible] per second (as measured near Richland by the Power Department in July, [illegible] about 450,000 gallons per second as measured at the same location in [illegible] 1947. The peak river flow observed for the period, October - November, [illegible] ber, 1947, was 900,000 gallons per second. Figure 6 shows the trend of [illegible] lumbia River flow from July thru December 1947; this trend is as anticipated [illegible] and agrees with the trends observed in the past years.

Map 3 is a location map indicating approximate locations where the [illegible] ples are taken. All of these samples are taken on a weekly basis.

Figure 7 summarizes, graphically, the average beta activity [illegible] ples of river water taken at the listed locations. The lowest levels [illegible] were in the 181-D water and in samples taken from above 100-B Area. [illegible] from the Yakima River at three locations are analyzed along with the [illegible] ver samples and may be considered as essentially background levels [illegible] the river water.

A study of the Columbia River for the period October - [illegible] indicated that the average beta activity found in samples taken near [illegible] bank of the river was significantly higher than the average activity [illegible] middle and near the north bank of the river. The average activity [illegible] of the river was significantly higher than the activity found near the [illegible] This observation coincides with the observation made for the period, [illegible] 1947. (2) However, for the period July - September, the average beta [illegible] tested in samples taken near the south and north banks of the river were [illegible]

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(2) HW-7317. "The Trend of Contamination in the Air, Columbia River, [illegible] at H.E.W. for period 3-25-47 to 6-30-47" by J.W. Healy August [illegible]

...and the activity in the middle of the river was significantly lower than ... of the bank. There is no obvious explanation for this trend; perhaps a ... of the channelling effects of the river during the minimum and maximum ... of the river may show some possible explanation for these differences.

The overall average beta activity measured in all the river samples was ... that measured during the last quarter. This is an anticipated trend ... the seasonal increase in the flow of the Columbia River.

... analysis of the average beta activity found in the river ... the various locations (please refer to Figure 7) is summarized below:

There was no significant difference between the average beta activities ... in river samples taken at 300 Area and at the Pasco K and H Depot.

No significant difference was found in comparing the average activity ... above 100-F Area with the average in Yakima Horn samples. A good ... comparisons could not be made to compare the average beta content measured ... samples above 100-F with the Yakima Horn samples as only three samples were ... above 100-F for the entire three month period. A T test does indicate, however, that the average for the three samples above 100-F is only doubtfully ... slightly higher than the average in Yakima Horn.

No significant difference was found between the averages of duplicate ... taken in the middle of the Columbia at Richland. (Richland Middle #1 and ... Middle #2). There was no significant difference in the average beta ... activity found in samples taken in the Columbia River at the north bank of ... and the ... when compared to the average beta activity found in samples ... in the Columbia at Richland.

The river samples taken at the three locations at Hanford were significantly ... from each other. Samples at the south bank and from the middle of the river were significantly higher than samples from all locations ...

All river samples taken during this period showed < 2 disintegrations ... activity

SECTION IV

Beta Contamination in the Rain and Snow

Map 4 is a location map identifying the approximate locations of the rain gauges where the rain and snow samples are collected. For this period, October - December 1947, from nine to eleven samples were collected at each location except at Meteorology, 200 West Area, where a total of [illegible] samples was collected.

Figure 7-A portrays graphically the average beta activity levels measured in the rain at the listed locations. The maximum average beta activity was again found in rain samples located in the 200 West Area; the maximum average for this period was 3.36×10^{-2} μc per liter as compared to 4.1×10^{-2} μc per liter measured during the last period. The overall average beta activity in the rain samples for this period is considerably lower than that observed in the last period.

A statistical analysis of the data for the rain samples is summarized below:

The average beta activity in rain samples collected in Richland, 700 Area, was significantly higher than the average activity measured in 200 Area rain samples.

In comparing the average beta activity measured in the rain samples, the test indicated no significant difference of the average values between 200 Area and Pasco; between Pasco and Benton City, between 100-B and 100-F areas, and between 100-B and 100-D Area. Samples collected at Route 4S, Mile Post 8 were significantly higher in beta activity than those samples collected in the 700 Area (Richland).

ANNEX I

Radiation Level Observed

With

Detachable Ionization Chambers

(Mrep per 24 Hours)

CHAMBER READINGS

"C" Chambers in mrep per 24 hours

Location	October	November	December	[illegible]
100-D	.36	.37	.41	
100-B	.33	.31	.31	
100-F	.40	.41	.38	
200-E	.43	.42	.69	
200-W	.36	.40	.26	
300-Area	.41	.35	.48	

"M" & "H" Chambers in mrep per 24 hours

Location	October	November	December	[illegible]
100 Area and Environs				
Rt. 1 Mile 8	.36	.29	.53	
Rt. 2 Mile 10	.24	.12	.43	
Rt. 2N Mile 5	.86	.43	.38	
Rt. 11A Mile 1	1.08	.72	1.08	
Rt. 1 Mile 5	.46	.34	.53	
Within 5 miles of 200 Areas				
Rt. 4S Mile 6	.18	.72	1.18	
Rt. 11A Mile 6	.72	.60	1.68	
Rt. 1 Mile 1	.24	.24	1.51	
702 building	1.08	.53	1.70	
Within 10 miles of 200 Areas				
Rt. 4S Mile 10	.48	.48	1.16	
Rt. 1C Mile 1	.53	.24	.77	
Rt. 10 Mile 3	.89	.72	.77	
Rt. 2S Mile 4	.98	.77	.77	
Near 300 Area				
Rt. 4S Mile 16	1.03	.48	.82	
Rt. 4S Mile 22	.19	.84	.82	

All the above values include the background measurements at the monitored [illegible] ity.

TABLE II

AIR SAMPLING PROGRAM

Period - October, November, December

1947

Location	μc per Liter
1. Pasco	4.2×10^{-10}
2. 700 Area	2.3×10^{-10}
3. Benton City	7.5×10^{-10}
4. 300 Area	5.2×10^{-10}
5. 200 East SE	12.0×10^{-10}
6. 200 East Tower #11	17.5×10^{-10}
7. 200 East Tower #18	40.5×10^{-10}
8. 200 West EC	42.1×10^{-10}
9. Hanford	3.0×10^{-10}
10. Cable Mountain	4.1×10^{-10}
11. 100-D	22.9×10^{-10}

[redacted]

Alpha and Beta Contamination In Drinking Water

Map 1 is a sampling location map for drinking water samples and test well samples. The frequency of samples taken at each location can be obtained by referring to Table III.

Table III is a summary of the average alpha and beta activity detected in the drinking water for the Hanford Works and vicinity during the period October - December 1947. No average beta activity as great as 3×10^{-5} μc per liter was detected in any of the drinking water. No average alpha activity as great as 2 dis/min/liter was detected in any drinking water except in the 300 Area Sanitary Water and 300 Area Wells #1 and #2 which are known to be slightly contaminated with uranium. On the basis of sixty-four samples taken at each 300 Area location the average alpha contamination found in the Sanitary Water, Well #1, and #2 was [redacted] and 3.4 dis/min/liter respectively. It is of interest to add that on the basis of special analyses in which ten liters of water was evaporated and analyzed for alpha contamination by the ether extraction method, trace amounts of uranium varying from 2 - 10 parts per billion were consistently found in samples of water taken at Richland Wells #2, #5, #13, #15, and #16. Samples taken at Prosser Bluffs and Benton City indicate similar trends. This additional data tends to substantiate results obtained in the last period at which time it was demonstrated that the quantity of uranium involved in the analyses was probably a natural amount present in these water samples. Samples taken at Benton City run somewhat higher in the alpha activity found than in other drinking water. (except the 300 area samples).

[redacted]

Figure 8 shows the trend of the alpha contamination in the 300 Area Sanitary water with the river flow for this period. When the river reached its minimum flow of about 400 thousand gallons per second, the contamination found in the 300 Sanitary Water dropped to almost background levels. The flow in the early part of July was about 1900 thousand gallons per second at which time alpha activity as high as 46 dis/min/liter was measured in the 300 Sanitary Water.

Figure 8-A shows a similar trend for the alpha activity measured in samples taken from 300 Area Well #1. A plot of the depth of the water in the well is also included; the well depth follows the trend of the flow of the river. The limits of accuracy designated for each point in the activity measurement shown on graphs 8 and 8-A are for counting errors only at the ninety percent confidence level.

Although the contamination levels in all drinking water samples (except in the 300 Area samples) showed activity to be less than the reporting level, i.e. 5×10^{-5} uc per liter for beta activity and < 2 dis/min/liter for alpha activity; a series of T tests were calculated for the average activities found in the various samples to determine any significant differences. The ninety-nine percent confidence level was used in this statistical analysis.

Table IV and IV-A summarize the results of the statistical analysis. It is of interest to point out the analysis between Pasco water and Benton City water. It has been previously noted that the beta activity in Pasco water was from 14.8 hour radiosodium with no alpha emitters. Indications have shown that the significantly higher activity in Benton City was from some alpha emitter, most likely uranium, with no detectable beta emitters (at that low

...vel for uranium). Statistical analysis has shown that the drinking ...ter at Pasco is significantly higher than the drinking water of Ben... City in beta activity; Benton City water is significantly higher than Pasco water in alpha activity. This tends to support the indica... of radium as the contaminant in Pasco water and Uranium as ... contaminant in Benton City water.

The statistical analysis also indicated that the average alpha ac... activity in Benton City water was significantly higher than the average ... activity detected in Richland Well #13 water; both locations ... trace amounts of uranium as analyzed by the Fluorophotometer.

Beta Contamination On Vegetation

The quantity of 8 day radioiodine in the metal dissolved in the 200-East and West Areas for the period, October - December, 1947, as calculated on the basis of weight of metal dissolved is tabulated below:

All values are in curies (c)

	200 East Area		200 West Area	
Month	8 Day Iodine		8 Day Iodine	
October	176.5		282	
November	229		204.5	
December	129.5		193	

Map VI is a location map designating the distribution of vegetation samples. Samples are taken at least once every four weeks at all locations. As many as sixty-five samples were taken for the 3 months period at Richland, 200-E Area and 200-W Area.

Figure 9 summarized graphically, the overall average beta activity detected in vegetation samples for this period. The average levels found for this period are slightly lower than that observed in the last period.

The overall average beta activity measured in vegetation sampled at Pasco, Kennewick, Benton City, Richland, Midway, Riverland, and the 100 Areas was below one-half the tolerance value of 8 day radioiodine in vegetation, 0.2, μc per kg. The levels in 200-W and 200-E Areas have dropped significantly this quarter.

Figure 10 shows the trend of beta contamination measured on vegetation samples taken at Route 4S, Mile Post 4 as compared to the daily calculated quantities

of 8 day radioiodine in the metal dissolved in 200 East and 200 West Areas.

Map VII is an iso-activity chart showing the spread of contamination on vegetation for the period, October - December, 1947. The spread of contamination follows the prevailing wind direction which was from the north-west. The "Wind rose" chart shown on the iso-activity map summarized the average wind directions as measured with an eight-point compass at the Meteorology Station in 200 West Area. The overall average beta contamination on vegetation is lower this period as compared to the last period; this is an anticipated trend as the quantity of radioiodine expelled from the stacks this period was lower by a factor of about two (2) as compared to the last period.

A series of T tests were calculated comparing the locations and their respective beta activities as listed in Figure 9.

It was found that the average activity of samples collected just outside the 200-West Area Gate was significantly higher than the average of samples collected inside of 200 West and 200 East Area. Samples from inside the 200 East Area were significantly higher than those in 200 West Area.

Samples collected at Gable Mountain were significantly higher than samples collected in Richland. There was only a doubtful significant difference between samples collected in Richland and Hanford.

No significant difference was found in samples collected in Richland, Kennewick, and Pasco. No significant difference was found in comparing the activity found on individual samples taken at different locations in any of the above cities. There was no significant difference between Benton City and any of the above locations.

No significant difference was found in comparing the activity on vegetation samples collected at 100-B, 100-D, and 100-F Areas.

13(a)

TABLE III

ALPHA AND BETA ACTIVITY IN WELLS AND SURFACE WATER

October - December 1947

Location	No. Samples	Average Beta Activity μc per liter	Average Alpha Activity
Pasco	13	6.9 X 10^{-6}	
Kennewick 614	13	8.4 X 10^{-6}	
Kennewick Standard Station	12	8.6 X 10^{-6}	
Benton City	24	3.8 X 10^{-6}	
Cobbs Corner	11	4.8 X 10^{-6}	
Headgate	13	4.2 X 10^{-6}	
Riverland	13	6.3 X 10^{-6}	
Midway	13	3.5 X 10^{-6}	
Pistol Range	13	4.0 X 10^{-6}	
Columbia Camp	11	3.2 X 10^{-6}	
Lower Knob	13	2.8 X 10^{-6}	
Wells Ranch	13	1.1 X 10^{-6}	
Richland #2	11	5.4 X 10^{-6}	
Richland #4	10	4.1 X 10^{-6}	
Richland #5	10	8.4 X 10^{-6}	
Richland #12	12	4.6 X 10^{-6}	
Richland #13	63	5.6 X 10^{-6}	
Richland #14	10	5.6 X 10^{-6}	
Richland #15	5	5.0 X 10^{-6}	
Richland #16	11	5.5 X 10^{-6}	
Richland #18	11	7.7 X 10^{-6}	
White Bluffs	46	4.6 X 10^{-6}	
300 Area Well #1	64	5.1 X 10^{-6}	
300 Area Well #2	64	5.2 X 10^{-6}	
300 Area Sanitary	64	5.0 X 10^{-6}	
3000 Area Durand #1	9	6.9 X 10^{-6}	
3000 Area Rannoy D	9	5.6 X 10^{-6}	
Trust House K-748	6	2.1 X 10^{-6}	
Hanford Well	8	3.8 X 10^{-6}	
100-B Sanitary	13	2.2 X 10^{-6}	
100-D Sanitary	13	2.1 X 10^{-6}	
100-F Sanitary	13	6.6 X 10^{-6}	
200-W Sanitary	13	3.9 X 10^{-6}	
200-E Sanitary	13	4.1 X 10^{-6}	
B-Y Well	2	3.1 X 10^{-6}	
Spring #13	3	13 X 10^{-6}	
Ranch #13	3	3.3 X 10^{-6}	
Bonson Ranch (no samples)			
Snively Ranch	3	3.6 X 10^{-6}	
Rattlesnake Springs	3	3.9 X 10^{-6}	
200 N #5	3	6.1 X 10^{-6}	
McGee Well	3	5.3 X 10^{-6}	
Ford Well	3	4.9 X 10^{-6}	
Mosier Well	3	4.6 X 10^{-6}	

13.6

TABLE IV

STATISTICAL ANALYSIS OF CONTAMINATION IN WELLS AND SANITARY WATER

T TESTS

Period October - December 1947

Beta Activity

Locations Compared	No. Samples	Average Activity	T Test Value	Conclusion
		μc per liter		
Pasco Kennewick #14	13 13	6.9×10^{-6} 8.4×10^{-6}	0.436	No significant difference
Burbank City Pasco	24 13	3.8×10^{-6} 6.9×10^{-6}	2.91	Pasco significantly high than Burbank
Pasco Richland #13	13 63	6.9×10^{-6} 5.6×10^{-6}	1.90	No significant difference
Burbank City Richland #13	24 63	3.8×10^{-6} 5.6×10^{-6}	1.12	No significant difference
Kennewick Standard Std Richland #4	12 10	8.6×10^{-6} 4.1×10^{-6}	2.18	No significant difference
Richland #4 Richland #18	10 11	4.1×10^{-6} 7.7×10^{-6}	1.43	No significant difference
White Bluffs Richland #4	46 10	4.6×10^{-6} 4.1×10^{-6}	0.25	No significant difference
Hanford Richland #4	8 10	3.8×10^{-6} 4.1×10^{-6}	0.20	No significant difference
100-F Sanitary Richland #5	13 10	6.6×10^{-6} 4.1×10^{-6}	0.20	No significant difference
Richland #13 100-D Sanitary	63 13	5.6×10^{-6} 2.1×10^{-6}	0.78	No significant difference
Richland #13 Richland #5	63 10	5.6×10^{-6} 8.4×10^{-6}	1.10	No significant difference

5-C

TABLE IV-A

STATISTICAL ANALYSIS OF CONTAMINATION IN WELLS AND SURFACE WATER

T TESTS

Period October - December 1947

Alpha Activity

Locations Compared	No. Samples	Average Activity uuc/ml/liter	T Test Value	Conclusion
Benton City Richland #13	24 63	1.33 0.55	5.55	Benton City significantly higher than Richland
[illegible] Benton City	13 24	0.48 1.33	4.07	Benton City significantly higher than Prosser
Prosser Richland #13	13 63	0.48 0.55	0.12	No significant difference
Prosser White Bluffs	13 46	0.48 1.04	2.49	No significant difference
Richland #13 [illegible] Area Sanitary	63 64	0.55 3.48	10.2	Very significantly higher
Richland #2 Richland #16	11 11	0.76 0.45	1.7	No significant difference

[redacted]

SECTION VII

Alpha and Beta Contamination in Hanford Wastes

The average contamination measured in the 100-Area wastes for the period October - December 1947, is tabulated below:

Location	Alpha Contamination	Beta Contamination
1904-B	/ 2 dis/min/liter	8.5×10^{-6} µc/liter
107-D	/ 2 dis/min/liter	19.0×10^{-8} µc/liter
107-F	/ 2 dis/min/liter	11.4×10^{-8} µc/liter

The maximum average contamination detected at the 200 North Area [illegible] using a portable G.M. counter for this period is summarized below:

[illegible] Ditch----about 6,600 counts per minute.

[illegible] Ditch----about 55,000 counts per minute.

[illegible] Ditch----about 45,000 counts per minute.

Four surveys of the fourteen test holes around the waste lines in the 200 West Area as measured by a G.M. probe indicated no unusual readings except Test Hole "K" which on three of the four surveys measured higher than the background of about fifty counts per minute by a factor varying from 2 to 4.

Ten surveys of the 200 West and 200 East waste lines for this period by means of a portable G.M. counter show no consistently significant readings above the normal background of about fifty counts per minute.

A brief summary of the 241-T Swamp Area contamination is tabulated (October - December 1947).

Water Samples	Beta Activity		Alpha Activity	
Location	μc/liter Maximum	μc/liter Average	d/m/liter Maximum	d/m/liter Average
T Swamp - Inlet	11.4×10^{-5}	2.6×10^{-5}	18	[illegible]
T Swamp - West Side	22.7×10^{-5}	3.1×10^{-5}	53	[illegible]
T Swamp - So. Side	19.1×10^{-5}	4.6×10^{-5}	40	[illegible]

The above results for the contamination in water are considerably lower than the activity levels measured for these locations last period.

Mud Samples	Beta Activity		Alpha Activity	
Location	μc/kg Maximum	μc/kg Average	d/m/gm Maximum	d/m/gm Average
T Swamp - West Side	4.2×10^{-4}	1.0×10^{-4}	100	[illegible]
T Swamp - So. Side	4.3×10^{-3}	5.1×10^{-4}	147	[illegible]

These values for the beta activity in mud are considerably lower than the values obtained last period; the alpha activity in the mud remained essentially the same.

A brief summary of the beta contamination detected in samples taken [illegible]

[redacted]

the [illegible] Area Retention Basin for this period is summarized below:

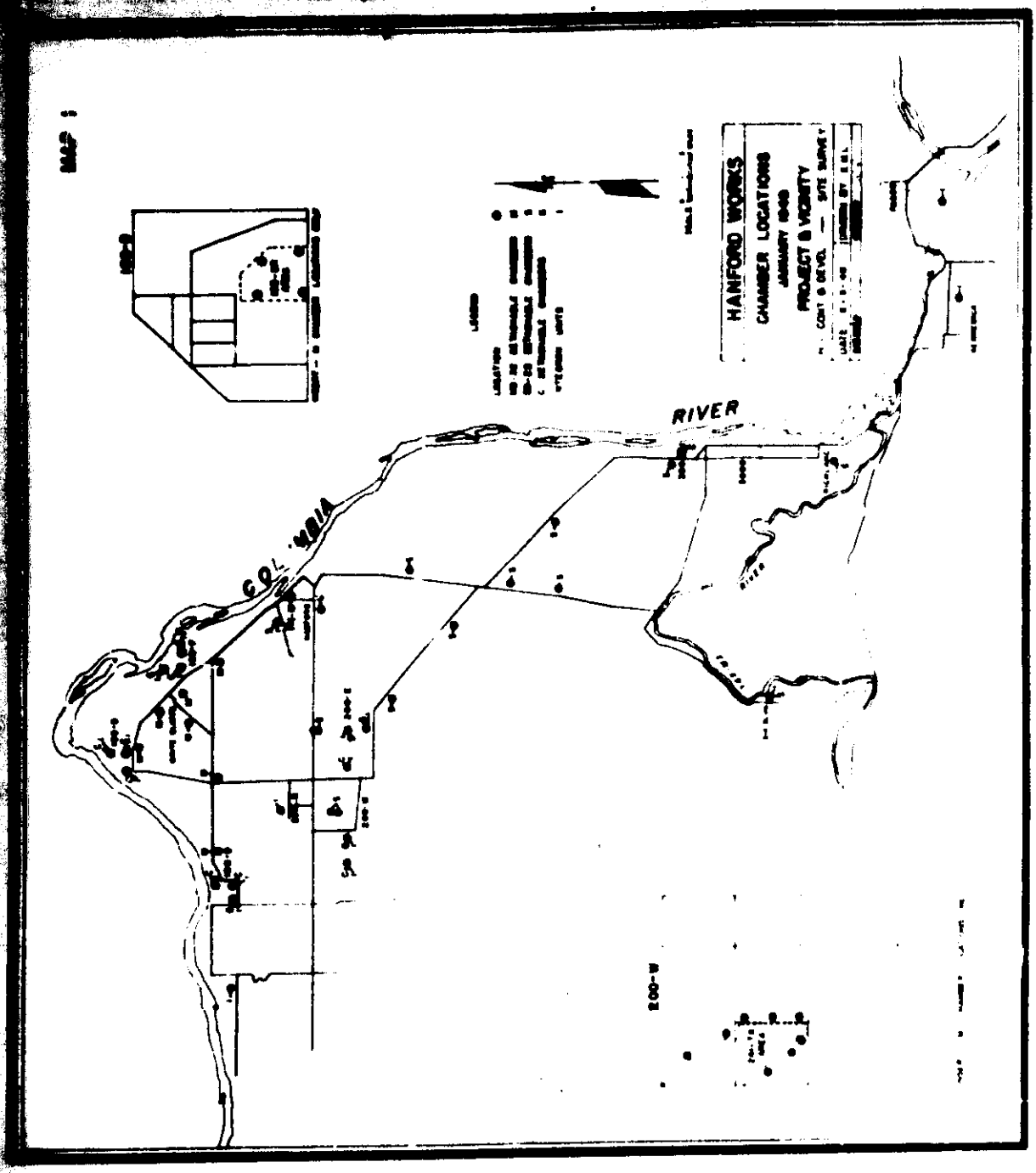
Type Samples	μc per liter			μc/liter
	July	August	September	Overall Average
Waste Liquors	4.0×10^{-4}	1.7×10^{-4}	5.7×10^{-4}	3.8×10^{-4}
Waste Mud	3.9×10^{-3}	8.4×10^{-4}	1.8×10^{-3}	2.2×10^{-3}

[illegible] the measured activities for 300 Area wastes are considerably [illegible] than [illegible] measured for the last period.

[signature]

HEALTH INSTRUMENT DEPARTMENT

[illegible]



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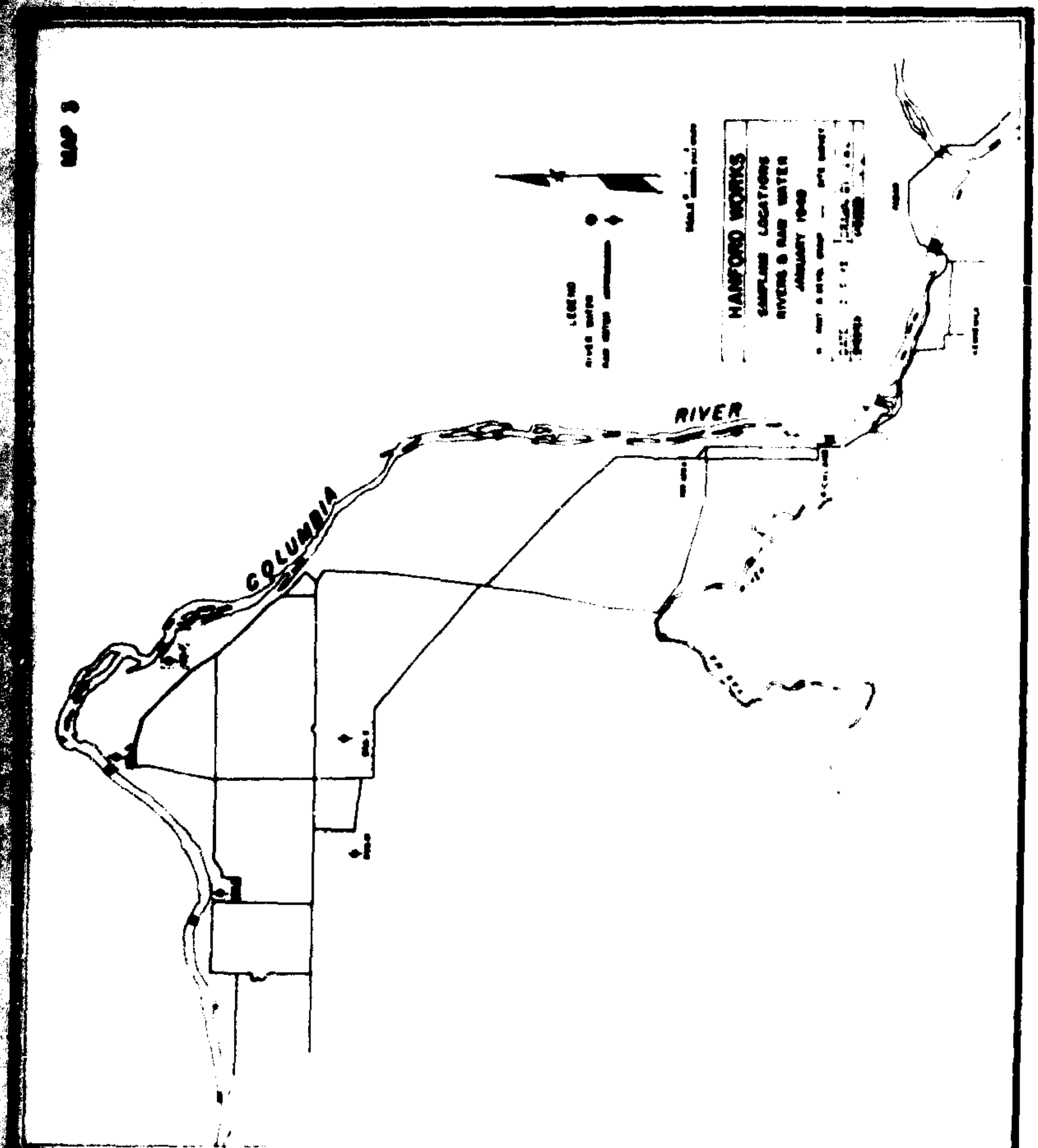

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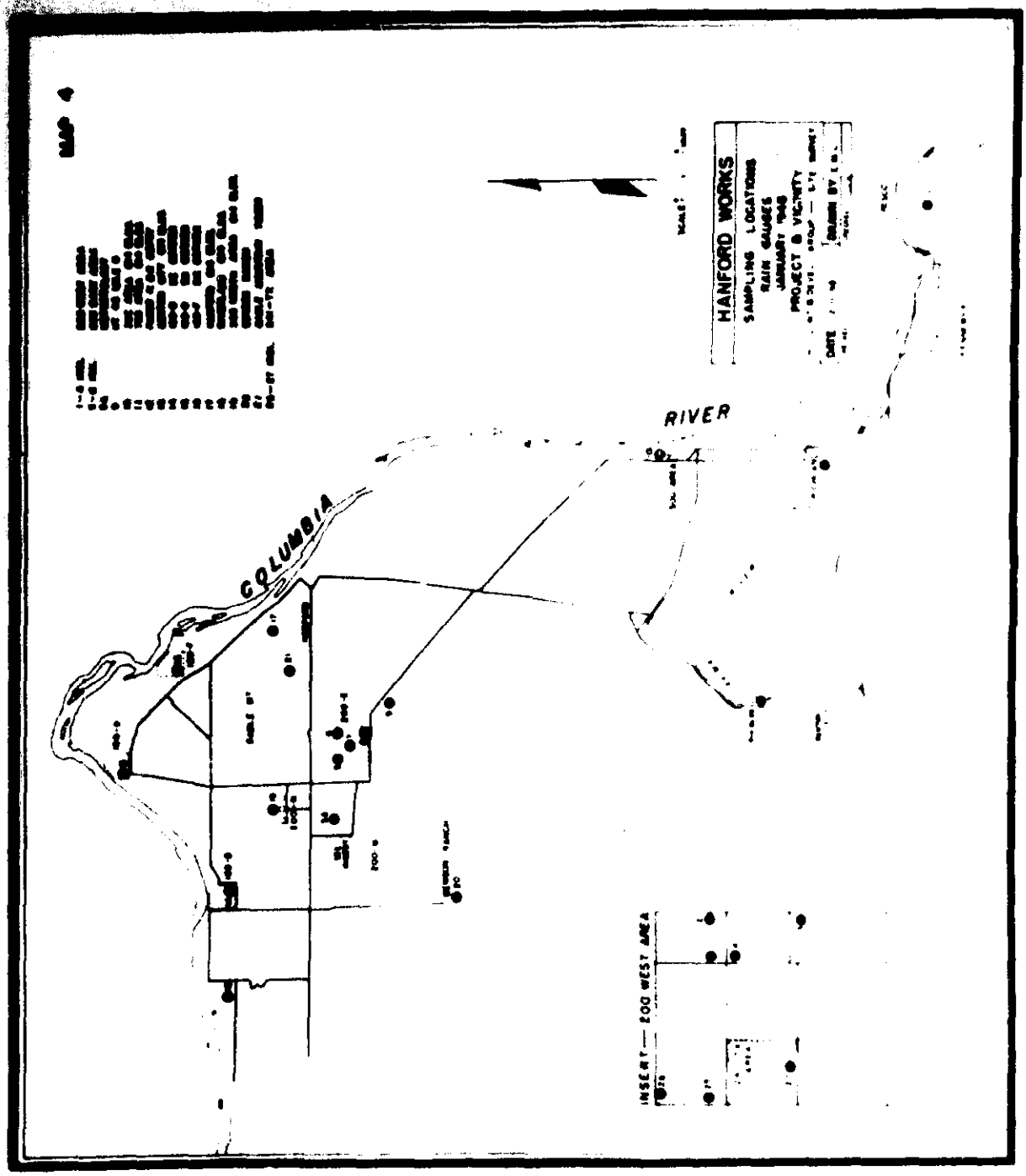

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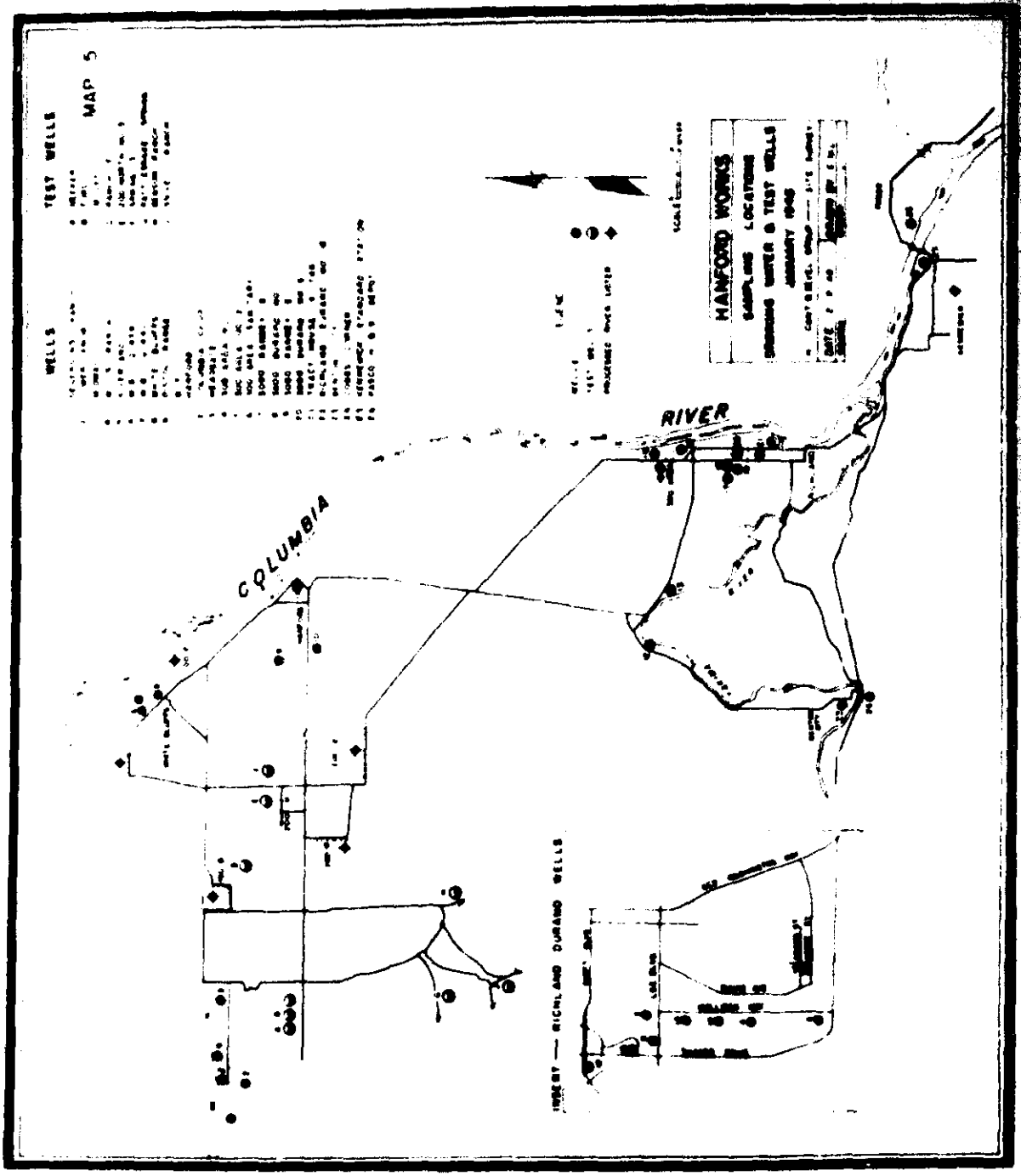

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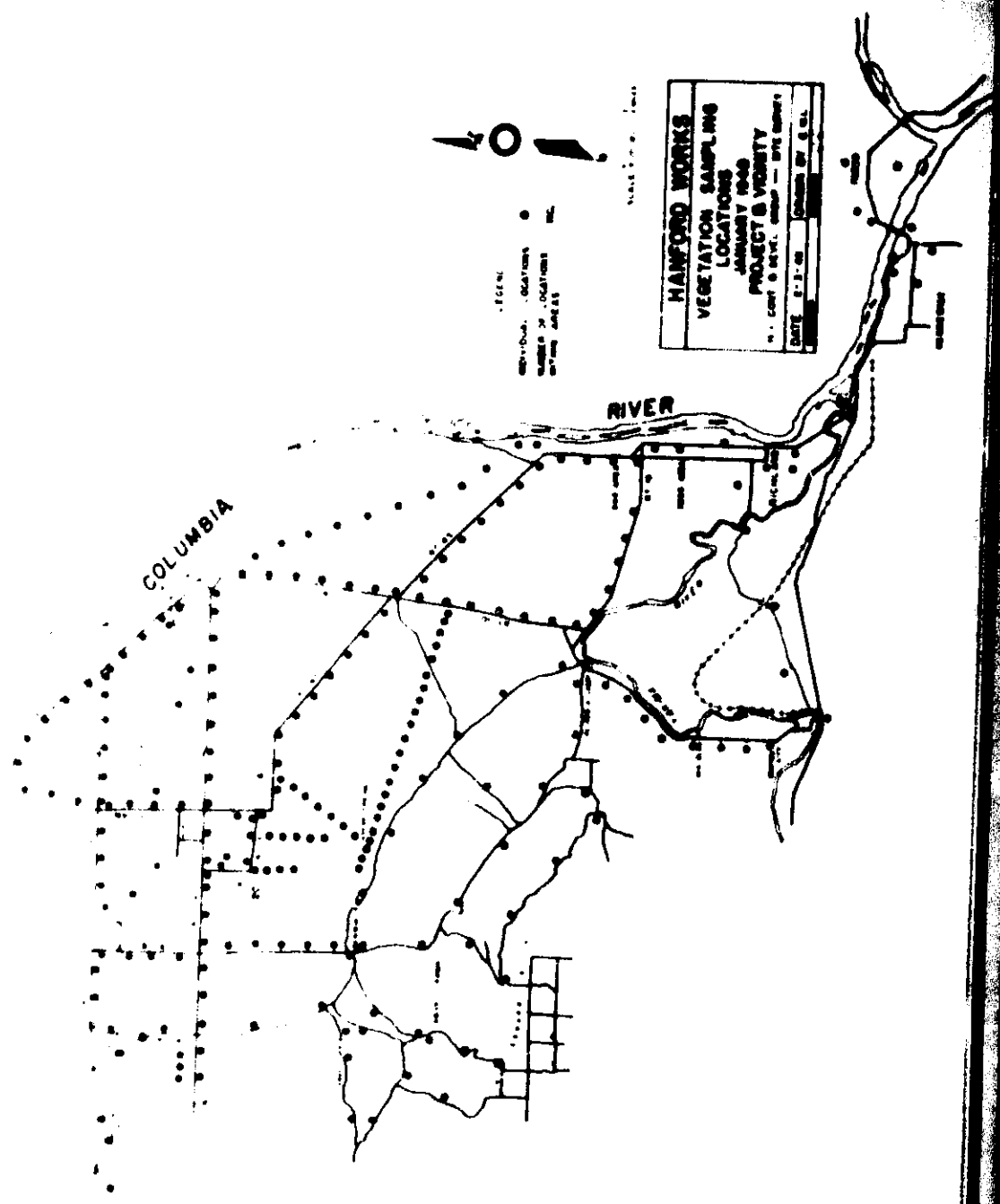
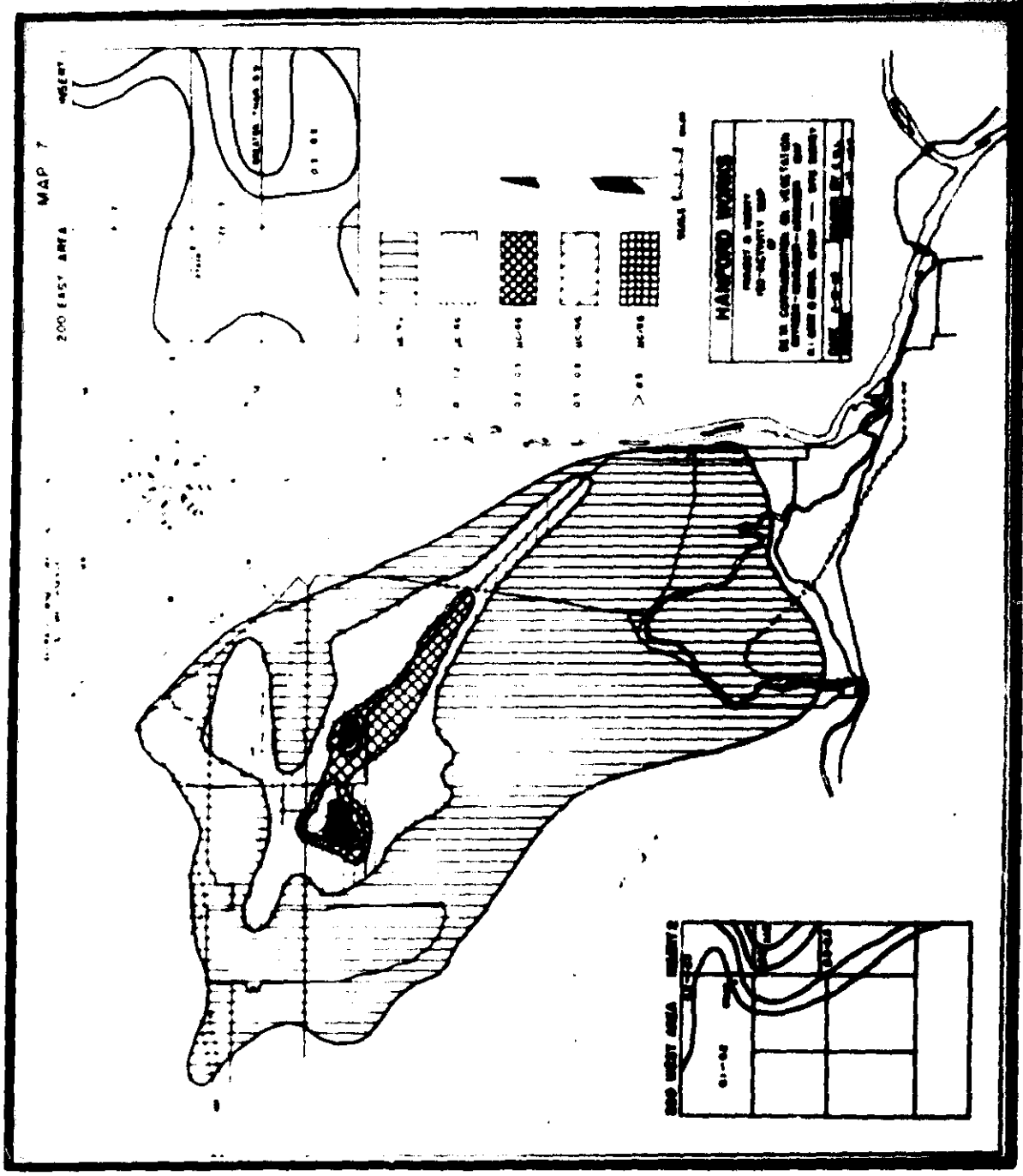
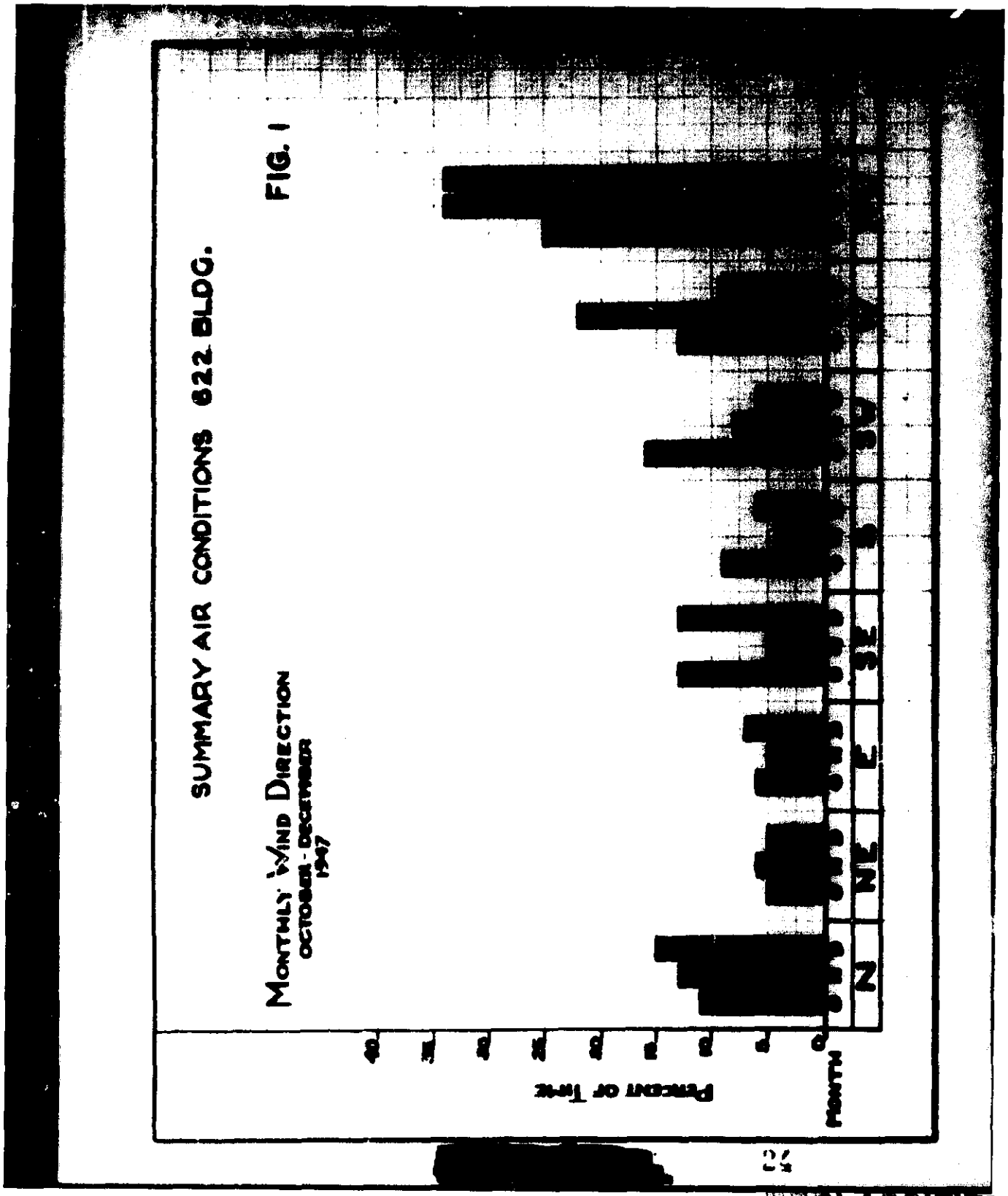






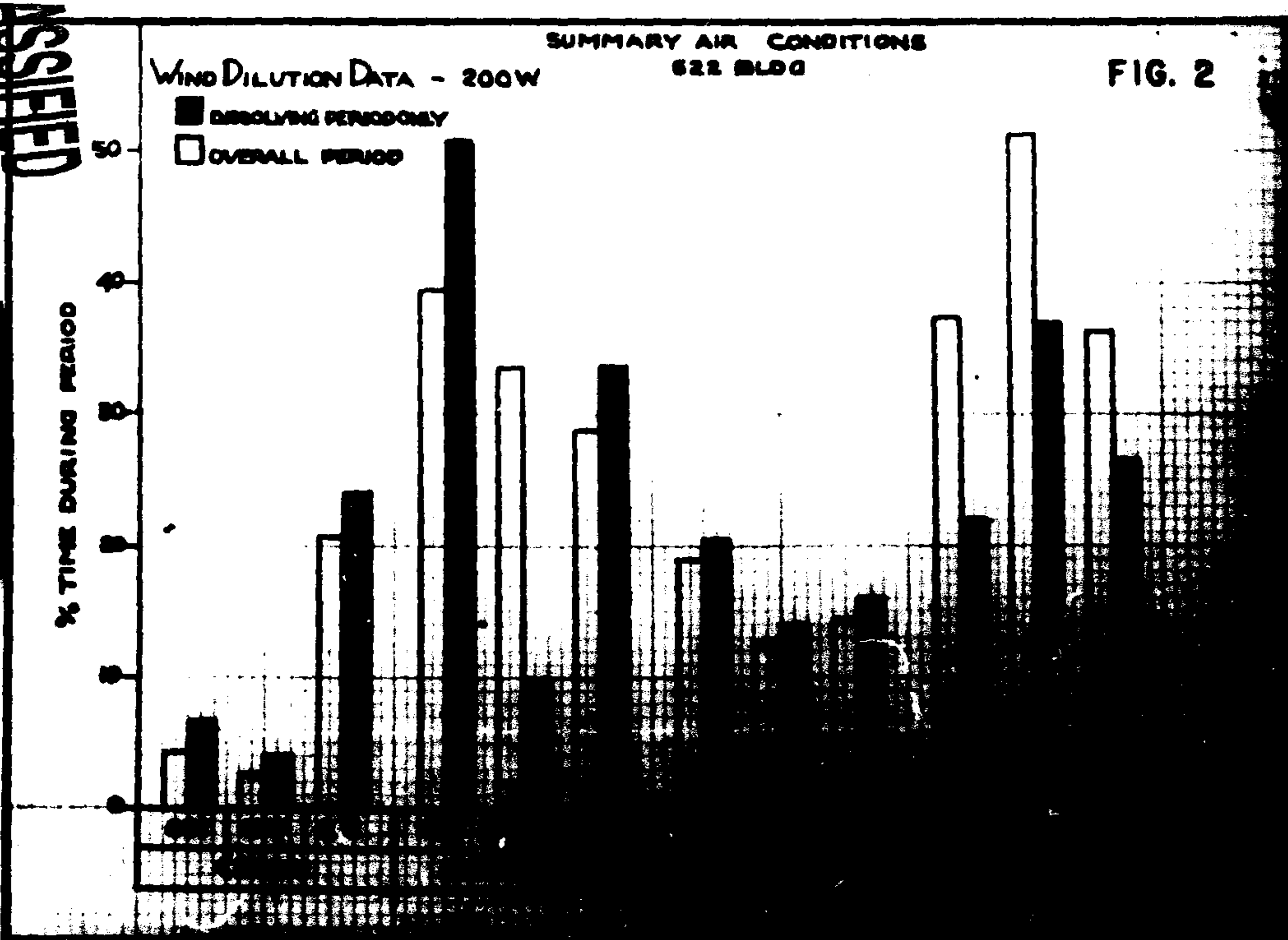


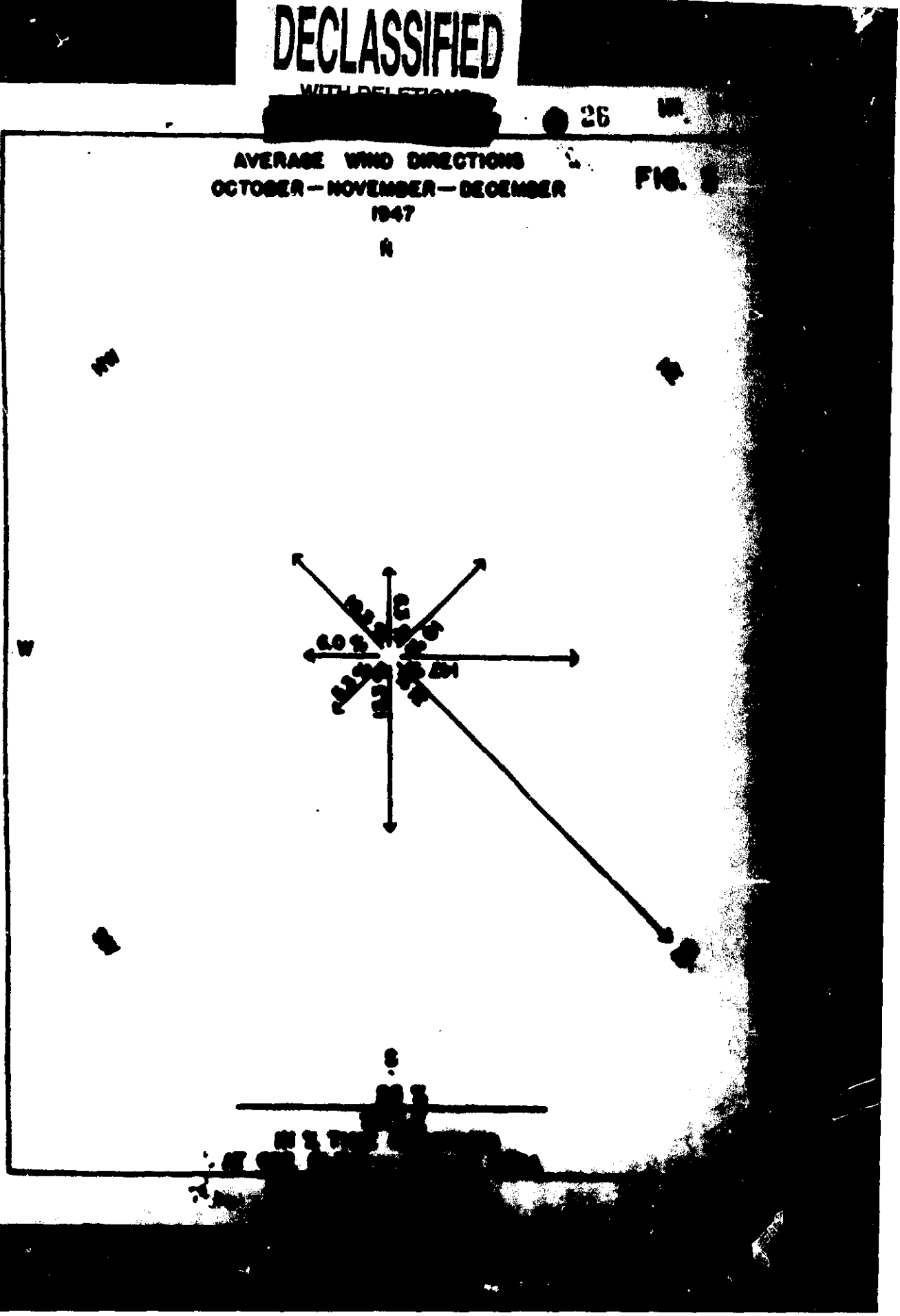
FIG. 2

DECLASSIFIED
WITH DELETIONS

[redacted] 26 MR.

AVERAGE WIND DIRECTIONS
OCTOBER—NOVEMBER—DECEMBER
1947

FIG.



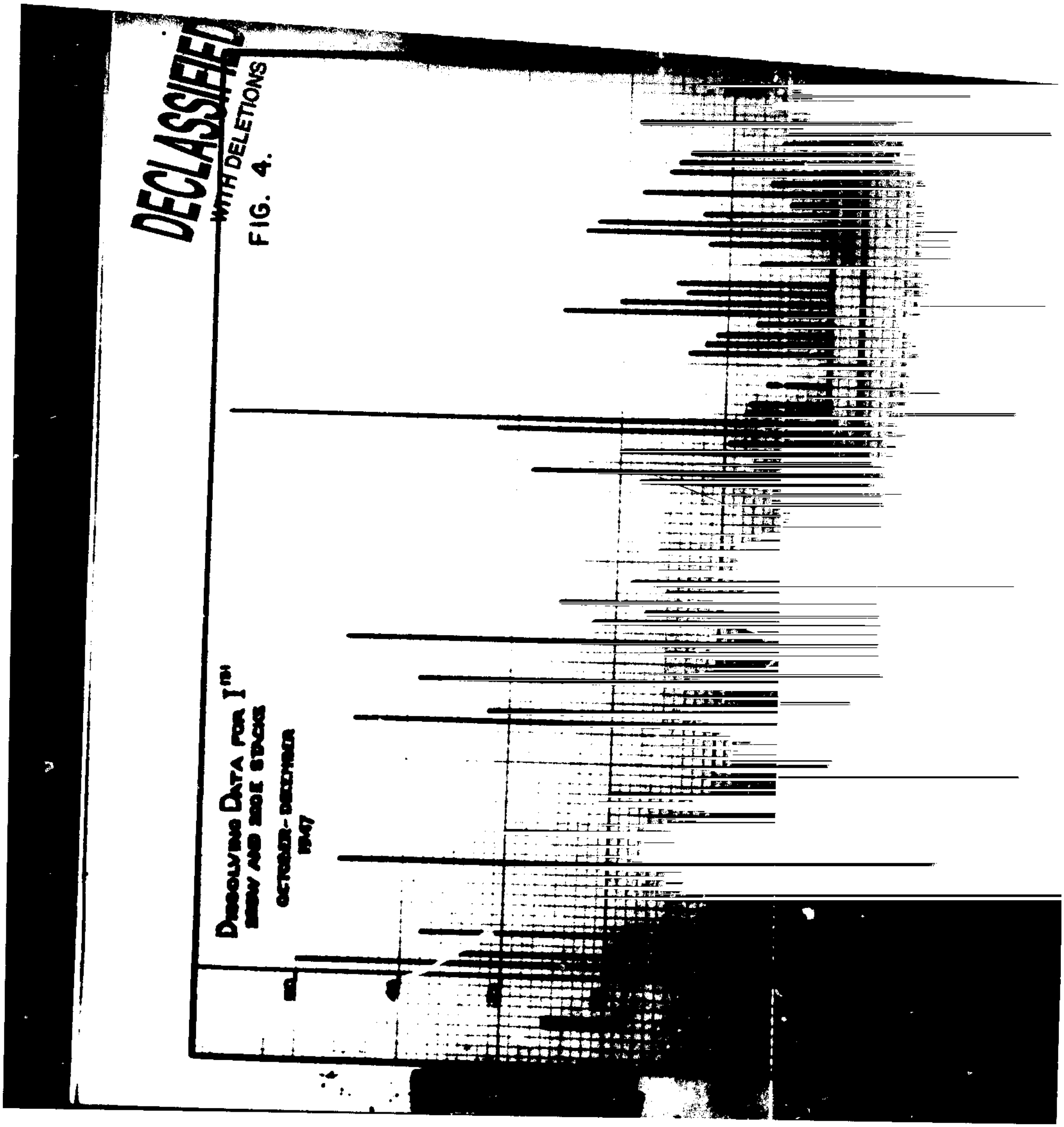


FIG. 4.

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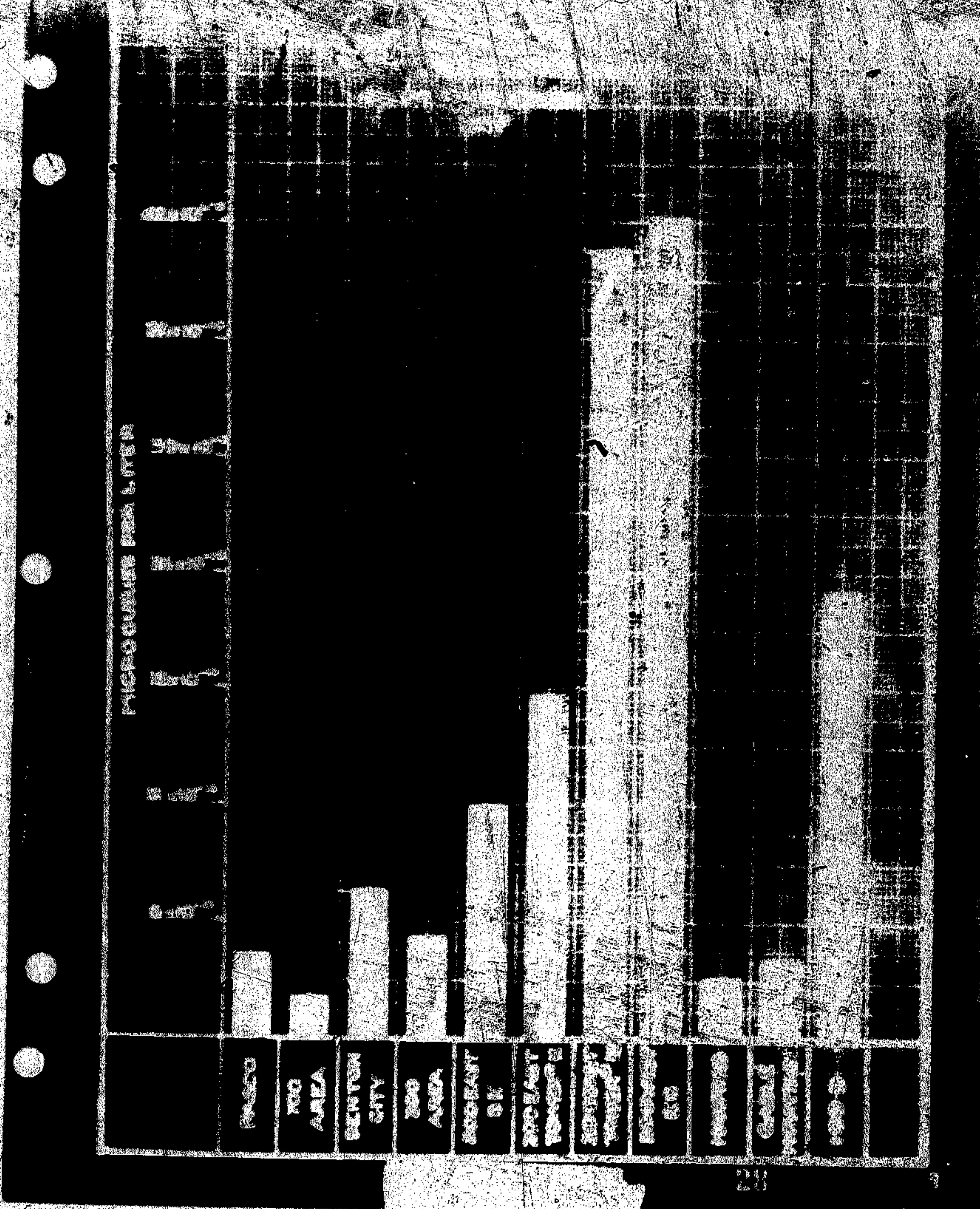
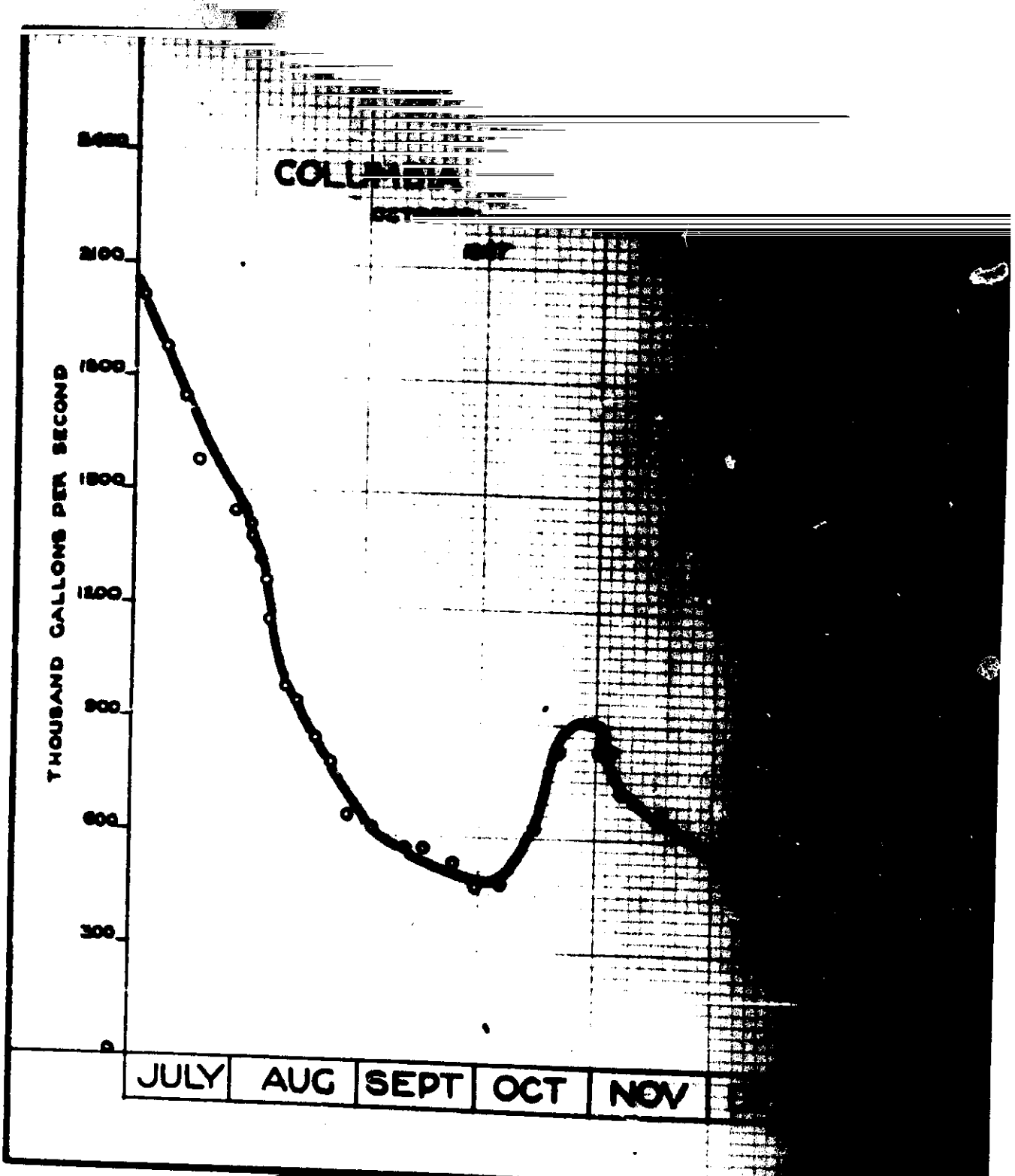
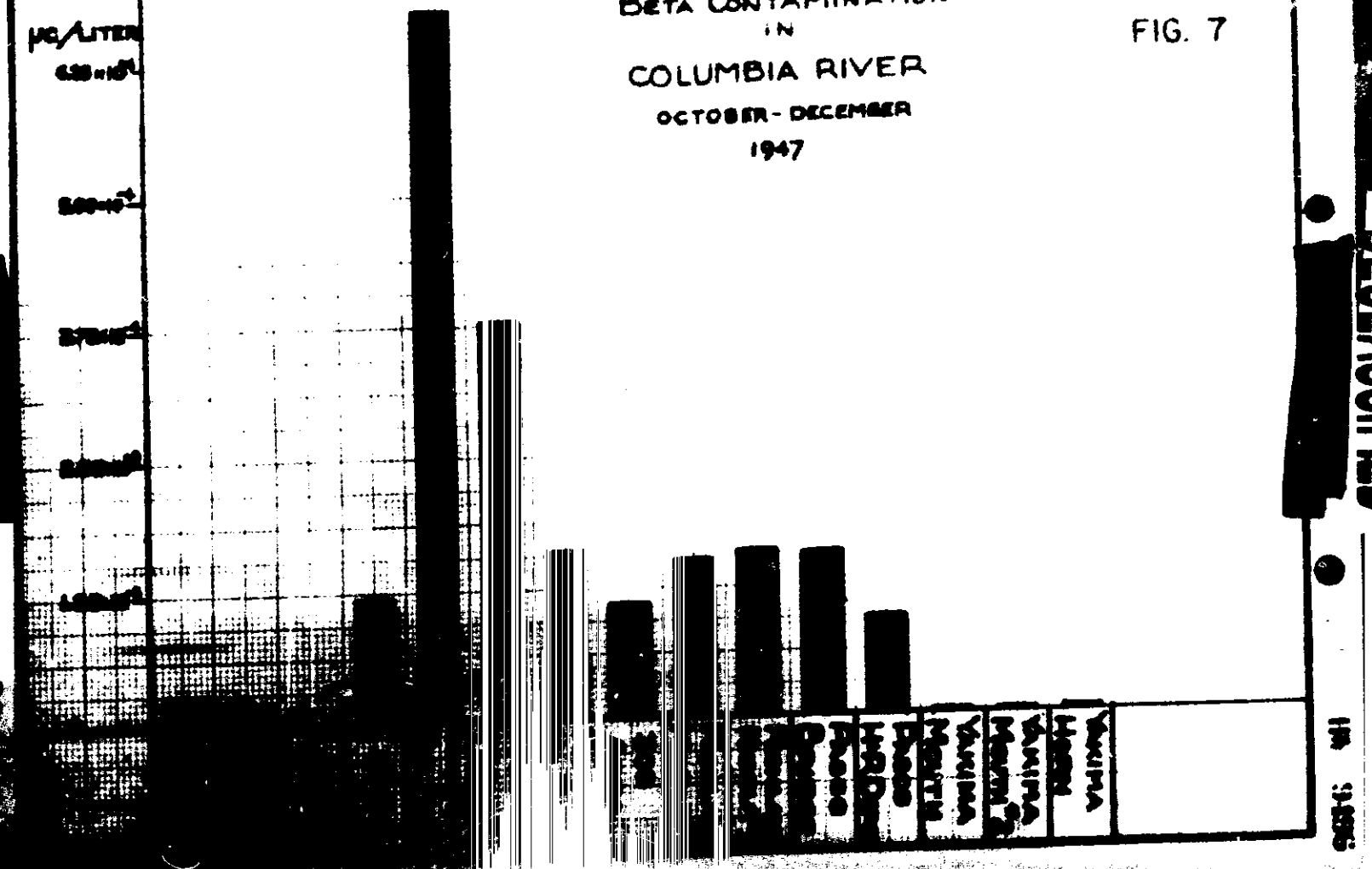


DECLASSIFIED
WITH DELETIONS



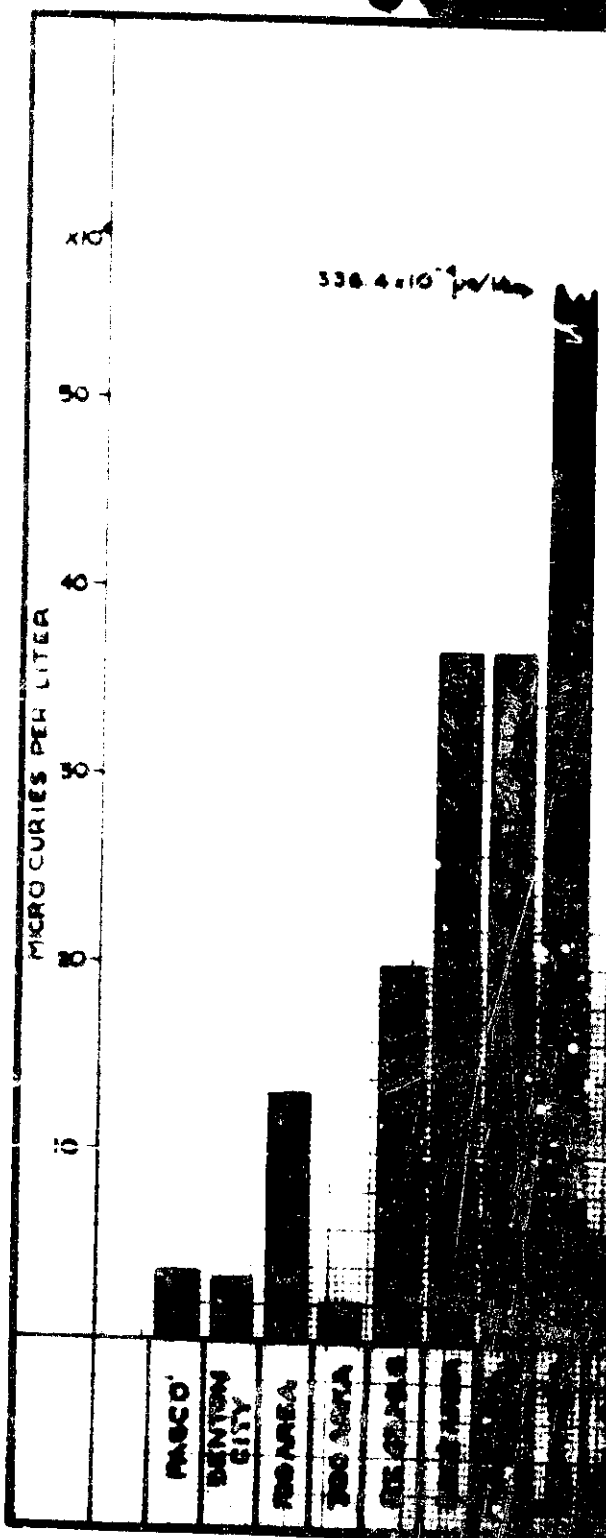
BETA CONTAMINATION
IN
COLUMBIA RIVER
OCTOBER - DECEMBER
1947

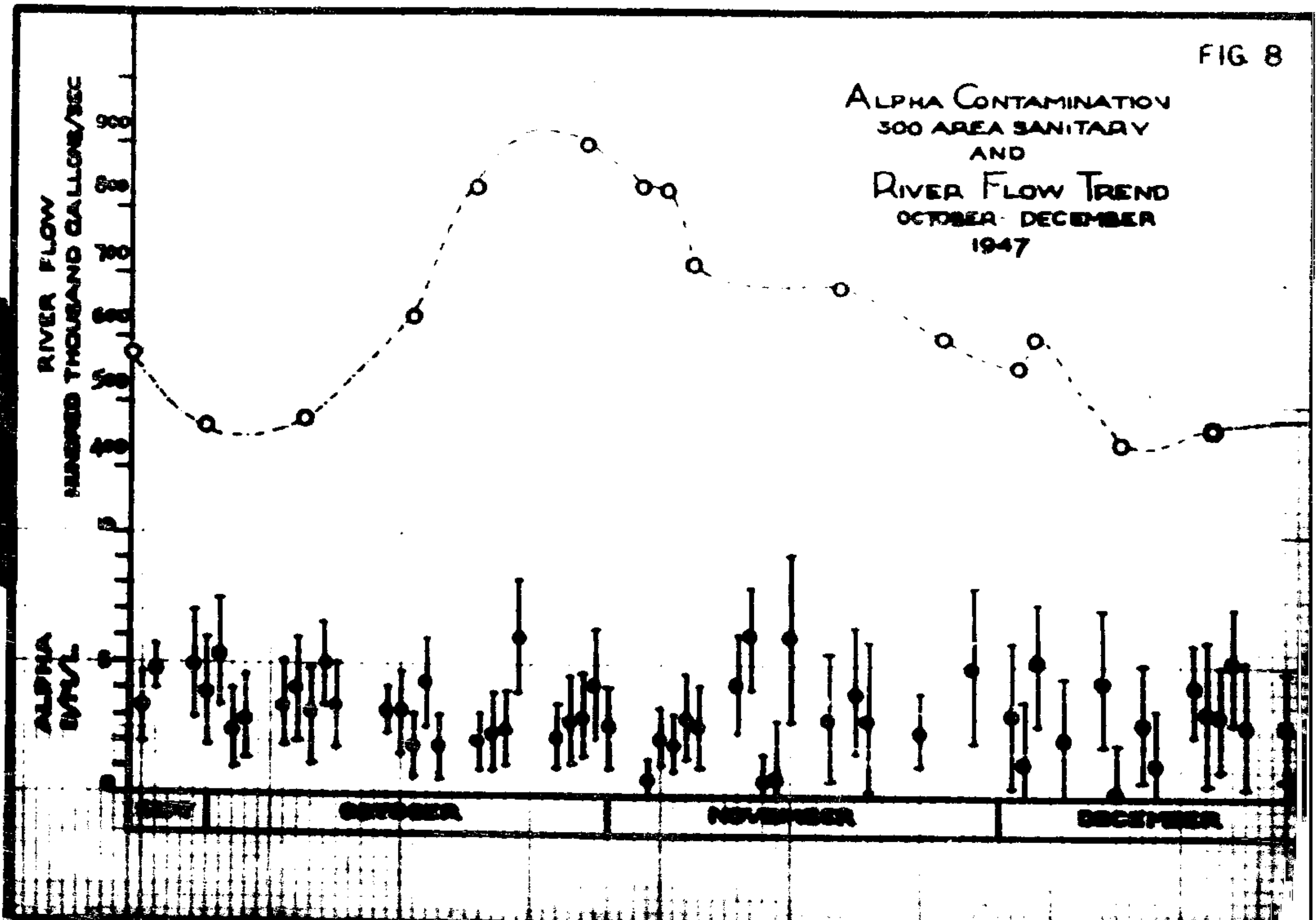
FIG. 7

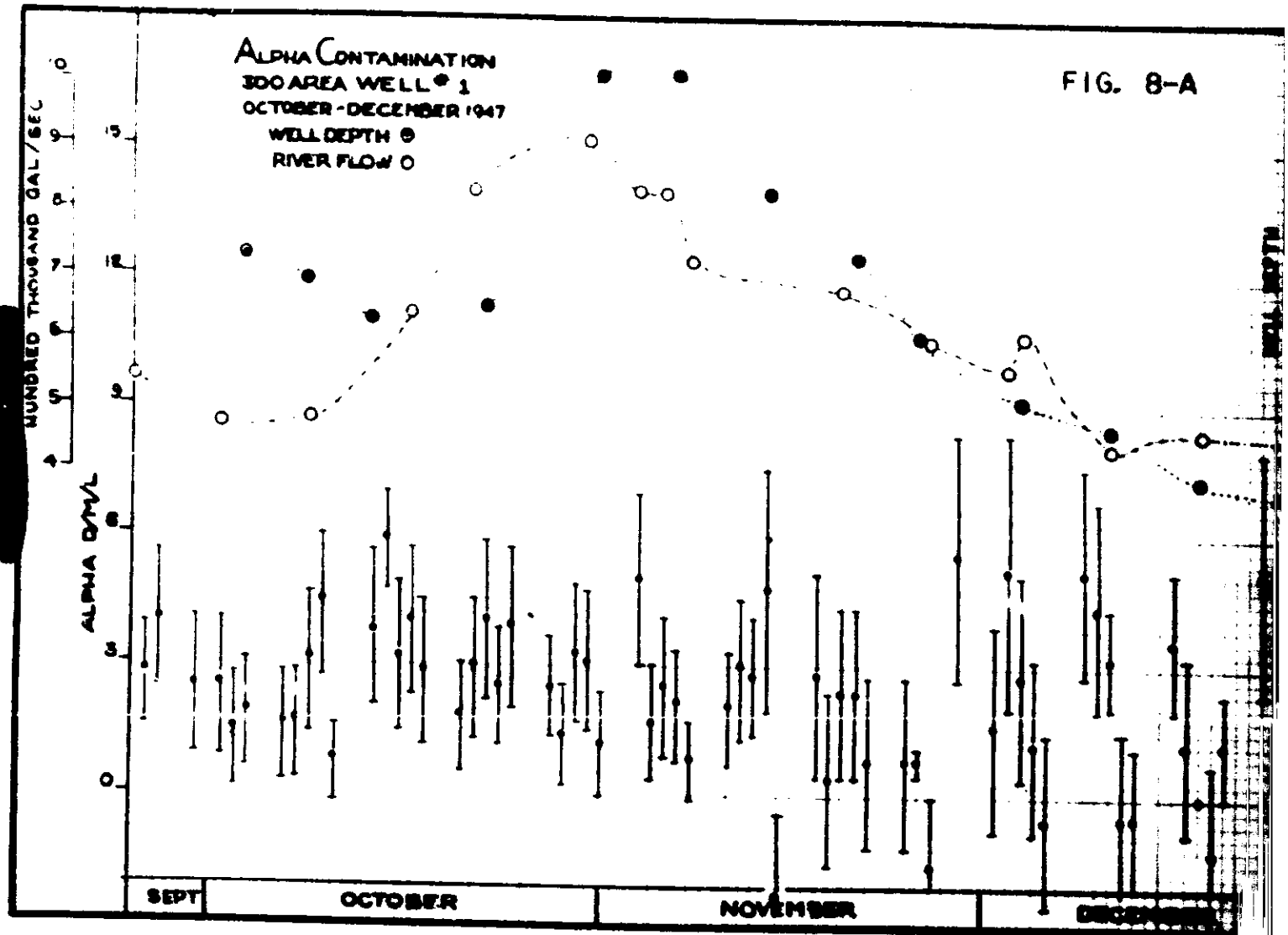


FIG

EXTENT BETA ACTIVITY
IN
RAIN
AT
HANFORD WORKS & VICINITY
OCTOBER - DECEMBER
1947







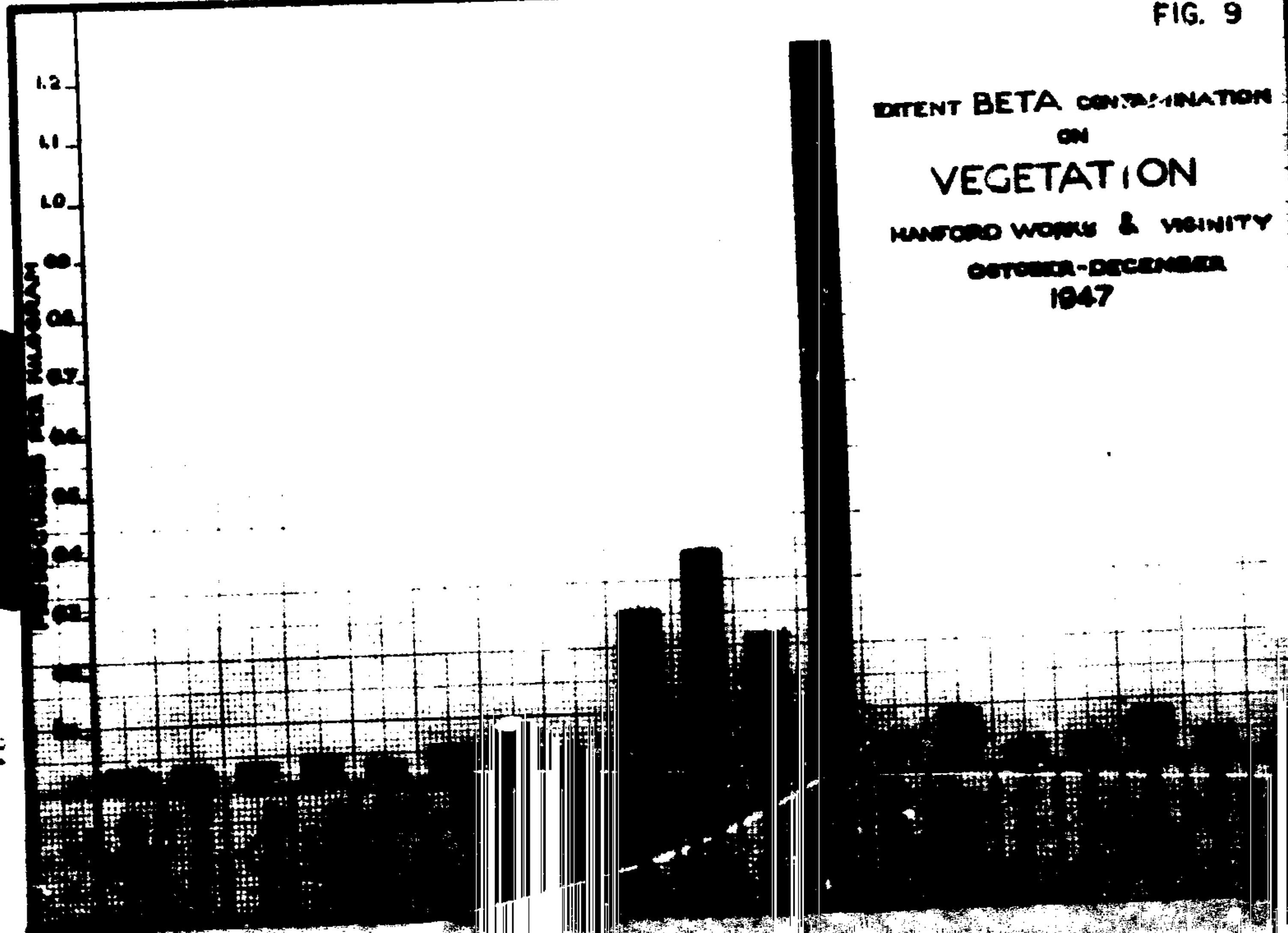


FIG. 9

EXTENT BETA CONTAMINATION
ON
VEGETATION
HANFORD WORKS & VICINITY
OCTOBER-DECEMBER
1947

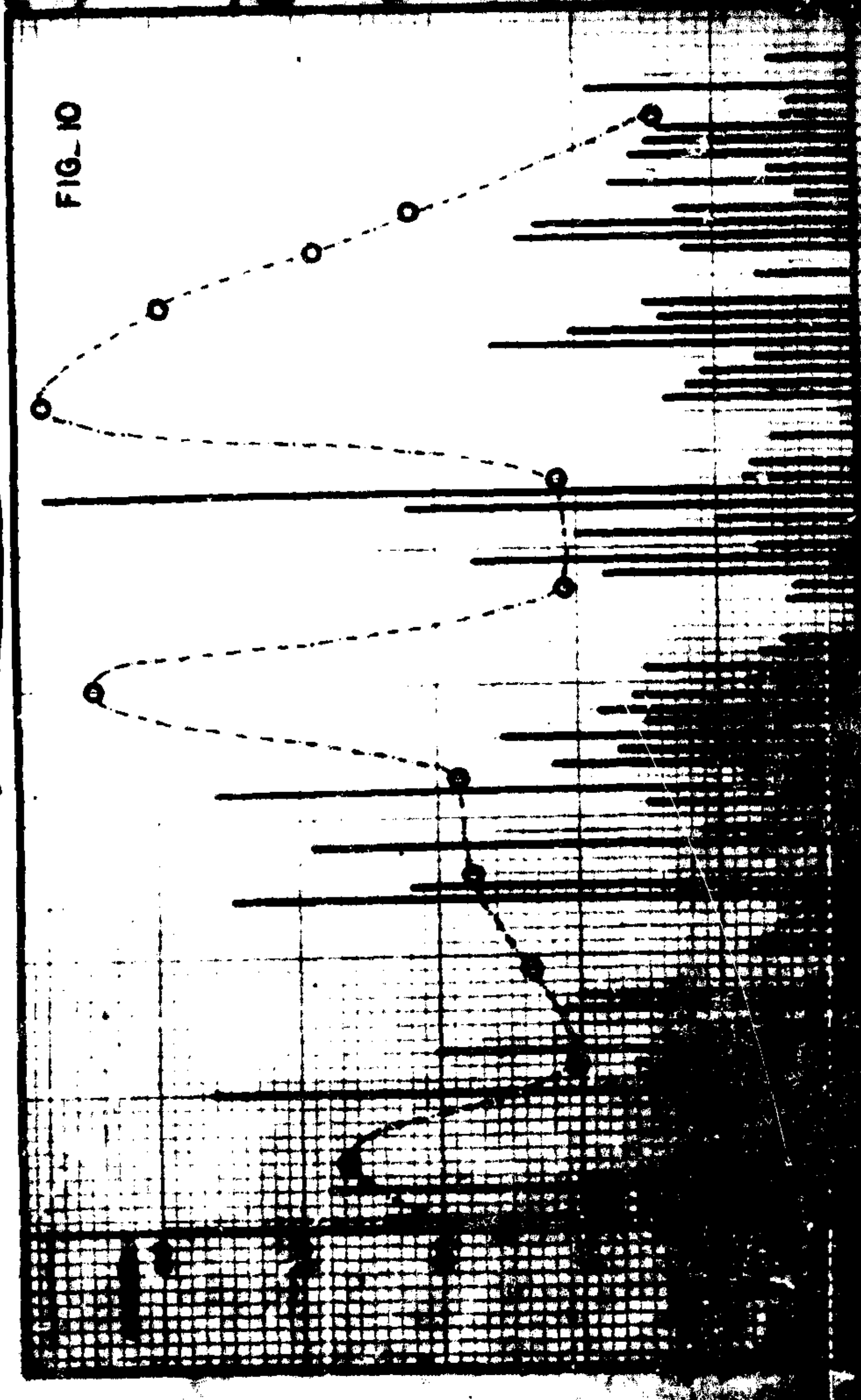


FIG_10