A preliminary analysis of THE SPREAD OF THE DEPRESSION

W. R. Tobler

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"The progress of business cycles was surprisingly slow, a little over half a mile daily on the average."

A. Lösch

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The closure of banks at the time of the depression can be regarded as an economic innovation which diffused throughout our society, culminating in the national bank holiday. The propagation of such events would seem likely to reveal the structure of the system. One may postulate that the general organization of the society has not changed in the last forty years, although the banking industry has been modified in its details. One would expect that technological innovations in today's society spread in a manner analagous to bank closures in that earlier period, probably at a somewhat accelerated rate.

The data, listed in the appendix, include the date of closure of individual banks, and the latitude, longitude, and population of the towns in which these banks were located, as reported during a six month period. There are thus 714 observations. This is quite inadequate, but even this was difficult to obtain, the normal scientific situation.

The extensive geographical literature on innovation diffusion suggests two types of hypotheses. There is the neighborhood contact process so adequately described by Hägerstrand. Then there is the pattern of spread through the central place hierarchy. Probably both processes are

involved. In the first instance, one attempts to estimate the parameters of a stochastic version of the classical diffusion equation,

$$\frac{\partial B}{\partial t} = \kappa\left(\frac{\partial^2 B}{\partial x^2} + \frac{\partial^2 B}{\partial y^2}\right) \quad .$$

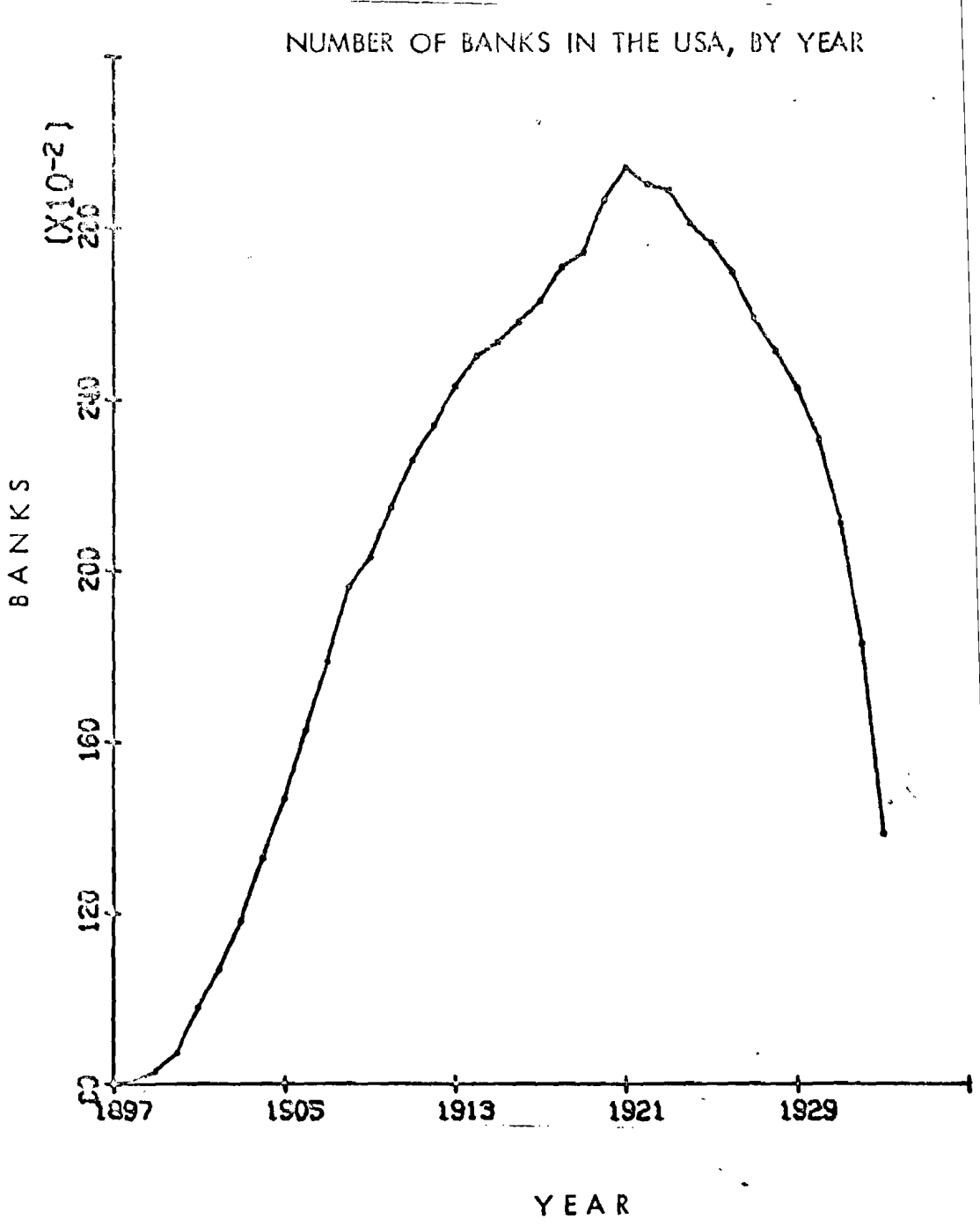
There is also epidemiological literature which takes this tack and which may be relevant; each bank closure may be considered an event in the spread of an "epidemic". There are many possible analogies here: only the worst cases are reported, there is probably an incubation period, etc. Unfortunately, the population at risk is not well known. Apparently nobody bothered to count the number of banks in the United States. In many cases the data do include the date of reopening of the banks. One might thus wish to test a version of the wave hypothesis:

$$\frac{\partial^2 B}{\partial t^2} = \kappa\left(\frac{\partial^2 B}{\partial x^2} + \frac{\partial^2 B}{\partial y^2}\right) \quad .$$

The idea being that the financial shock wave passes on with some finite velocity. Examination of the data reveals a pattern of simultaneous bank closures on most days which tends to complicate the analysis.

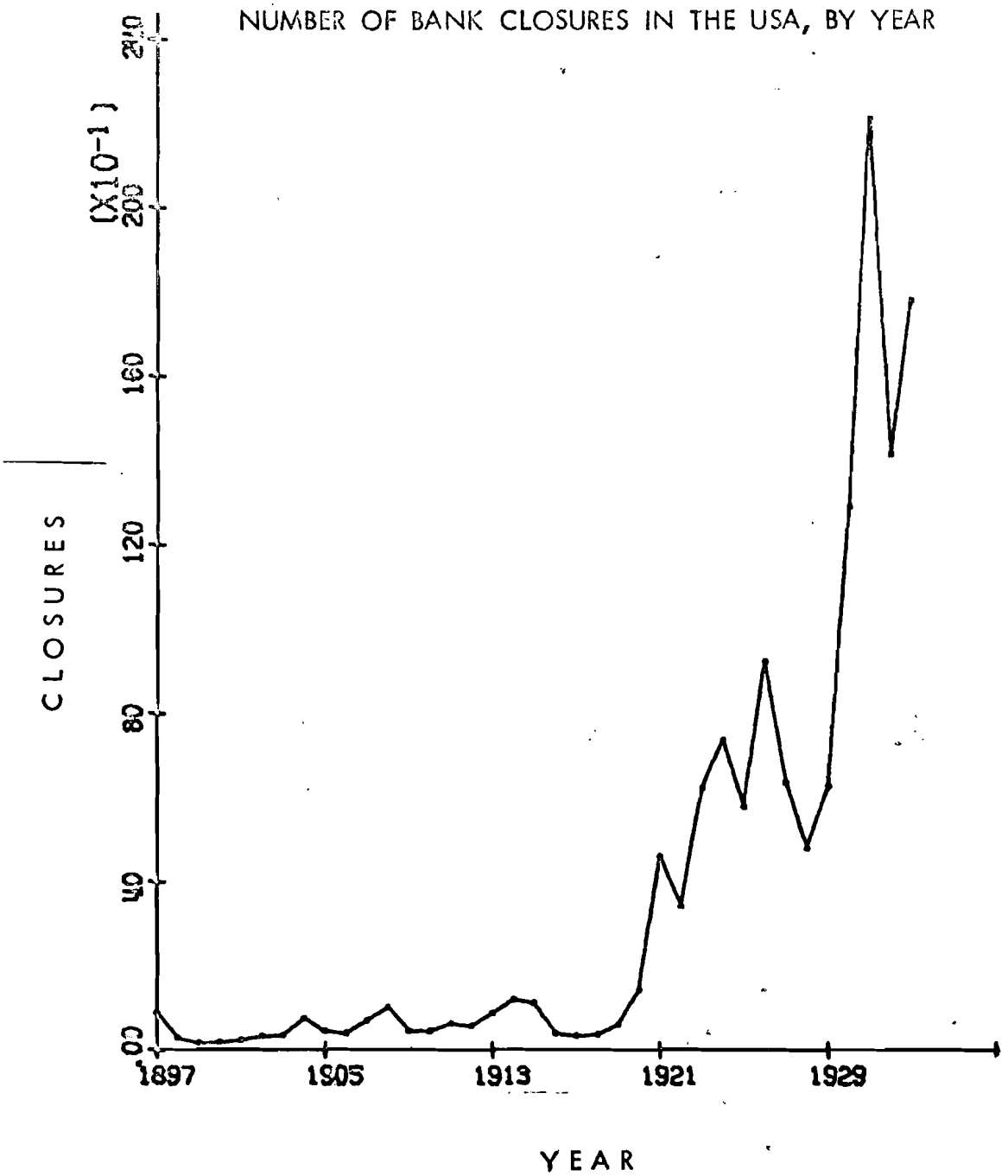
The hierarchical model asserts that events propagate from high order central places to their lower order neighbors. The most detailed models are those suggested by Hudson. Evidence for this hypothesis might be revealed, inter alia, by the occurance of bank closures at larger places before closures at smaller neighboring places. Presumably this would correspond, at least roughly, to the relations within the banking industry.

Only crude tests of both types of hypotheses are presented here. Figures I and II show that the present data, with the detailed locations of the banks, covers only a small portion of the event. The next figures illustrate the geographical spread. These maps do not show a strong directional movement during the short time period for which we have data. Viewing the same data on a cathode ray tube in the correct temporal sequence -- a simulated movie, or dynamic cartography -- also does not leave one with the impression of simple spatial spread. A linear regression suggests a westward movement of 0.84 km per day, and a northward movement of 0.40 km per day, consistent with Lösch's statement, but the correlations are too low to be important (r^2 = 7%, approximately, in both cases). Nor is any trend relating city size and the date of bank closure discernable. A similar conclusion is reached for the 156 banks for which both opening and closing dates are observed. The only strong correlation which emerged was that the earlier a bank closed, the longer it stayed closed. This strong (r^2 = 72%, n = 156) linear relation presumably measures the marginality of these enterprises. The data have not been examined for any particularistic effects as might be observed from looking at the detailed inter-industry connections, nor has a test for spatial randomness been applied.



Source: Upham and Lamke, 1934.

FIGURE I



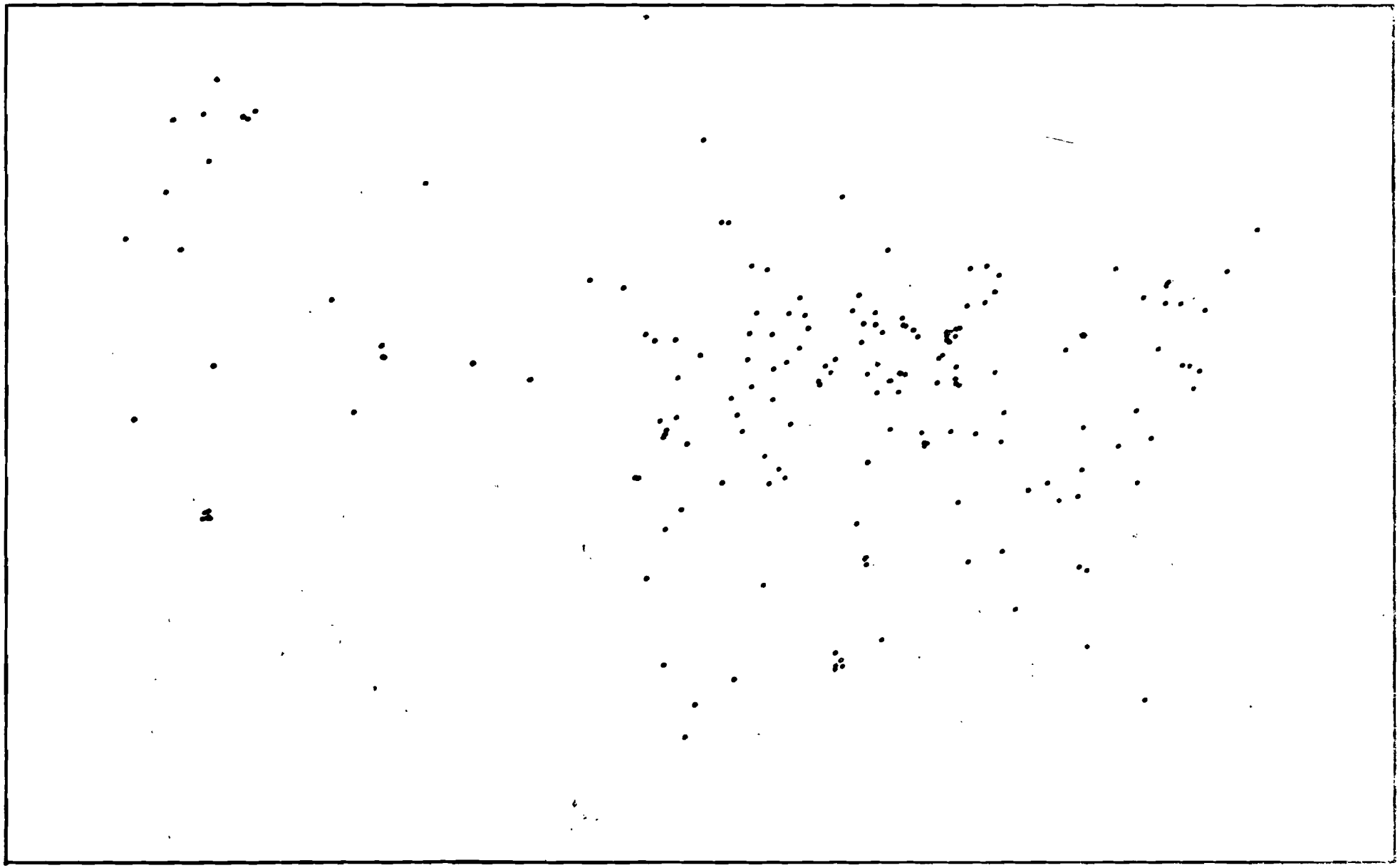
Source: Upham and Lamke, 1934

FIGURE II

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS

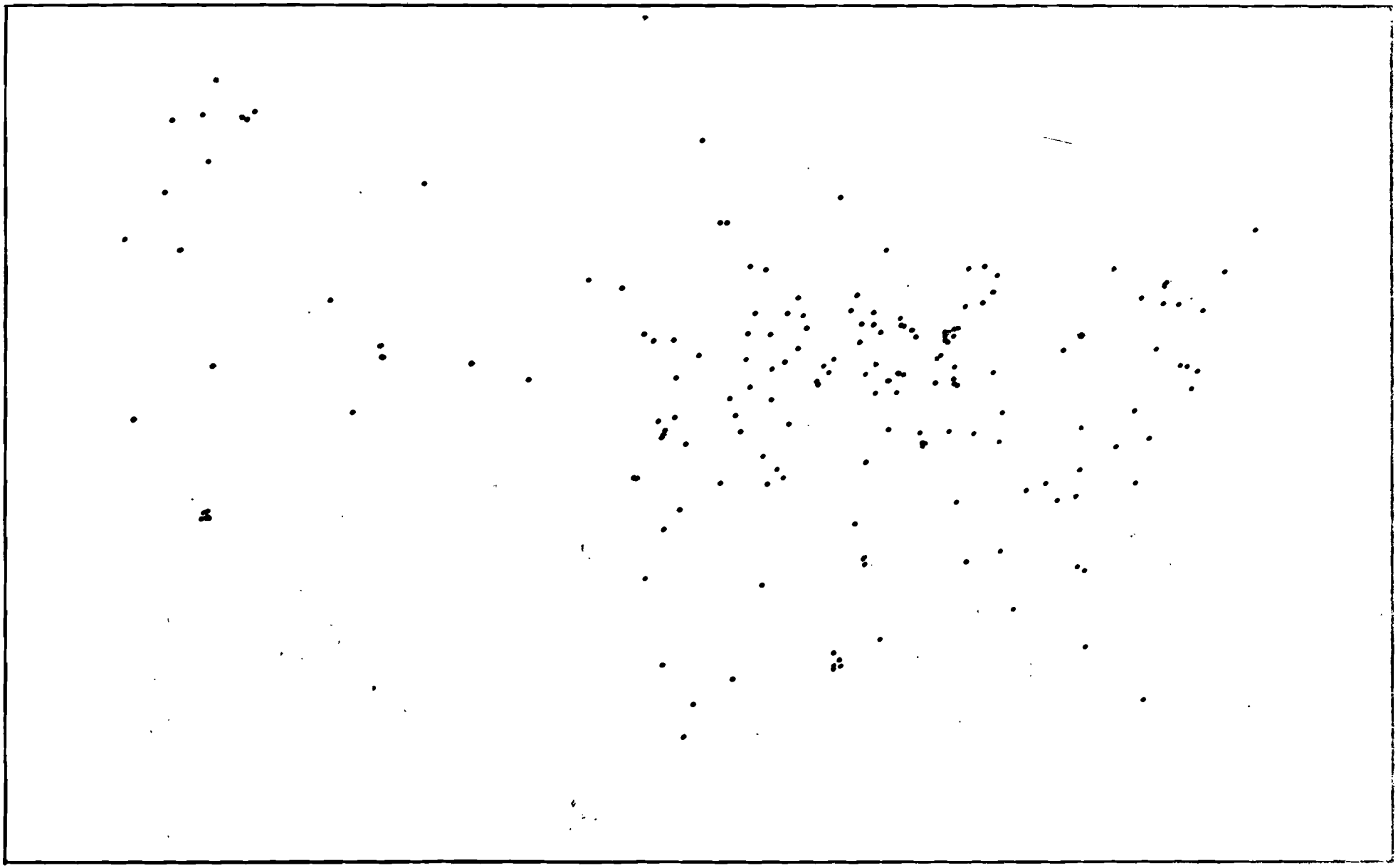
SEPTEMBER 1931 THROUGH DECEMBER 1931 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



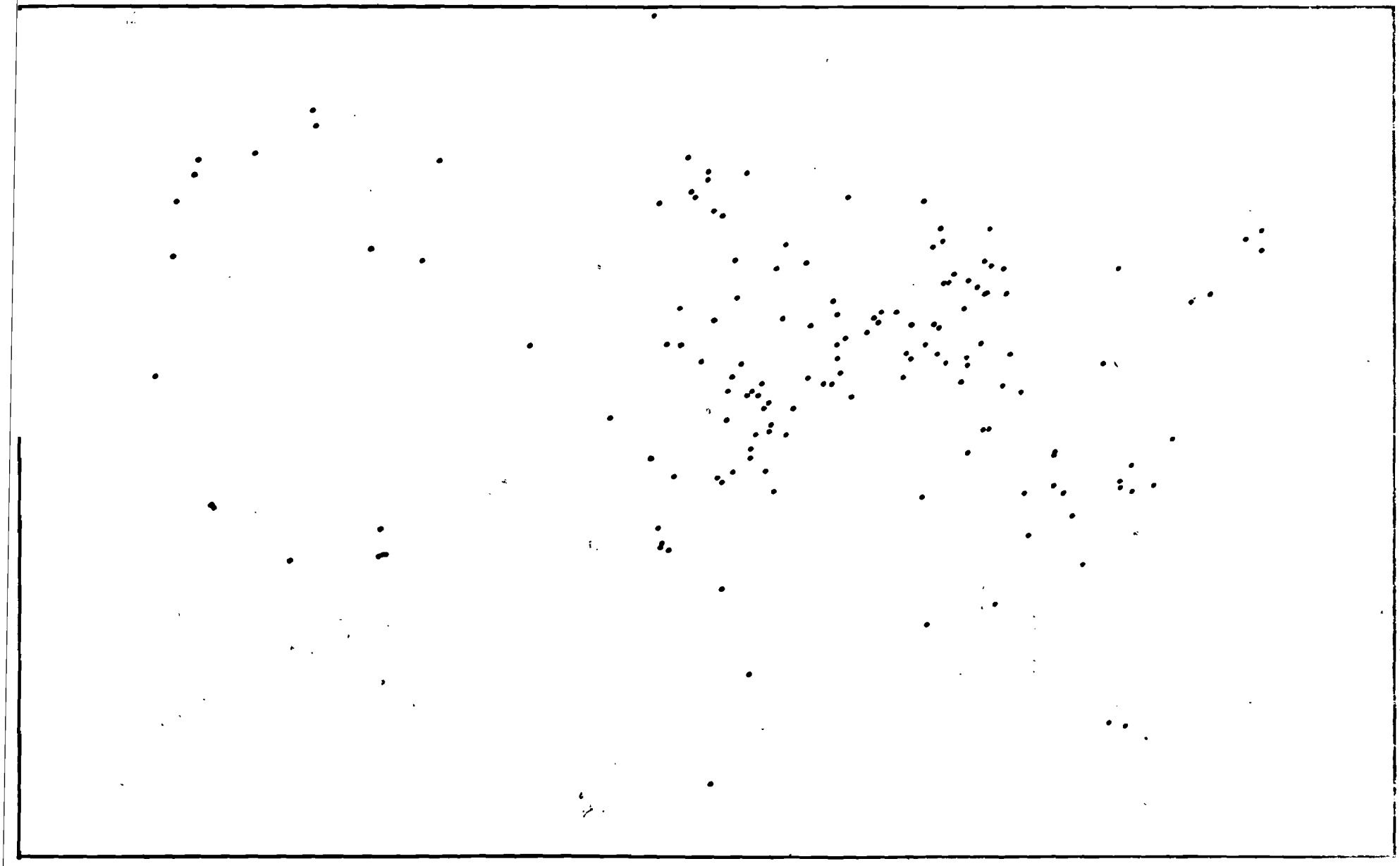
JANUARY 1932 THROUGH FEBRUARY 1932 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



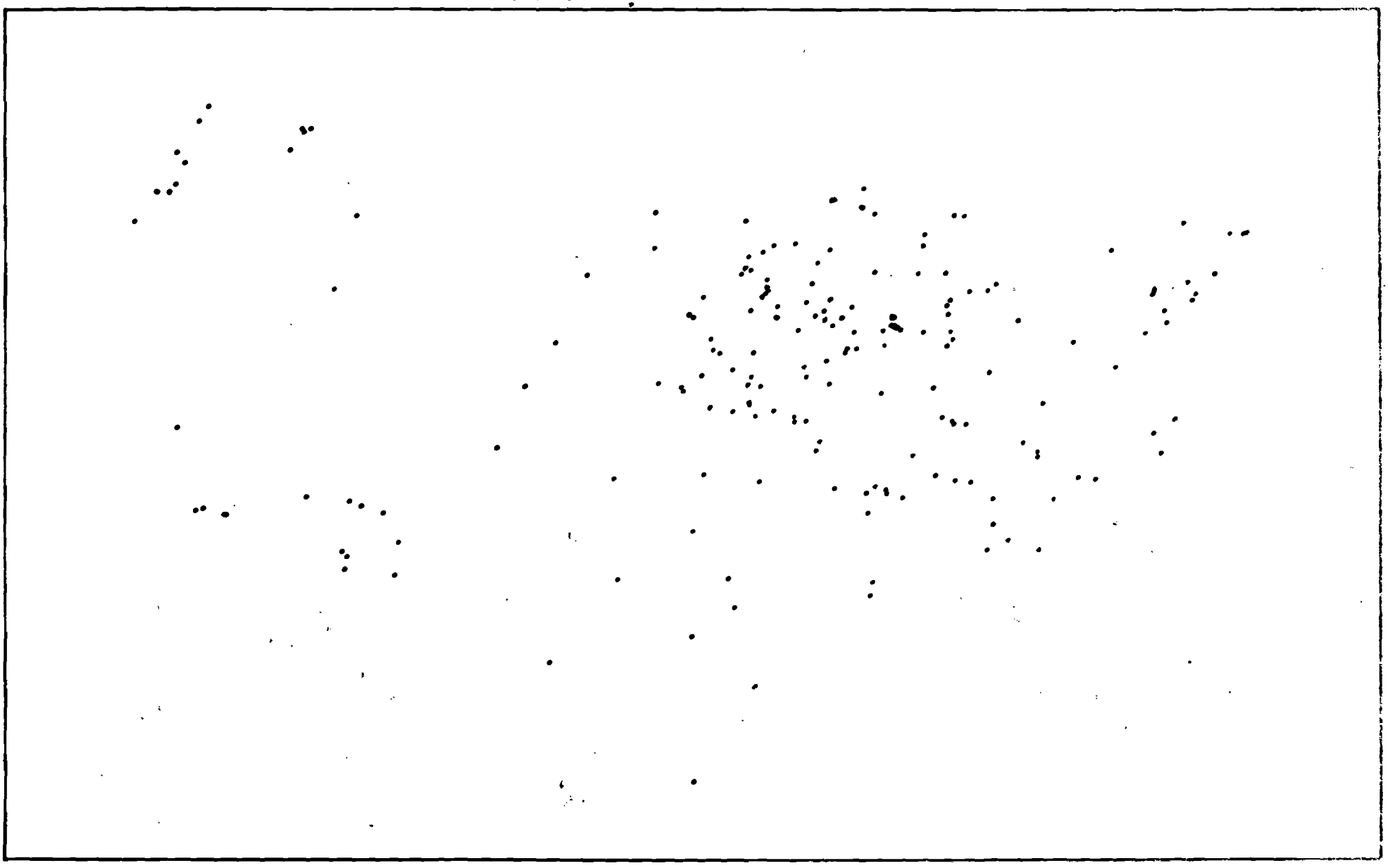
JANUARY 1932 THROUGH FEBRUARY 1932 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



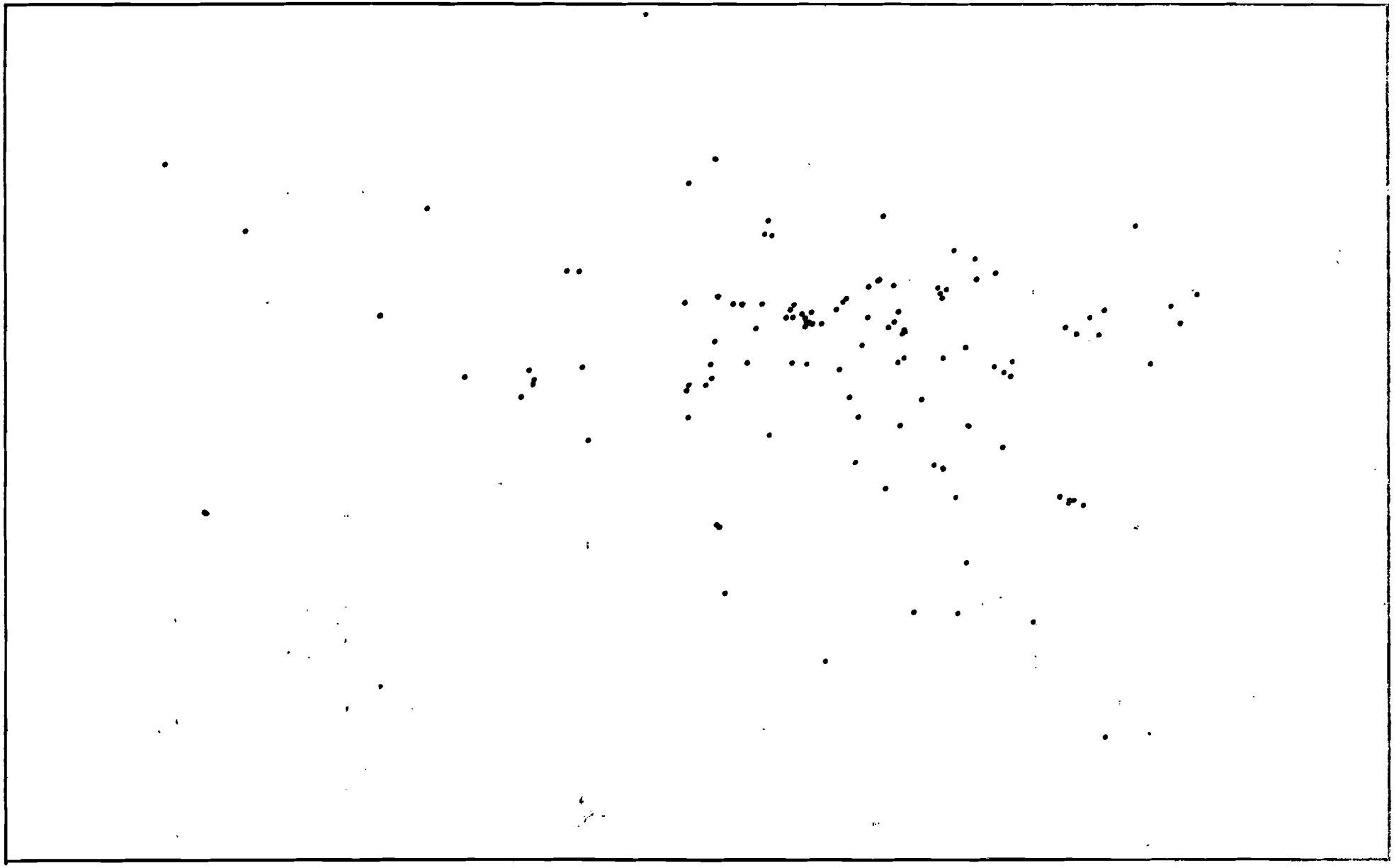
MARCH 1932 THROUGH APRIL 1932 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



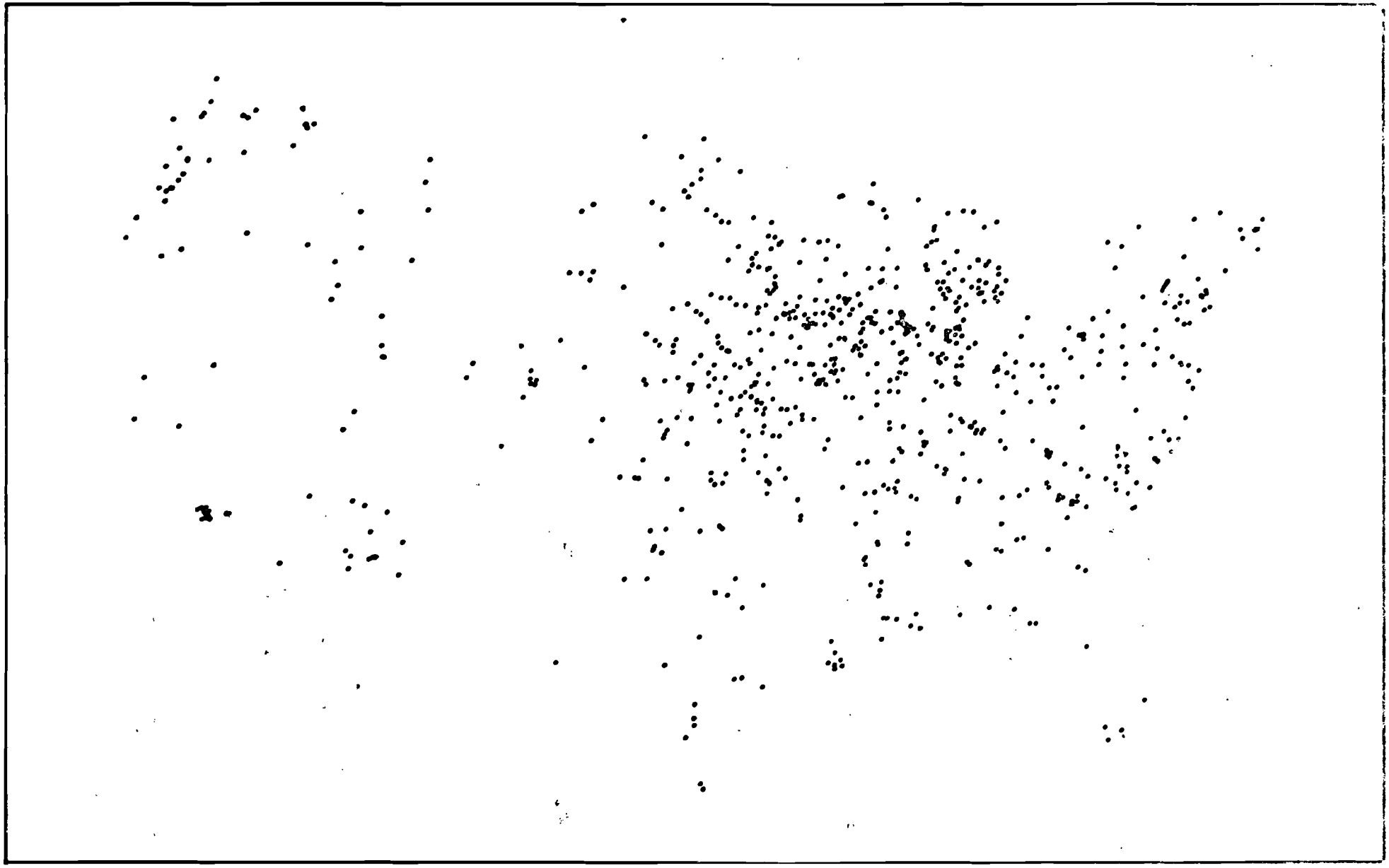
MAY 1932 THROUGH JUNE 1932 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



JULY 1932 BANK CLOSURES

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS



SEPTEMBER 1931 THROUGH JULY 1932 BANK CLOSURES

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DATA APPENDIX

Dates and locations of bank closings are taken from:

Polk Co., Monthly Bulletin, supplemental to Polk's Bankers Encyclopedia, Polks Bank Information Service, 75th ed., no 6, (August 1932), pp. 4 - 21; "Reported Consolidations, Liquidations, Changes of Title, etc."

This source was locatyd by H. Woods Bowman of the Federal Reserve Bank of Chicago, and to whom I wish to acknowledge this debt. Copies covering other time periods have not been located. Latitude and longitude and 1930 census populations were added and the detail coding was done by H. Dupree and J. Kahimbaara, students at the University of Michigan. Bank closures without dates, or in towns which could not be located were omitted. Partial support was received under National Science Foundation Grant GS 34070X.

KEY

A) Number of days from 1 January 1931 to closing of bank
B) Number of days closed, if reopening date known.
C) Number of days from 1 Jan. 1931 to reopening. 900 = reopening not noted.
D) 1930 population
E) Arbitrary sequence number, corresponds to position in Polk
F) X, Y map projection coordinates in kilometers
G) Latitude and longitude, in decimal degrees
H) Date of bank closing
I) Date of bank reopening, if known
J) Name of town, state

(3I3, I7, I3, 2F6.0, F6.3, F8.3, 2(A2,A4), 5A4, I3)

[illegible]	2240334	432.	00.00.000	-00.000	[illegible]	[illegible]	[illegible]
-1450044[illegible]	1546751	671.	467.43.733	-90.267	DEC13	APR30ELROY	WI
8422430	703330	795.	-43.30.083	-89.383	JAN 9	MAR [illegible]CHESTER	IL
2853055[illegible]	2814743	1436.	-112.39.633	-91.833	JAN29	JUL11NEW MARTINSVILLE	WV
5034830[illegible]	30251750	875.	402.43.750	-87.733	FEB10	FEB 2SHEBOYGAN	WI
1623054[illegible]	730530	256.	575.44.050	-95.350	JUN11	APR11CLARA CITY	MN
1652911[illegible]	1229757	1260.	670.44.767	-89.700	JUN15	MAR21MOSINEE	WI
1702254[illegible]	9539749	570.	593.44.933	-91.383	JUN29	FEB 8CRIDDEMA FALLS	WI
1833045[illegible]	1231509	1265.	362.42.033	-93.283	JUL 2	JUL30FLAT ROCK	NC
1913611[illegible]	916535	304.	529.44.517	-94.717	JUL10	JUN25FAIRFAX	MN
1953285[illegible]	3171507	1219.	434.42.783	-83.700	JUL14	JUN 6FENTON	MI
2021053[illegible]	1988761	605.	559.44.467	-90.033	JUL21	FEB 1STANLEY	WI
2222644[illegible]	2140066[illegible]	216.	165.41.283	-96.000	AUG10	APR30OMAHA	NE
2333255[illegible]	4671494	1057.	511.43.683	-85.483	AUG21	JUL11BIG RAPIDS	MI
2332534[illegible]	1546750	671.	467.43.733	-90.267	AUG21	APR30ELROY	WI
2342775[illegible]	469449	1070.	410.42.783	-85.500	AUG22	MAY25CALEDONIA	MI
2422044[illegible]	551840	1074.	384.40.917	-75.117	AUG31	MAR21PORTLAND	PA
2451814[illegible]	1183759	762.	490.43.250	-89.117	SEP 2	MAR 1PRINCETON	WI
2483015[illegible]	2554500	1230.	517.43.483	-93.383	SEP 5	JUL 2CAPE	MI
2541466[illegible]	349446	1202.	-154.37.650	-84.950	SEP11	FEB 4PERRYVILLE	KY
2602214[illegible]	3300702	874.	-344.36.333	-88.850	SEP17	APR15MARTIN	TN
2611694[illegible]	755525	1254.	276.42.217	-89.383	SEP19	MAR 5ROBBINS	MI
2691444[illegible]	308451	-207.	740.44.417	-102.550	SEP25	FEB14REGENT	ND
2711414[illegible]	967482	1747.	184.39.700	-79.183	SEP28	FEB16HANCOCK	MD
2731434[illegible]	2907445[illegible]	1391.	-32.38.450	-82.633	SEP30	FEB20ASHLAND	KY
2732095[illegible]	495616	1988.	535.42.150	-74.517	SEP30	JUL15FLETSCHMANNS	NY
2742785[illegible]	60751404	666.	218.41.517	-90.567	OCT 1	JUL 5DAVENPORT	IA
2751444[illegible]	253768	723.	176.41.100	-80.967	OCT 2	FEB23LAFAYETTE	TN
2761213[illegible]	288456	1941.	146.38.983	-76.150	OCT 3	FEB 1QUEENSTOWN	MD
2782405[illegible]	4892678	1753.	265.40.383	-77.917	OCT 5	JUN 1MOUNT UNION	PA
2791544[illegible]	572330	733.	149.40.850	-80.883	OCT 5	MAR 7BRIDGEFIELD	TN
2791424[illegible]	1459731	1751.	62.38.650	-78.450	OCT 6	FEB25LURAY	VA
2811183[illegible]	315495	1071.	120.38.700	-75.900	OCT 8	FEB 3PRESTON	MD
2811754[illegible]	11560423	462.	223.41.700	-93.033	OCT 8	MAR31NEWTON	IA
2827300[illegible]	494647	-108.	1003.48.933	-100.033	OCT 9	FEB 1DUNSEITH	ND
2822185[illegible]	3592614	2008.	278.39.950	-75.050	OCT 9	MAY14MERCHANTVILLE	NJ
283 65348	4806712	85.	-1272.28.400	-97.733	OCT10	DEC14REEVILLE	TX
2832655[illegible]	2493744	1455.	27.38.400	-81.350	OCT10	JUL 1SPENCER	WV
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2994057[illegible]	3478583	477.	-54.39.217	-93.050	OCT26	DEC 5SLATER	MO
2992435[illegible]	3516574	359.	-58.39.233	-94.417	OCT26	JUN25 IRERTY	MO
2991244[illegible]	341822	820.	-878.31.633	-90.017	OCT26	FEB27SILVER CREEK	MS
2991334[illegible]	306323	-1309.	514.43.333	-114.717	OCT26	MAR 7FAIRFIELD	TN
3032495[illegible]	400801	1664.	166.39.700	-79.150	OCT31	JUL 5GRANTSVILLE	MD
3032564[illegible]	2464477	618.	-969.30.950	-92.183	OCT31	JUL12BUNKIE	LA
3031234[illegible]	236798	858.	-263.37.067	-88.933	OCT31	MAR 1KEVIL	KY
306 92[illegible]	115344	884.	-214.37.483	-88.583	NOV 2	FEB 2FRUITVILLE	TN
3062125[illegible]	1184352	894.	-226.37.367	-88.483	NOV 2	JUN 1GOLCONDA	IL
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