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A Preliminary Analysis of the Spread of the Depression

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IIASA Working Paper

WP-75-076

1975

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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W. R. Tobler

The closure of banks at the time of the depression can
be regarded as an economic innovation which diffused through-
out 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 some-
what 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,

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

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:

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

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.

NUMBER OF BANKS IN THE USA, BY YEAR

BANKS (×10⁻²)
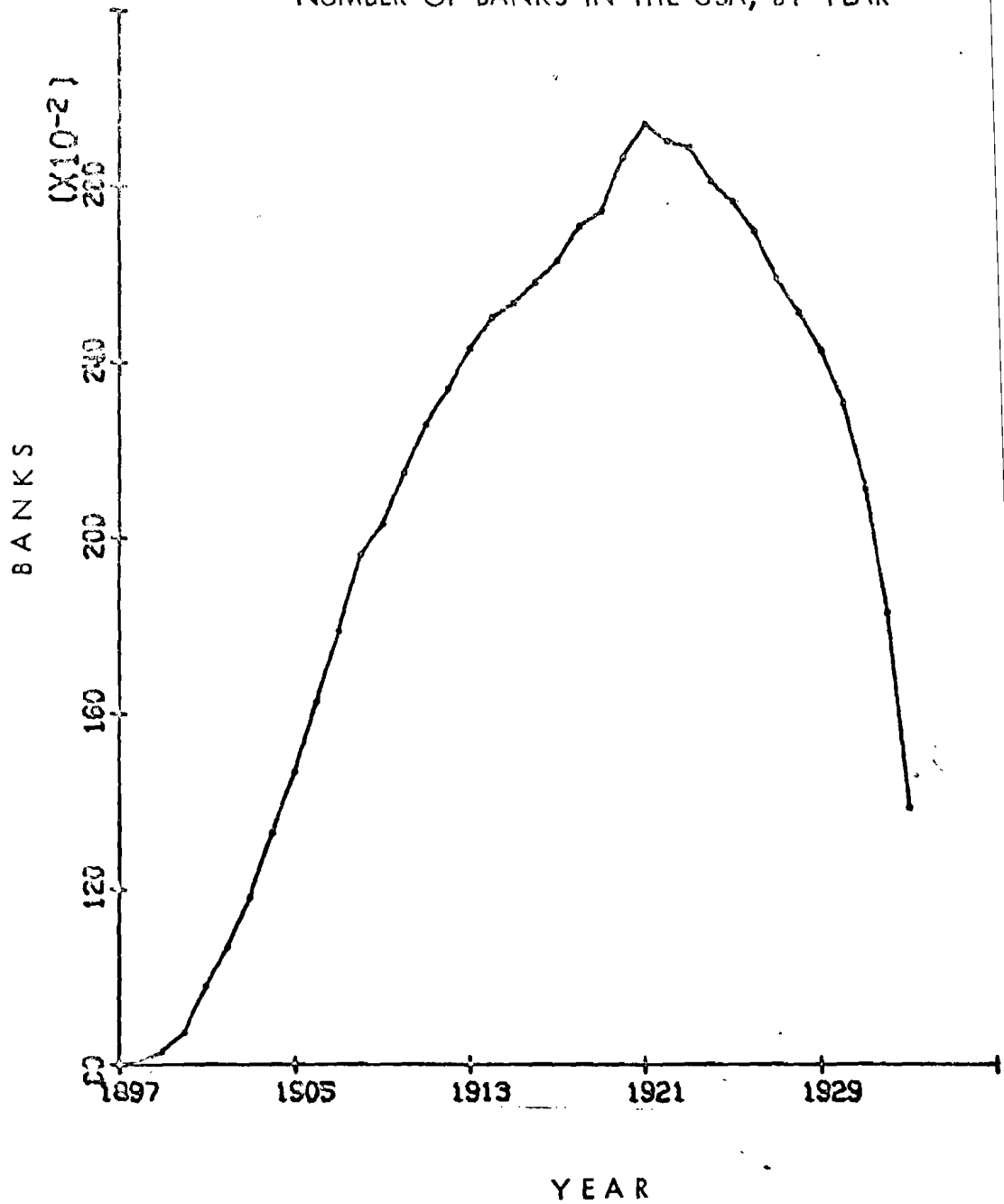
YEAR

Source: Upham and Lamke, 1934.

FIGURE I

NUMBER OF BANK CLOSURES IN THE USA, BY YEAR

YEAR
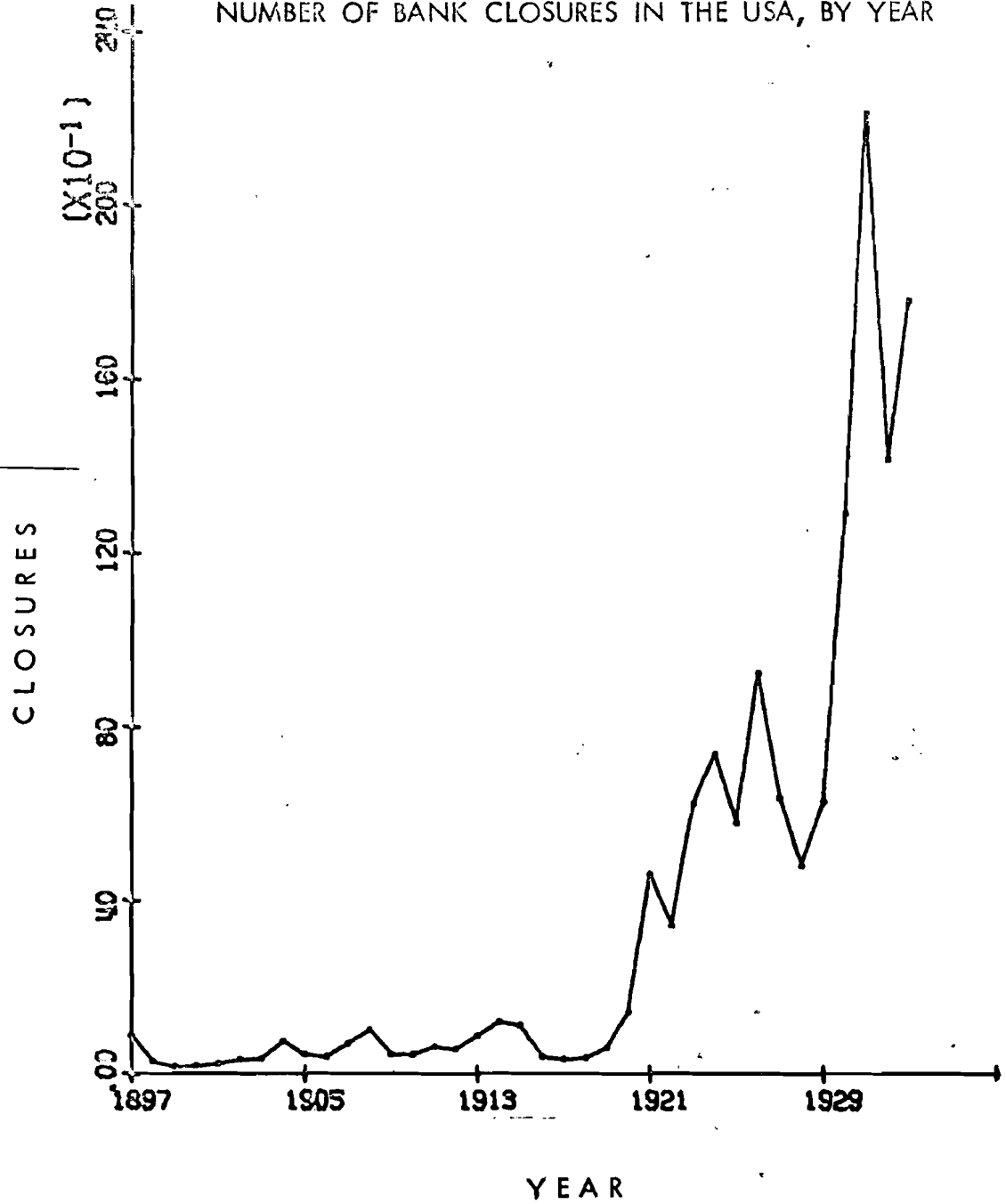
Source: Upham and Lamke, 1934

FIGURE II

GEOGRAPHICAL ARRANGEMENT OF BANK CLOSINGS
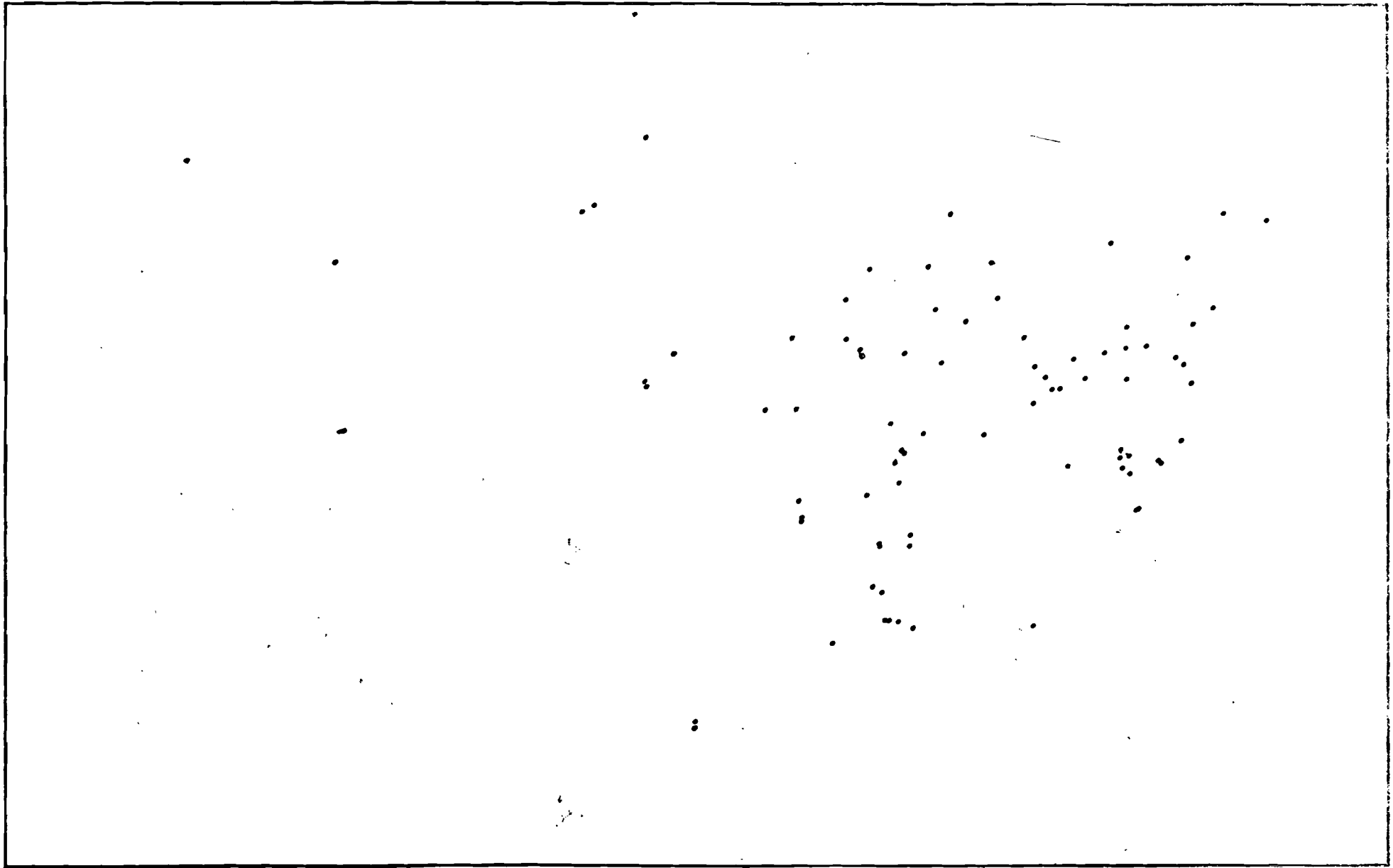
SEPTEMBER 1931 THROUGH DECEMBER 1931 BANK CLOSURES

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
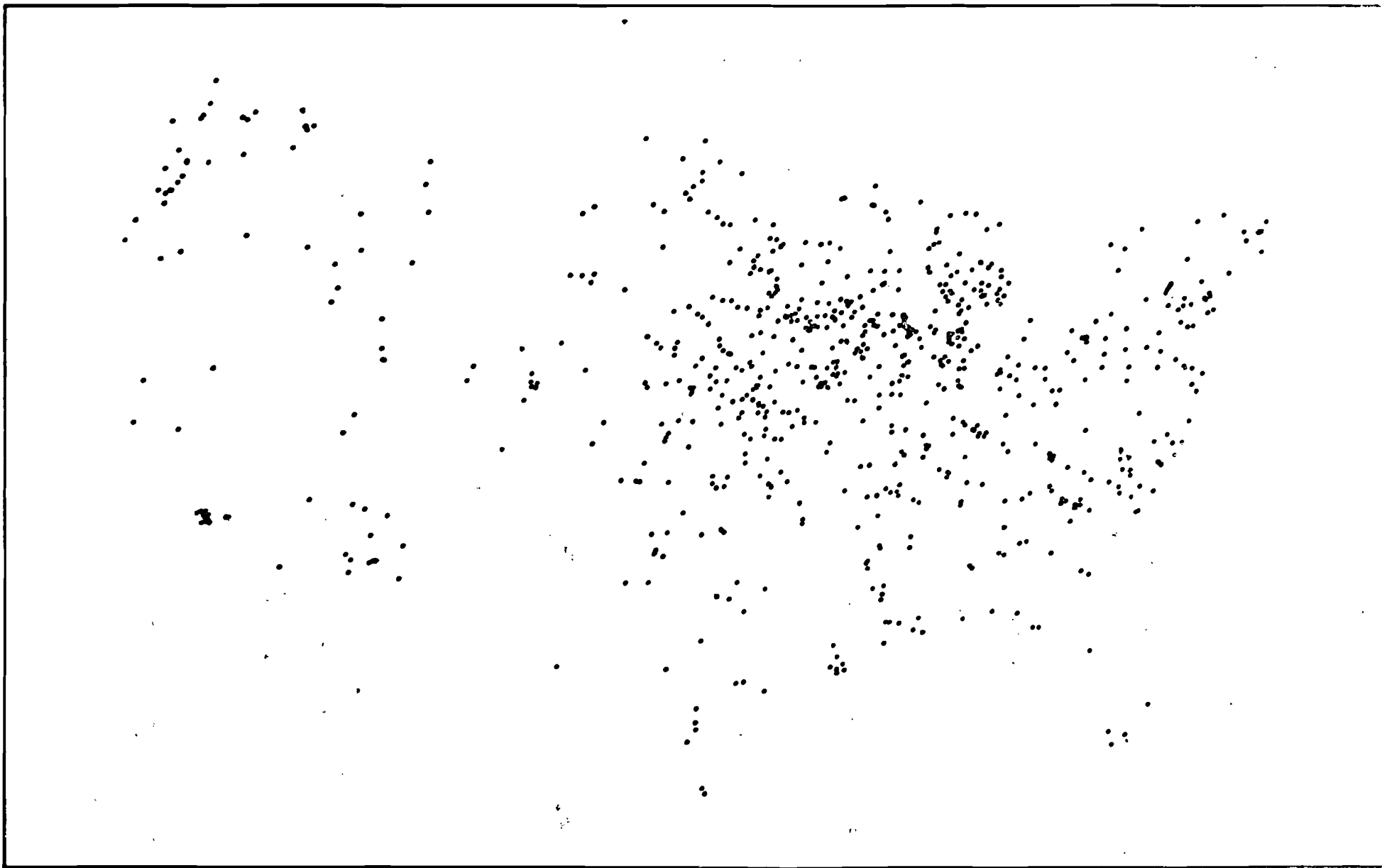
SEPTEMBER 1931 THROUGH JULY 1932 BANK CLOSURES
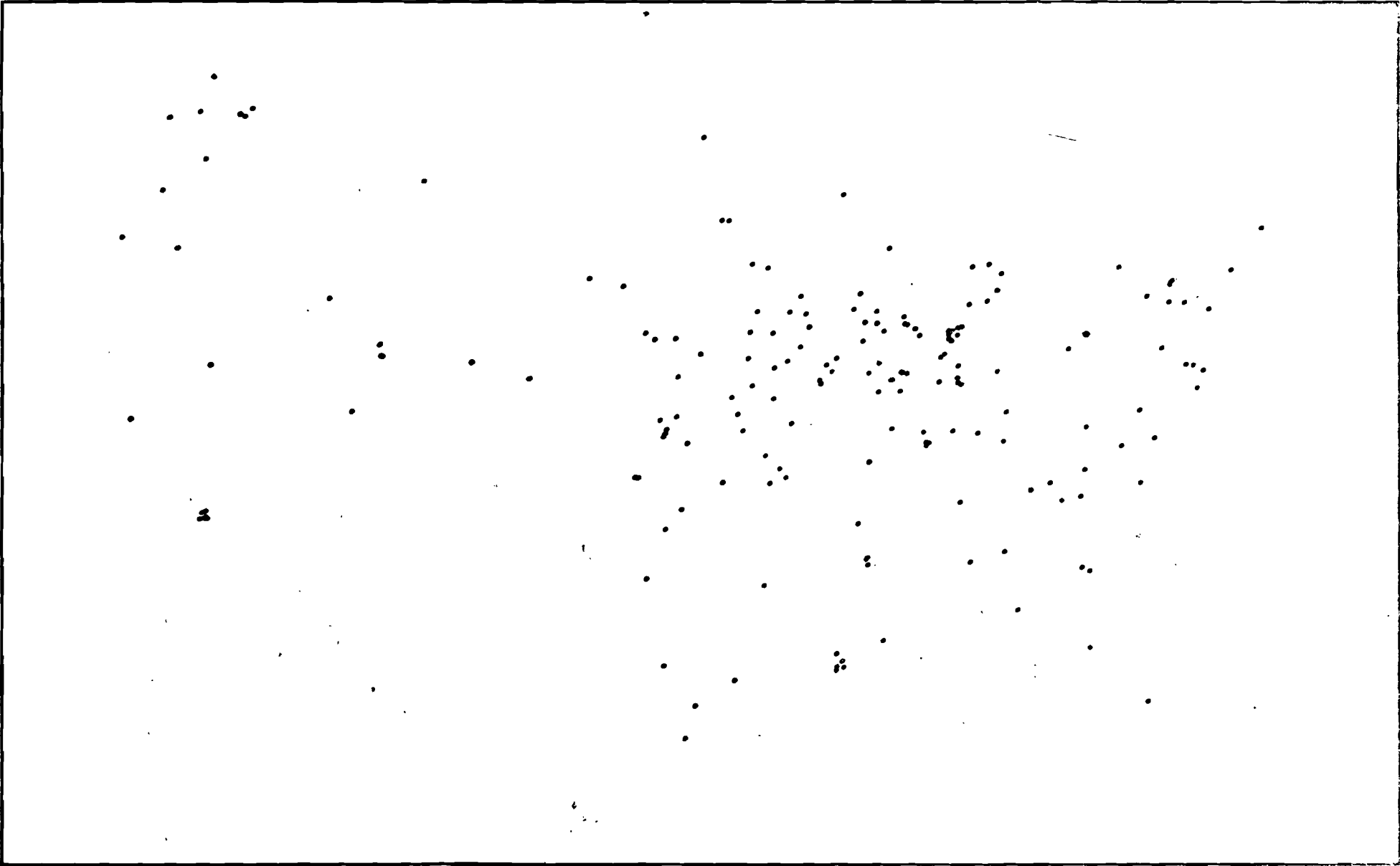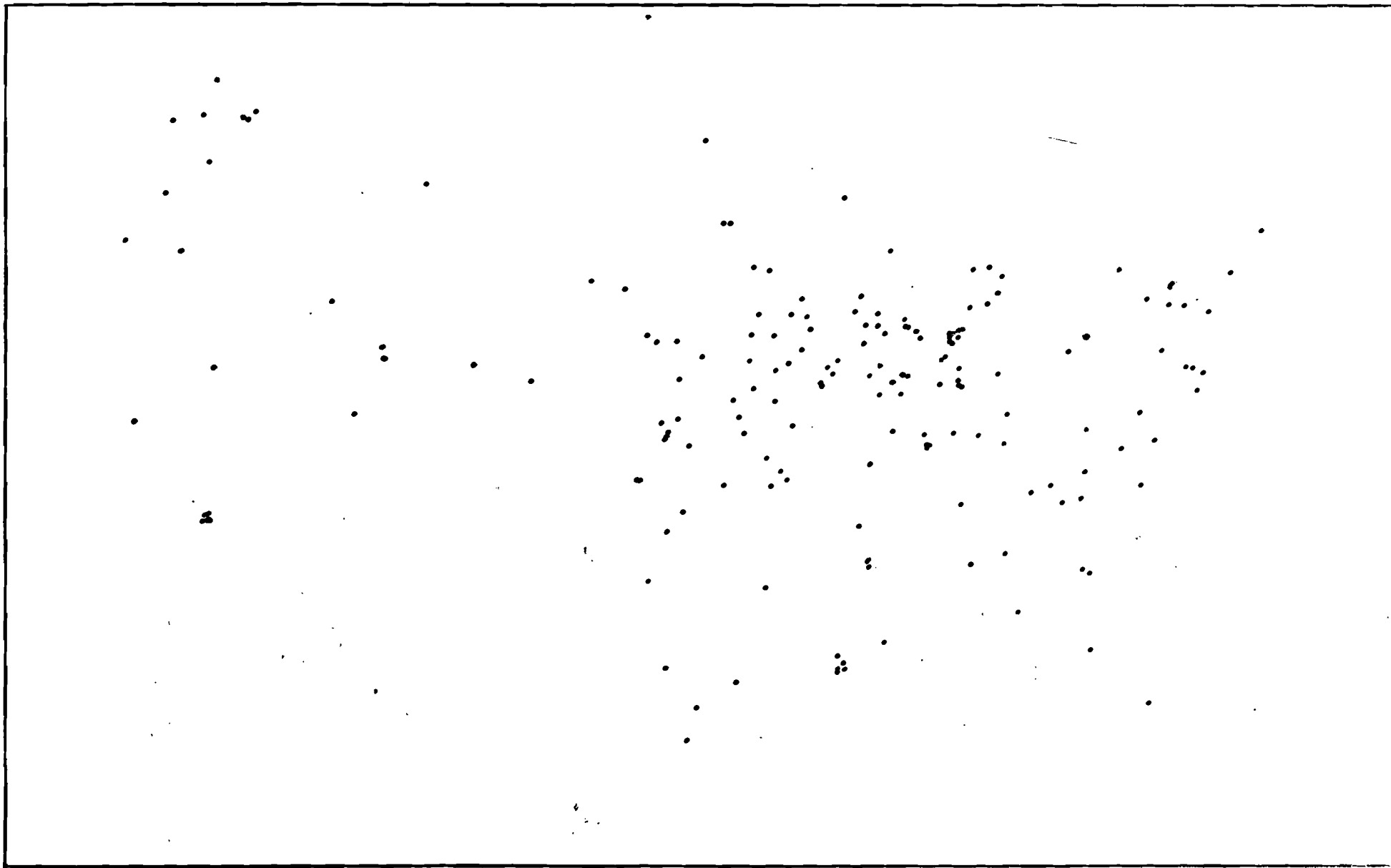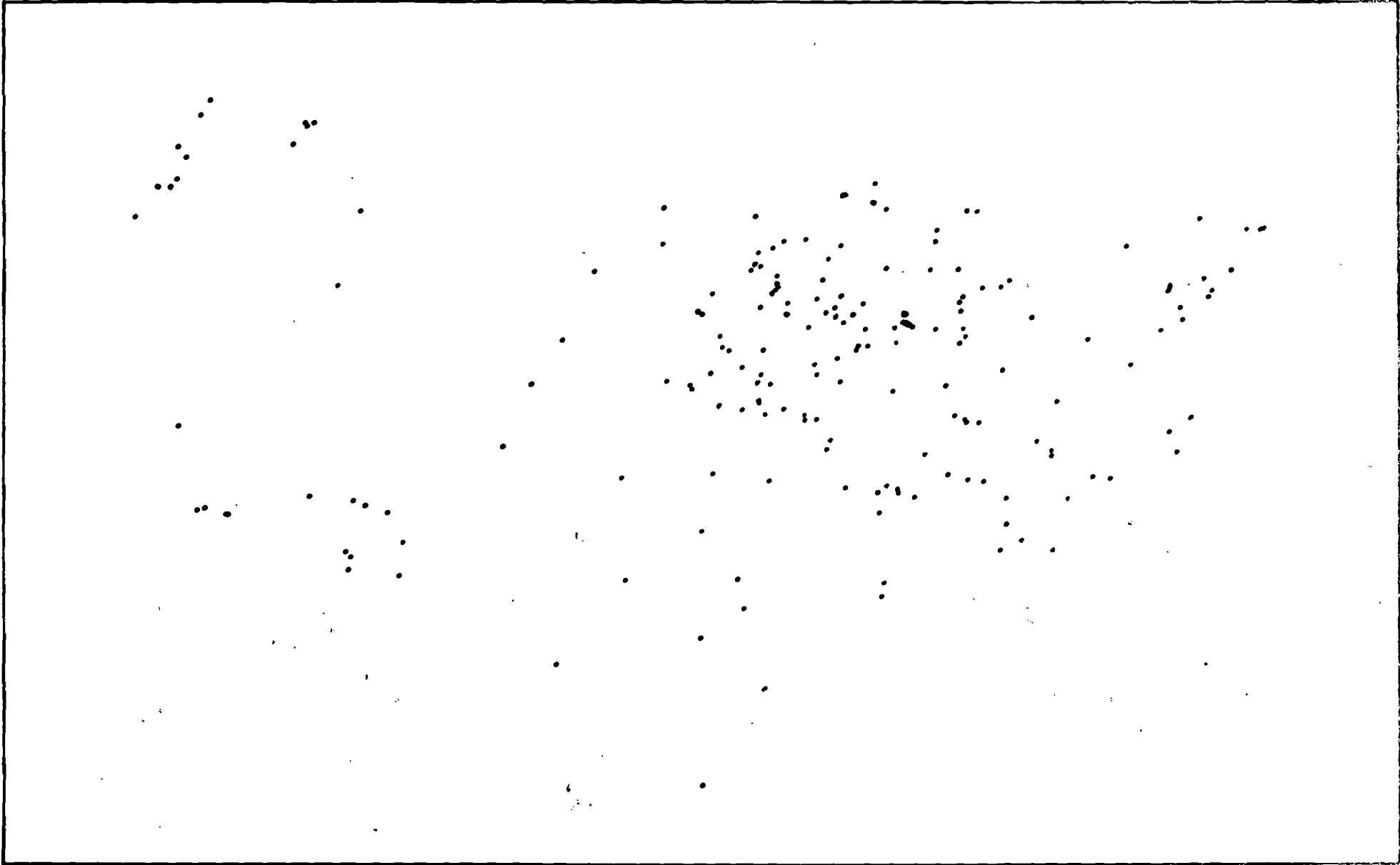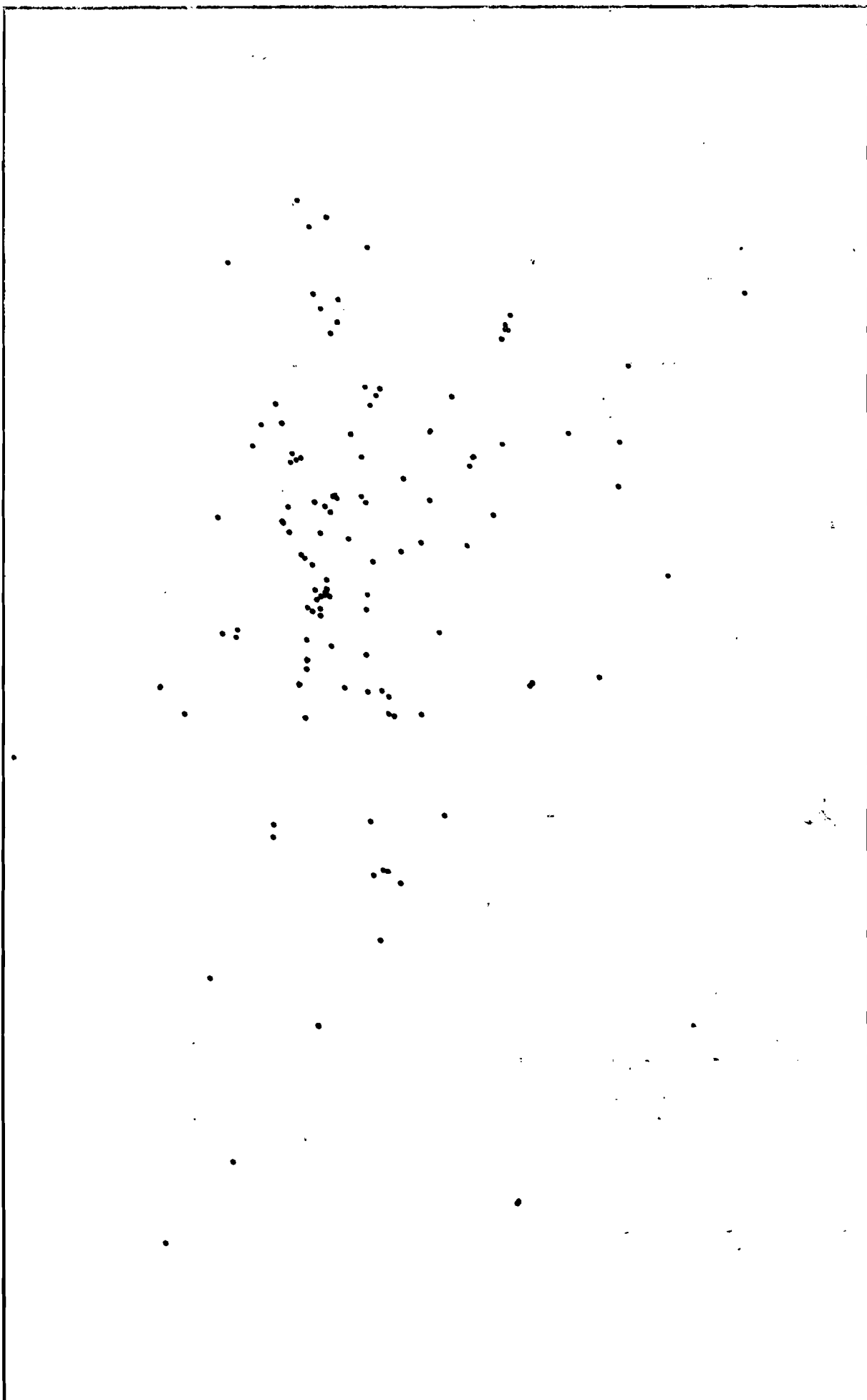
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DATA APPENDIX

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)

-325.22.400	2240334	632.	00.40.400	-01.133	MAY20	MAY 20ANTRACR	IL
-145.04.426	1546751	671.	467.43.733	-90.267	DEC12	APR30FLRHY	WI
94.22.430	703330	705.	-43.39.083	-80.303	JAN 9	MAY 9CHIEFFEN	IL
245.30.553	2814743	1425.	-112.39.633	-01.822	JAN29	JUL11NEW MARTINSVILLE	WV
502.48.308	302517750	875.	492.43.750	-87.733	FEB19	FEB 2SHEBOYGAN	WI
162.505467	730520	256.	575.44.050	-05.350	JUN11	APR11CLARA CITY	MN
165.201444	1229757	1260.	670.44.767	-82.700	JUN15	MAR21MOSINEE	WI
170.225404	9539740	570.	593.44.933	-01.385	JUN20	FEB 8CHIPPEWA FALLS	WI
193.204577	1231504	1265.	362.42.003	-93.283	JUL 2	JUL30FLAT ROCK	WI
191.261542	916535	303.	529.44.517	-04.717	JUL 10	JAN25FAIRFAY	IA
195.328522	3171507	1218.	434.42.783	-83.700	JUL 14	JUN 6BENTON	WI
202.105307	1988761	605.	549.44.467	-06.033	JUL21	FEB 1STANLEY	WI
222.264426	214006603	316.	165.41.283	-96.000	AUG10	APR30OMAHA	NE
233.325550	4671494	1057.	511.43.683	-85.483	AUG21	JUL11BIG RAPIDS	MI
233.253496	1546750	671.	467.43.733	-09.267	AUG21	APR30FLRHY	WI
234.277511	469494	1070.	410.42.783	-85.500	AUG22	MAY25CALEDONIA	MI
243.204444	551840	1072.	384.40.917	-75.117	AUG31	MAR21PORTLAND	PA
245.181424	1183755	762.	490.43.250	-89.117	SEP 2	MAR 1PRINCETON	WI
248.301549	2554500	1230.	517.43.483	-83.283	SEP 5	JUL 2CARO	MI
254.146400	349449	1202.	-154.37.650	-84.050	SEP11	FEB 4PERRYVILLE	KY
260.221481	3300702	874.	-344.36.333	-88.850	SEP17	APR15MARTIN	TN
261.169430	755525	1254.	276.42.217	-83.383	SEP18	MAR 5ROMULUS	MI
264.144412	308451	-307.	740.44.417	-102.650	SEP25	FEB 1AREGENT	ND
271.141412	647482	1747.	184.35.700	-79.183	SEP28	FEB16HANCOCK	NC
273.143416	24074450	1391.	-32.38.450	-82.633	SEP30	FEB20ASHLAND	KY
273.209562	405616	1958.	535.42.150	-74.517	SEP30	JUL15FLEISCHMANNS	NY
274.278552	60751404	664.	218.41.517	-90.567	OCT 1	JUL 5DAVENPORT	IA
275.144410	253768	722.	176.41.100	-80.967	OCT 2	FEB23LAFAYETTE	IL
276.121307	2488466	1041.	146.38.483	-76.150	OCT 3	FEB 1QUEENSTOWN	MD
278.240518	484267H	1752.	265.40.383	-77.917	OCT 5	JUN 1MOUNT UNION	PA
279.154432	572330	733.	149.40.850	-80.883	OCT 5	MAR 7FAIRFIELD	IL
279.142421	1459731	1751.	62.38.650	-78.450	OCT 6	FEB25URAY	VA
281.118300	315495	1071.	120.38.700	-75.000	OCT 8	FEB 3PRESTON	MD
281.175446	11560423	462.	223.41.700	-93.033	OCT 8	MAR31NEWTON	IA
282.730000	484647	-108.	1003.48.433	-100.033	OCT 9	FEB 1DUNSEITH	ND
282.218500	3592614	2008.	278.39.950	-75.050	OCT 9	MAY14MERCHANTVILLE	NJ
283 65348	4806712	85.	-1272.28.400	-97.733	OCT10	DEC14BEEVILLE	TX
283.265640	2493744	1445.	27.38.400	-81.350	OCT10	JUL 1SPENCER	WV
286.242528	1106544	917.	-546.34.500	-88.633	OCT13	JUL11BALDWYN	MS
287.104481	204653	-353.	713.46.150	-103.133	OCT14	APR25SCRANTON	ND
290.106445	4374741	1500.	67.39.083	-80.217	OCT16	APR29BUCKHANNON	WV
290.188477	5740523	1072.	705.45.367	-84.050	OCT16	APR21PETOSKEY	MI
290.221511	648742	1547.	141.39.700	-80.517	OCT17	MAY25LITTLETON	WV
294.164488	102249340	467.	-150.37.467	-87.567	OCT21	MAY 2EVANSVILLE	IN
299.405704	3478583	477.	-54.39.217	-93.050	OCT26	DEC 5SLATER	MO
299.243542	3516574	359.	-58.39.233	-94.417	OCT26	JUN25LIBERTY	MO
299.124423	341822	820.	-878.31.633	-90.017	OCT26	FEB27SILVER CREEK	MS
299.133432	306323	-1309.	514.43.333	-114.717	OCT26	MAR 7FAIRFIELD	ID
303.249552	400801	1664.	166.39.700	-79.150	OCT31	JUL 5GRANTSVILLE	MD
303.256559	2464477	618.	-969.30.950	-92.183	OCT31	JUL12BURKE	LA
303.123426	236748	858.	-263.37.067	-88.933	OCT31	MAR 1KEVIL	KY
306 02.408	115244	884.	-214.37.483	-88.583	NOV 2	FEB 2EDDYVILLE	IL
306.212514	1184352	844.	-226.37.367	-88.483	NOV 2	JUN 1GOLCONDA	IL
306.105411	29623744	1434.	70.39.267	-81.883	NOV 2	FEB15PARKERSBURG	WV
307.225532	33525657	1355.	225.40.150	-82.517	NOV 3	JUL15MANSFIELD	OH
309.166474	669745	1465.	23.38.617	-81.700	NOV 5	APR19RIPLEY	WV
310.230640	2665372	1131.	269.41.633	-85.000	NOV 6	JUN23ANGOLA	IN
312 074411	3401656	1368.	112.39.700	-82.267	NOV10	FEB15NEW LEXINGTON	OH
314 04465	1017587	717.	-63.39.000	-87.000	NOV12	FEB 4ARAPAHO	OK