

STATE OF ILLINOIS  
WILLIAM G. STRATTON, Governor



**FIRST PROGRESS REPORT  
ILLINOIS COOPERATIVE PROJECT IN CLIMATOLOGY  
I DECEMBER 1954 TO I JULY 1955**

**STANLEY A. CHANGNON, JR.**

**A COOPERATIVE PROJECT  
OF THE  
ILLINOIS STATE WATER SURVEY  
AND THE  
UNITED STATES WEATHER BUREAU**

**DEPARTMENT OF REGISTRATION AND EDUCATION**

**VERA M. BINKS, Director**

**STATE WATER SURVEY DIVISION**

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(Printed by authority of State of Illinois)

**URBANA, ILLINOIS  
I JULY 1955**

## PREFACE

This report discusses the progress of the Illinois Co-operative Project in Climatology between the Illinois State Water Survey and the United States Weather Bureau for the period of 1 December 1954 to 1 July 1955. In this beginning period, the project was concerned with the planning of each phase as well as the initiation of activities.

Planning of the project was based upon the State Water Survey's needs for weather data in a form that could be quickly analyzed as well as the anticipated needs of other state agencies and educational institutions for the same information.

Since the Illinois State Water Survey is located on the campus of the University of Illinois, arrangements were made with the University Statistical Service Unit to provide the essential IBM facilities for the project. In February 1955 the office of the U. S. Weather Bureau State Climatologist for Illinois was moved from Springfield to quarters at the Survey. The State Climatologist served as the Weather Bureau representative to the project.

In the following report the procedures used in the Illinois project for planning, card-station selection, editing, punching, card checking and research analysis are described in detail.

The main purpose of this report is to furnish the U. S. Weather Bureau with a detailed description of the Illinois project. However, all groups desiring to use the Illinois cards may find the information presented herein helpful in planning climatological research projects.

## ACKNOWLEDGMENTS

The project was under the general supervision of Glenn E. Stout, Head of the Meteorology Subdivision, and the direction of A. M. Buswell, Chief of the Illinois State Water Survey.

George R. Beam, Director of the University of Illinois Statistical Service Unit, assisted by arranging facilities and personnel for the project. Leonard Staugas, Supervisor Research Section of the Statistical Service Unit, had close supervision of the Water Survey keypunch personnel. His assistance, advice, and interest contributed much to the success of the project,

Gerald Barger, Central Area Climatologist of the U. S. Weather Bureau, provided initial guidance to the project. H. C. McComb, Meteorologist in charge of the Columbia, Missouri Weather Bureau office, initially gave valuable suggestions and later furnished the Cairo, Illinois, card records which had been produced in Missouri. In his advisory position, Paul Sutton, U. S. Weather Bureau State Climatologist for Illinois, provided valuable assistance in explaining the Illinois weather records. The cooperation of Leslie Smith of the National Weather Records Center, Asheville, North Carolina, is also acknowledged, for having made available the necessary blank card supplies, duplicate punched cards of recent weather data, and general punch card information.

## PERSONNEL

Detailed editing of the Illinois Weather records and direct supervision of the project were done by Stanley A. Changnon, Jr., Research Climatologist and hereafter referred to as the Editor.

Mrs. Patricia Howe was in charge of machine card analysis and also served as a keypunch operator. Mr. Robert E. Ericson served as a part-time keypunch operator throughout the report period. In addition, an equivalent of two half-time keypunch operators were engaged, but their services were not continuous.

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## HISTORY

In 1948 the U. S. Weather Bureau initiated a program to record climatological and meteorological observations on IBM cards for the entire country. Funds, however, were not available to process data previous to the inception of the program. The Weather Bureau then sought the cooperation of state universities or state agencies to assist processing weather records prior to 1948. In this arrangement the Weather Bureau furnishes the cards, instructions, and the original past records. The cooperating state group edits the records, punches and checks the cards, and produces duplicate card decks for the Weather Bureau. In return the Weather Bureau will produce duplicate cards for future weather records, that is after 1948, in an amount equal to the number of years for which the state has produced cards.

The Weather Bureau, in 1950, suggested that the Illinois State Water Survey initiate a program to produce cards for Illinois weather records. The State Water Survey had been aware of the need for such cards, but was unable to begin the cooperative program until the fall of 1954. An agreement was signed 10 November 1954, and the project began in December of that year.

## PROJECT PLANNING OUTLINE

The following outline covers the operating tenets for the Illinois Cooperative Project in Climatology between the Illinois State Water Survey and the United States Weather Bureau, Hereafter in this report, the Illinois State Water Survey will be called the Cooperator. Specifically, the report deals with the planning, inaugurating, and continuation of the program to place weather records of Illinois stations on IBM cards for the years prior to 1948. This planning outline is expanded in the following report and will serve as the organizing concept for this report,

## I, Major Points of the Illinois Program.

- A, Amount and type of data desired, including years to be selected and the number and kind of stations to be punched,
- B, Length of the program, as related to the budget and research needs.
- C, Personnel requirements.

## II, Evaluation of the Proposed Plans for Illinois Punch Card Project,

- A, Advice from the Weather Bureau Regional and State Climatologists.
- B. Hydrologic research needs of the Cooperator and other state groups such as the University of Illinois College of Agriculture.

## III. Problems Considered in Planning and Continuing Program.

- A. Establish working arrangement with the U, S, Weather Bureau State Climatologist for Illinois to supply the original data and necessary blank cards, to evaluate the data, and to provide information concerning the various Illinois stations and their records,
- B, Determine stations to be punched in Illinois through consideration of research needs, evaluation of data, and geographical location of stations in Illinois,

- C. Investigation through the National Weather Record Center of other possible card decks prepared previously for stations in Illinois.
- D. Determine data desired on cards by considering such factors as standard Weather Bureau card data, availability of data, particular research data desired, and any forms of supplementary data punched by other state weather projects.
- E. Compilation of editing and punching instructions through use of published Weather Bureau standards, other states' standards, and discussions with Weather Bureau personnel.
- P. Available personnel and their qualifications including the editor and the keypunch personnel.
- G. Project equipment needs, including punching and tabulating IBM equipment available from the University of Illinois, card supplies furnished by the Weather Bureau, and card storage facilities.
- H. Determine card types to be used (hourly, daily, weekly or monthly) by considering the varying kinds of research which might be done.
- I. Determine checking procedures for card decks through investigation of methods of other states and the Weather Bureau. However, the Illinois project derived checking procedures mainly from the type of IBM equipment available to it.
- J. Other aspects concerning the program procedure, such as recording the cost of card production, recording all written instructions, inaugurating correspondence to states adjacent to Illinois, advising other state groups and agencies of the availability of the cards, and making arrangements to exchange duplicate cards with the National Weather Record Center in Asheville, North Carolina.



## STATIONS AND CARD PUNCHING IN ILLINOIS

The selection of stations and the period of years to be punched at each station depended largely upon the needs of the Cooperator. Inasmuch as the prime interest of the Cooperator is water resources, particularly precipitation data, long-term climatological records of 50 years or more were considered necessary. Consequently, the Illinois Project began punching station records for 1901 through 1948. This period, plus the Weather Bureau post-1948 cards, resulted in weather records for over 50 years.

Illinois Stations

The selection of Illinois stations for the first year of the project depended upon each station (1) having a continuous record from about 1901 to the present and (2) being located so as to fit within a widespread areal pattern for the entire state. It was estimated that 50 years of records for 20 stations would be placed on IBM cards during the first year. Subsequently any particular research needs concerning specific areas in Illinois will decide the selection of other stations.

During the first seven months or as of the date of this report, eight Climatological Substations and two First Order stations have been completed<sup>(1)</sup> resulting in the production of 158,031 punched cards. The completed stations, their code numbers, and their length of record on cards are listed in Tables I and II. Figure 1 shows the stations completed and stations yet to be punched during the 'first year, as well as all Illinois stations having 50 years or more of records.

TABLE I

ILLINOIS COOPERATIVE SUBSTATIONS ON 1009 CARDS

<u>Station</u>	<u>Code Number</u> (Illinois prefix is 11)	<u>Length of Record</u> (Temperature and Precipitation)
Carlinville	1280	1/1/01 - 12/31/48
Minonk	5712	1/1/01 - 12/31/48
Monmouth	5768	1/1/01 - 12/31/48
Mt. Vernon	5943	1/1/01 - 12/31/48
New Burnside	6093	1/1/01 - 12/31/48
Palestine	6558	1/1/01 - 12/31/48
Rockford	7375	4/1/05 - 12/31/48
Urbana	8740	1/1/03 - 12/31/48

(1) The Cairo, Illinois duplicate deck for the period of 1908-1952 was received from the Missouri Cooperative Project with the U. S. Weather Bureau.

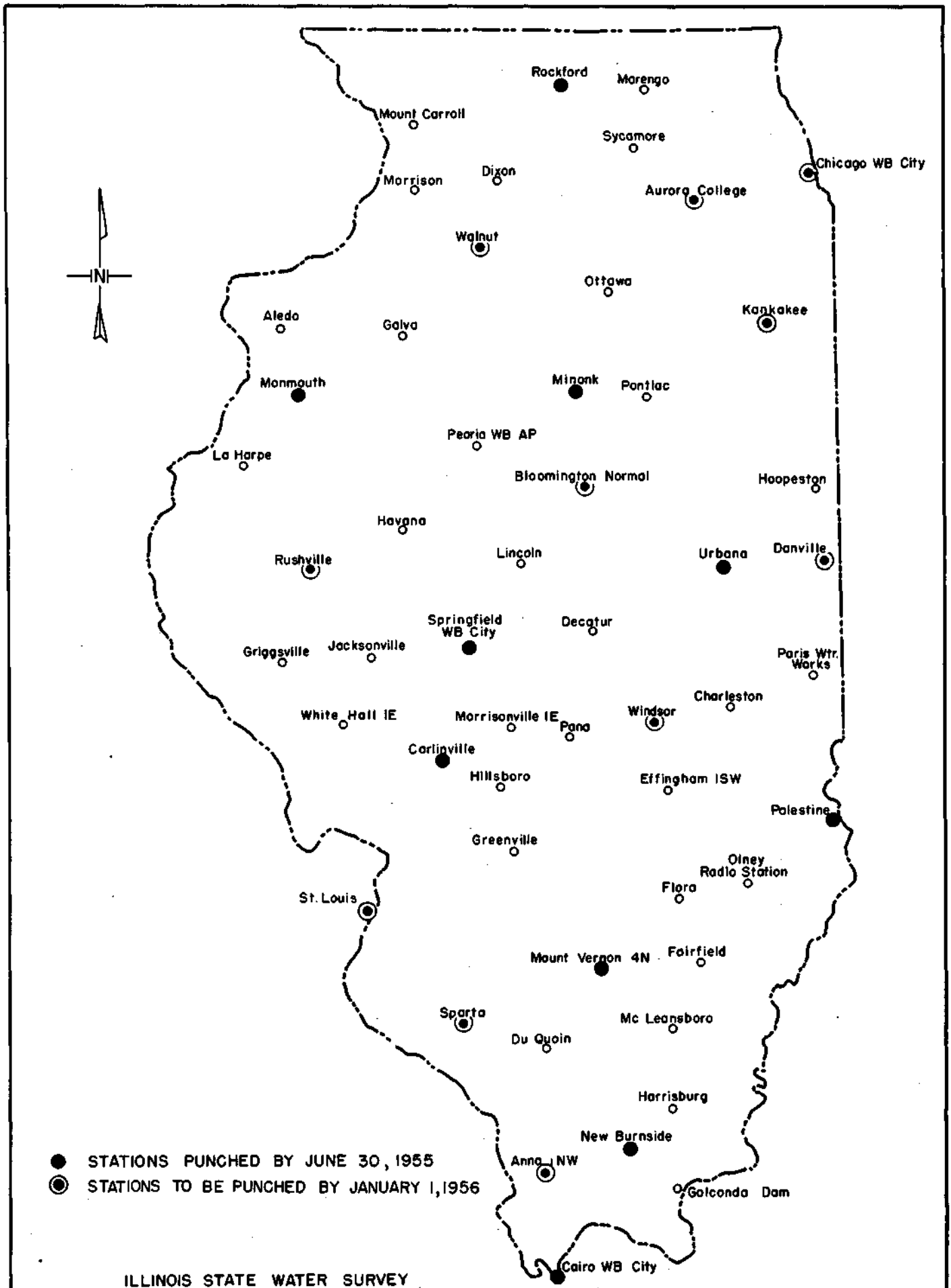


FIG. 1 ILLINOIS STATIONS RECORDING 50 OR MORE YEARS OF TEMPERATURE AND PRECIPITATION

In the initial phases many problems, not explained in published Weather Bureau instructions for processing and editing data, were found. As these occurred, editing procedures were developed to meet the problems and to maintain the basic Weather Bureau standards. These problems and editing procedures are described in the Appendix, Parts 9 and 10.

TABLE II

## ILLINOIS FIRST ORDER STATIONS ON NO. 3 CARDS

Station	Code Number	Length of Record
Cairo	93809	1/1/08 - 12/31/52
Springfield	93896	1/1/01 - 12/31/48

The types of information entered on the cards are listed in the Appendix. The three card types in use are shown in Figure 2: the 1009 card for the Illinois Cooperative substation daily record punching; the No. 3 card for entering the daily data for the First Order Stations in Illinois; and the Monthly Summary Data card for all types of stations.

Some Illinois weather data were available on cards from four Air Force Bases in Illinois. These records however included only a short period of years during World War II,<sup>(2)</sup> and have not been procured for this reason.

#### Climatological Cooperative Substation Card Data

The editing and punching of data from Illinois substations were done according to Weather Bureau specifications. The punching instructions in use are listed in the Appendix, Part 2. On the substation 1009 cards, temperature and precipitation information were punched plus the "Days With" phenomena. Not all state cooperative projects have included the "Days With" phenomena, but it was believed that some future Illinois research projects might find this data quite useful. Although the "Days With" data were carefully edited, subjective evaluation will be required in their use in analysis projects. The "Days With" phenomena were entered for all Illinois stations according to the particular editing

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(2) United States Weather Bureau, 1954. Inventory of Published Climatological Tabulations, U. S. Government Printing Office, Washington, D. C.

STATION NUMBER	DATE	TEMPERATURE °F			PRECIP. (INCHES)	SNOW (INCHES)	DAY WITH	MAX. DEP.	MAX. CIG.	MIN. DEP.	MIN. CIG.	MEAN TEMPERATURE	DEGREE DAYS	WIND	HOURS	WIND	HOURS	WIND	HOURS
		MAX.	MIN.	AT TIME OF OBS.															
000000	0000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
111111	1111	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
222222	2222	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
333333	3333	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
444444	4444	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
555555	5555	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
666666	6666	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
777777	7777	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
888888	8888	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
999999	9999	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

NO. 1009 DAILY SUMMARY CARD FOR SUBSTATIONS

STATION NUMBER	DATE	MAX. TEMP. (°F)			MIN. TEMP. (°F)	PRECIP. (INCHES)	SNOW (INCHES)	PEAK GUST	MAX. WIND	MIN. WIND	DAY WITH	HCC	FOUNDED	RIVER	MEAN TEMP.	DEPT.	HOURS
		REL.	REL.	REL.													
000000	0000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
111111	1111	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
222222	2222	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
333333	3333	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
444444	4444	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
555555	5555	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
666666	6666	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
777777	7777	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
888888	8888	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
999999	9999	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

NO. 3 DAILY SUMMARY CARD FOR FIRST ORDER STATIONS

STATION NUMBER	YEAR	TEMPERATURE					PRECIPITATION					RIVER STAGES					
		MEAN	MAX.	MIN.	DEPARTURE FROM NORMAL	HIGHEST	DATE	LOWEST	DATE	TOTAL	REPARTURE FROM NORMAL	GREATEST	DATE	MIN. STAGE	DATE	HIGHEST STAGE	DATE
000000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
111111	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
222222	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
333333	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
444444	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
555555	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
666666	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
777777	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
888888	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
999999	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

MONTHLY SUMMARY CARD FOR ALL TYPES OF STATIONS

FIG. 2 IBM CARD TYPES USED BY ILLINOIS WEATHER RECORD PUNCH CARD PROJECT ILLINOIS STATE WATER SURVEY

instructions for "Days With" phenomena listed in the Appendix, Part 1, If evaporation data were available at any of the substations, the evaporation and corresponding wind movement figures were also included. If the substation 1009 cards were to be used in producing monthly cards, the mean temperature and degree days were also punched. The calculation of these two entries and their punching on the 1009 cards were done entirely by machine.

#### First Order Station Card Data

The basic temperature, precipitation, "Days With" phenomena, and relative humidity data prescribed for the No. 3 cards have been punched for the Illinois First Order stations. Moreover, two daily sea level pressures, daily average wind speed and direction, hours and percentage of sunshine, mean temperature, and degree days were also punched. These additional data were entered to meet future research needs and to conform with portions of the additional data being entered on No. 3 cards by the Missouri project<sup>(3)</sup>. The listing of the data entered on the Illinois No. 3 card and the No. 3 card punching instructions are given in the Appendix, Parts 3 and 4. Variations in the forms of the original data for Springfield created the need for special punching instructions, Appendix, Parts 5 and 6.

#### Monthly Summary Card Stations and Data

Monthly Summary cards were produced for four substations whose data had been previously entered on daily cards. These four stations and their period of record on Monthly Summary cards are given in Table III, The editing instructions and punching instructions are given in the Appendix, Parts 7 and 8.

TABLE III  
ILLINOIS STATIONS ON MONTHLY SUMMARY CARDS

<u>Station</u>	<u>Code Number</u>	<u>Length of Record</u>
Monmouth	5768	1/1/01 - 12/31/53
Mt. Vernon	5943	1/1/01 - 12/31/53
Rockford	7375	1/1/06 - 12/31/53
Urbana	8740	1/1/03 - 12/31/53

(3) Missouri Climatological Research Project, 1950, University of Missouri, Progress Report, No, 2, pp.2.





The keypunch operators, who had been furnished with the punching instructions pertaining to the particular type of cards concerned, proceeded to enter data on cards using Type 026 key punches. Upon completion of each station year the operator then initialed and entered the completion date on the check slip. This year of cards was then verified on the Type 056 verifier by another keypunch operator.

After a station year of cards had been verified and recorded on the check slip, the cards were put through the Type 101 Statistical Machine to "edit-test" the punching. A detailed list of the Type 101 edit-tests used in the Illinois project will be found in the Appendix, Part 11.

Cards rejected by this test were checked individually by the keypunch operators against the original records. The rejected cards fell into one of three categories according to the type of action to be taken by the 101 machine operator:

1) The first category included cards incorrectly punched due to a keypunch error which was not discovered in the verifying. This error occurred most often on cards punched from Illegible records where both the keypunch operator and verifier agreed on an incorrect number to be punched, but examination by the Editor of the original record did not result in concurrence with the punched entry. Also, a stray punch in a card field, normally blank, was sometimes overlooked in verifying. The Editor returned the listing of the corrections to the 101 operator, and corrections were then entered in new cards by the 101 machine operator. In this first category, cards were corrected to agree with the original records and/or the original published records.

2) The second category concerned cards which were rejected for examination because an Improbable weather condition had been punched on a card. This category included such conditions as snowfall recorded during months of June, July, and August (other than hail); sleet, glaze, or blowing snow reported on a day when the minimum temperature was 41 degrees or higher, etc. In such cases, the original record was checked to see whether the card entry was correctly made. The 101 machine operator initialed the IBM card to indicate it had been checked and made a note on the back of the check slip concerning the date and the questionable condition. However, no change was made on the IBM card. The Editor then examined the improbable conditions noted and referred to the original records to confirm or to alter the card as punched.



3) The third category related to cards having incorrect weather relationships due to incorrect entries in the original records. If, during checking, errors were detected which required changes in the original records, a somewhat different procedure was followed. These were usually from cases when the minimum temperature exceeded the maximum; the set maximum was outside the range of the maximum-minimum; snowfall was recorded but no precipitation was shown; sleet was indicated but no snowfall or precipitation shown, etc. These were errors not previously discovered by Weather Bureau personnel. In these cases, the 101 operator decided the proper modification or addition to be made to the original record. The alteration was noted on the back of the check slip and the IBM card changed to conform. Since this error implied a change of the original record, these changes were reviewed by the Editor after the check slips were returned to him. If concurrence with the 101 operator's corrections was in order, the Editor initialed the change on the back of the check slip and filed it. If the Editor disagreed, the correct entry was "noted on the back of the slip, and the card correction was returned to the 101 operator for a new card. For this reason, the check slip became a part of the original record, insofar as the punch card records were concerned. This procedure depended on the 101 operator being aware of correct weather-data relationships. Otherwise, the error list went directly to the Editor without an alteration by the 101 operator.

After all card errors from these tests were corrected, a preliminary "Type 101 listing" for as many station years as had been completed during a few days<sup>1</sup> work was prepared and sent to the Editor together with the appropriate check slips and original weather records. A description of the annual totals obtained on the Type 101 listing will be found in the Appendix, Part 12.

The Editor then examined the preliminary 101 listing for general correctness such as the right number of cards, the total snowfall, the total precipitation, and the number of days with at least 0.01 inches of precipitation. The card totals were proofed by comparing with annual totals published in the "Climatological Data" record for the station and year involved, and any discrepancy was noted on the preliminary 101 sheet. The Editor next made a detailed study of the original records to ascertain where the discrepancy occurred; and if a card error was present, the IBM card was corrected accordingly. The Editor also retained a listing of the 101 errors so that any discrepancy between the published climatological data and the data on cards could be easily referred to. As soon as all the cards for a given station had been completely checked and corrected, a final 101 listing was prepared. This served as a detailed catalog of data available on IBM cards for each station together with information about the adequacy of the records.

The checking method developed on the Illinois weather card project is one of the special features of the project. First it resulted in more accurate cards, and secondly reduced the editing time. The accuracy of the checking method used is reflected in the fact that over 30 per cent of all discrepancies between the card totals printed on the Type 101 printout and the past published Weather Bureau data were due to errors in summing or printing the Weather Bureau data.

An analysis of the discrepancies from the completed substations and the First Order Stations is shown in Table IV. For the three categories (annual precipitation, snowfall, and

TABLE IV

ERROR LOCATIONS DISCOVERED FROM DISCREPANCIES  
BETWEEN TYPE 101 PRINTOUT AND  
PUBLISHED U. S. WEATHER BUREAU DATA

Subject Annual Total	Errors		Subject Totals
	On Cards	in USWB Data	
Precipitation	48	10	58
Snowfall	21	4	25
No Days Precip = .01"	19	24	43
<b>Total Errors</b>	<b>88</b>	<b>38</b>	<b>126</b>

number of days of precipitation of 0.01 inches or more), 1,278 separate annual comparisons were made between the published data and the Type 101 card printouts. Out of this number, 126 discrepancies were discovered or almost 10 per cent of the comparisons were in disagreement. However, in consideration of the total possibilities (cards) for error the ratio was only one error in 3,700 cards.

During the editing of each station, the Editor kept a continuous yearly record of the time of observation for both temperature and precipitation, the observer's name, and any pertinent remarks concerning the condition of the records for each year. This station catalog along with the aforementioned final Type 101 annual listings were assembled in a reference notebook for use in planning research projects.

The cost production of cards in the Illinois project for this period averaged 1.1 cent per card for punching, verifying and checking. This average cost figure includes the initial teaching phase with its slow card production resulting in a higher average cost figure. As yet, no duplicate cards for the U. S. Weather Bureau have been produced. Cards received from the Weather Bureau are listed in Table V.

TABLE V

## UNPUNCHED CARDS RECEIVED FROM WEATHER BUREAU\*

December 1, 1954-July 1, 1955

Card Type	Number Received
No. 1009, IBM 782918	250,000
No. 3, IBM 791616	40,000
Monthly Summary, IBM 770337	6,000

\* a) Duplicates of No. 1009 punched cards for Harrisburg, Minonk, Monmouth, Mt. Vernon, Rockford and Urbana from 6/48-12/53 were received.

b) Duplicates of No. 3 punched cards were received for Chicago and Springfield for 1/48-12/53 and Effingham for 1/48-3/51.

## WEATHER CARD RESEARCH PROJECTS

During the period covered by this report, almost no research has been done with the cards since the number of stations punched was not sufficient for any statewide analyses.

However, monthly weather summaries were prepared for the four stations for which daily cards were available. The stations chosen were considered as representative of the four general geographic areas in Illinois: Northern, West Central, East Central, and Southern Illinois. These were Monmouth, Mt. Vernon, Rockford, and Urbana, for which "Local Climatological Data" brochures were produced from monthly cards. These brochures are similar to the U. S. Weather Bureau "Local Climatological Data" publications for First Order Stations in the United States.

The Animal Genetics Department of the University of Illinois College of Agriculture made use of the May through October cards for 1921-1951 at Urbana for a research project

which sought to establish correlations between local weather conditions and sheep breeding records at the local University farms. This research project also desired sunshine data; however, none were available on the Urbana cards. Therefore, the Springfield, Illinois card records for the above mentioned period were used for the hours and percentage of sunshine. The correlations were largely negative in the sense that weather conditions did not appear to have any relation to the breeding statistics.

Personnel of the Water Survey are analyzing precipitation records from the completed stations. These records have been sorted on the Type 101 machine into precipitation amounts of 60 intervals of approximately 0.1 inch per day per interval according to months. From these precipitation interval sortings, frequency studies on Illinois daily precipitation occurrence for the past 50 years will be accomplished. Some preliminary results are shown in Table VI.

TABLE VI  
MAXIMUM DAILY PRECIPITATION AMOUNTS FOR DIFFERENT  
REOCCURRENCE INTERVALS

Station	Maximum Amounts for differing Lengths of Reoccurrence Intervals		
	10 Years	25 Years	50 Years
Rockford	3.65*	4.70	5.50
Minonk	4.00	5.10	5.80
Monmouth	4.30	5.25	5.95
Urbana	3.55	4.10	4.50
Springfield	4.00	4.90	5.60
Carlinville	4.30	5.50	6.60
Palestine	3.70	4.30	4.75
Mt. Vernon	4.00	5.10	6.00
New Burnside	5.05	6.60	7.85
Cairo	5.00	5.75	6.50

\* All amounts in inches.

To inform other educational groups in the state of the availability of the Illinois IBM weather cards, a paper describing the project was presented at the Illinois Academy

of Science Meeting at Carbondale, Illinois, in May 1955<sup>(4)</sup>. The "Local Climatological Data" brochures are also serving the purpose of spreading information of the availability<sup>(5)</sup> of the cards.

More detailed discussions of the types and results of weather research projects using the Illinois IBM weather cards will be presented in future progress reports.

- (4) Changnon, Stanley A., Jr. "The Illinois Weather Record Punch Card Project", Transactions of the Illinois Academy of Science, Vol. 48, April 1956, to be published.
- (5) Copies of these brochures are available by writing the Illinois State Water Survey, Box 232, Urbana, Illinois.

## APPENDIX

## 1. 1009 CARD EDITING RULES FOR "DAYS WITH" CONDITIONS

Comment on Original Form	Edit and Punch an Entry in these Columns	
Hail	Precipitation (23-26)	At least a trace on that day or day after.
	Snowfall (27-29)	At least a trace if none reported on that day or day after.
	Snow Depth (30-32)	If any left at time of observation, otherwise punched as missing if nothing indicated by observer.
	Hail (41)	
Drizzle	Precipitation (23-26)	At least a trace if none is reported on that day or the day after.
	Drizzle (37)	
Sleet	Precipitation (23-26)	At least trace on that day or day after.
	Snowfall (27-29)	At least a trace on that day or day after if none reported.
	Snow Depth (30-32)	If any left at time of observation, otherwise punched as missing if nothing indicated by observer.
	Sleet (38)	
Freezing Rain Drizzle or Mist	Precipitation (23-26)	
	Glaze (39) Never punch in snowfall record.	
Ice Storm	Precipitation (23-26)	If it is available, otherwise punch as a trace.
	Glaze (39)	
Freezing Mist	Precipitation (23-26)	
	Glaze (39)	

Foggy Rain	Precipitation (23-26) Drizzle (37) Fog (36)	
Fog	Fog (36)	
Mist	Precipitation (23-26) Drizzle (37)	At least a trace on that day or day after, if none reported.
Lightning	Do not edit as thunder	
Thunderstorm or Thunder	Thunder (40)	
Electrical Storm	Thunder (40)	
Glaze	Glaze (39) Precipitation (23-26)	At least a trace should be punched <u>unless</u> conditions from prior day have continued into this day, or precip. reported on following day.
Sprinkle	Precipitation (23-26)	A trace should be indicated if none is reported.
Tornado	Tornado (45) High Winds (44)	Only if the observer saw it.
Cyclone	High Winds (44)	
Wind	High Winds (44)	If severeness is indicated with subjective care by the editor.
Blizzard	High Wind (44) Blowing Snow (43)	No precipitation is required.

Drifting Snow	High Wind (44) Blowing Snow (43)
Dust Storm	Dust, Sandstorm (42) High Winds (44)
Dusty	No punch unless conditions of high wind or storm are specifically indicated.
Blowing dust, sand, or soil	Dust, sandstorm (42) High Winds (44)
Haze, hazy, or Smoke	Smoke, Haze (35)
Snow Flurries	Snowfall - Trace if none reported. Precipitation - Trace if none reported.



## 2. 1009 CARD PUNCHING INSTRUCTIONS

<u>Field</u>	<u>Columns</u>	<u>Number of Columns</u>	<u>Punch Instructions</u>
Station Number (CD alpha No.)	1-6	6	As coded. (First two numbers are 11)
Date (Year, Month, Day)	7-12	6	Punch 1950 as 50, etc. Punch January as 01, December as 12, etc. Punch first day as 01, 21st day as 21, etc.
Division	13	1	Area division as coded. (1, 2, or 3)
Time of Temperature Observation	13	1	"X" overpunch if a.m., no over-punch if p.m.
Maximum Temperature	14-16	3	Punch 35 degrees as 035, 110 degrees as 110, etc. "X" in column 14 for minus temperature; that is, -14 punch as X14. Leave all columns blank if missing or not reported.
Minimum Temperature	17-19	3	Same as maximum temperature.
Temperature at time of Observation	20-22	2	Same as maximum temperature.
Precipitation	23-26	4	(a) 00.01 or more. Punch as entered. (b) Trace 000X. (c) Precipitation on subsequent day 00X-. (d) No precipitation (or blank on form but not definitely missing) X---. (e) <u>Precipitation definitely missing blank.</u>

Snowfall	27-29	3	(a) <u>00.1</u> or more, punch as entered. (b) <u>Trace</u> OOX. (c) <u>Snowfall</u> on subsequent day OX-. (d) No snow (not definitely missing) X--. (e) <u>Snow definitely missing</u> blank all columns.
Snowdepth	30-32	3	(a) <u>1"</u> or more, punch as entered. (b) <u>Trace</u> OOX. (c) <u>No snow</u> X--. (d) <u>Missing</u> - blank all columns.
Day With	33-45	13	"1" in appropriate column for each occurrence, leave blank otherwise, Nos. 33 & 34 will be blank.
Wind Movement	64-66	3	Punch as entered, blank if not reported. Wind on subsequent day OX-.
Amount of Evaporation	67-69	4	Punch as entered, to hundredths, blank if not reported. Evaporation on subsequent day OX-.

NOTE: A dash "-" is used in the above to denote no punch in the column.

## 3. NO. 3 CARD INFORMATION AND EDITING

(Daily Summary Cards for Illinois First Order Stations )

<u>Columns</u>	<u>Category</u>
1-5	Station No. (WBAN Station No.)
6-7	Year
8-9	Month
10-11	Day
12-14	Maximum temp. (F°).
15-17	Minimum temp. (F°).
18-21	Precipitation - midnight to midnight.
22-24	Snowfall - midnight to midnight.
25-27	Snow depth at 1900 (to be decided on according to records).
28-31	Sea Level pressure in AM (4 columns - 0630 approx.).
32-35	Sea Level pressure in PM (4 columns - 1830 approx.).
36-38	Relative Humidity at 0630 or 0700.
39-40	Relative Humidity at 1200 or 1230 (at 1900 from 1901-1915 at SPI).
41-50	"Days With" (write in lower right corner of 1014 form) and sometimes at bottom center of page.

Punch even if 24 hr. watch is not kept

<u>Column</u>	<u>Punch all intensities of;</u>		
41 Fog	F	GF	IF
42 Thunder	T		
43 Sleet	E	EW	

44 Hail	A	AP		
45 Drizzle, Mist	Mist (following 1948 will be days of rain, prior to 1948 will be drizzle for SPI & CHI.).			
46 Tornado	(following 1948 will be Days of Snow at SPI - CHI).			
47 Glaze	ZR	ZL		
48 Dust Storm	D*	BN*	BD*	(no visibility classification considered)
49 Smoke or Haze	K	H	KH	
50 Blowing Snow	BS			
51-62	Blank (ice, frozen, and river gage headings).			
63	Blank			
64-65	Daily prevailing wind direction (to. 8 directions) use Second number if more than one listed.			
66-68	Average Daily Wind Velocity in tenths.			
69-71	Percent of possible Sunshine.			
72-74	Mean daily temperature (machine calculated).			
75-77	Number of hours of Sunshine in tenths (SPI not Cairo).			
78-79	Degree days - computed from Daily Mean (65 <sup>0</sup> - Daily Mean) (Machine calculated).			

\* Visibility must be less than 5/8 mile.

1. Cairo Ho. 3 cards will have different data - column locations following column 62 (63-79).

## 4. NO 3 CARD PUNCHING INSTRUCTIONS

Cols.	Item	Code	Code Definition	Remarks
1-5	Station Number	00001- 99999	Gang punched with appropriate station number supplied by Weather Bureau	
6-7	Year	00-48	1900-1948	
8-9	Month	01-12	January through December	
10-11	Day	01-31	Days of Month	
12-14	Maximum Temperature	X01-X99 000-199	-1 through -99° 0° through 199°	Maximum and minimum temperatures, midnight to midnight. Temperatures in °F.
15-17	Minimum Temperature	X01-X99 000-099	-1 through -99° 0° through 99°	
18-21	Precipitation	0001-4999 Blank in 18-20 and X in 21 0000	0.01" to 49.99" Trace None	Precipitation in inches and hundredths midnight to midnight.
22-24	Snowfall	001-599 Blank in 22-23 and X in 24 000	0.1" to 59.9" Trace None	Snowfall in inches and tenths. Sleet and hail included in totals, beginning with July, 1948. Amounts for 1908 and prior are for 24 hours ending at 7 PM; subsequent years are midnight to midnight.

25-27	Snow depth	001-499	1" to 499"	Whole inches, measured at about 7PM*. Includes sleet, hail, and ice. Depth of .5 or less punched as trace. *(Time to be determined after examining records.)
		Blank in 25-26 and Trace X in 27		
		000	None	
28-31	Pressure reduced to Sea Level (AM)	0000-9999	.0000 to .9999	If a group of 4 pressures given, this is 2nd number.
32-35	Pressure reduced to Sea Level (PM)	Same as above		4 places listed with x over punch for 30 whole numbers preceding and no x over punch for 29 prefix to fractions. If 4 pressures, this is 4th number.
36-38	Relative humidity 6:30 or 7:00 A.M.	100 001-099	100% 1% to 99%	Expressed with respect to ice. If 4 given this is 2nd number.
39-40	Relative humidity 12 noon or 12:30 P.M.	01-99	1% to 100%	In columns 39-40, both 99% and 100% are punched as 99. If 4 given this is 3rd number.
41-50	"Days With"	0 1	No occurrence Occurrence	Punched in accordance with "Instructions for WRAN Card Punching", issued July, 1948. However, 45 = drizzle, 46 = tornado for 1901-1947.
51-63		This field not punched		
64-65	Prevailing Wind Direction	00-88	11N, 22NE, 33E, 44SE, 55S, 66SW, 77W, 88NW, 00 Calm	Punched to eight directions plus calm if more than 1 given, use 2nd number.

66-68	Average wind velocity	001-999	.1 to 99.9	Miles per hour, to tenths.
69-71	Percent of possible sunshine	$\frac{100}{000-099}$	$\frac{100\%}{0\% \text{ to } 99\%}$	Whole percentages only.
72-74	Mean Temperature	$\frac{X01-X99}{000-199}$	$\frac{-1^{\circ} \text{ to } -99^{\circ}}{0^{\circ} \text{ to } 199^{\circ}}$	Mean temp. obtained by averaging the max. and min. temperatures, and rounding to the even number. Temperatures in °F. 0° is punched as 000. (To be machine calculated).
75-77	Sunshine in hours	000 to 240	0.00 to 24.0.	Hours in tenths from zero.
78-79	Degree Days	$\frac{00}{01-99}$	$\frac{\text{None}}{1 \text{ to } 99}$	Base 65°F (To be calculated).

Any field left blank indicates data missing.

## 5. INSTRUCTIONS FOR PUNCHING SPRINGFIELD RECORDS, 1901-1904

## I. Introduction

The 1901 - 1904 Springfield Records are different from the other records and have some punching differences from the basic instructions in Part 4 of the Appendix. The daily data for each month is partially summarized on 1 page; however, it takes 6 different pages for each month.

The data are found in two books. The first book has Forms 1001 & 1002 and each month has 8 pages, all numbered. The data in these books and page numbers for each month are as outlined.

## II. Book Number One

A. First, page 6 of each month has:

1. Daily maximum temperature.
2. Daily minimum temperature.
3. Precipitation from 8 PM - 8 PM (actually 7 PM - 7 PM).
4. Snowfall from 8 PM - .8 PM (actually 7 PM - 7 PM).
5. Snow depth on ground at 8 PM.

B. Second, on page 2 are 7 AM Observations of:

1. Barometric pressure reduced to sea level.
2. Relative humidity.

C. Third, on page 3 of each month are 7 PM Observations of:

1. Barometric pressure reduced to sea level.
2. Relative humidity.
3. "Days With" phenomena, either encircled or stamped on.

D. Fourth, page 5 of each month has total Wind Movement and is to be entered because no average wind velocity was given (no decimals).

If movement over 999, X punch for 1000 and enter any other numbers-1910 (910 then) accordingly.

## III. Book Number Two

The hours of sunshine, percent of sunshine, and prevailing wind direction are found in the second book, the Daily Journal of Sunshine, Wind Velocity, and Direction. There will be 3 pages for each month's data.





## 6. INSTRUCTIONS FOR PUNCHING THE SPRINGFIELD RECORDS, 1944-48

- I. All entries except the two relative humidity and the two pressure entries will be found on individual daily pages as per records prior to 1944. Other data differences require special attention for editing and punching.

The Weather Bureau entry for amount of sunshine is given in minutes not hours. The minutes have been translated to hours and written in for punching.

- II. The relative humidity and the pressure figures are on separate sheets, each containing a total month's entries. These sheets are in the front part of each year's book.

- A. The barometric pressure reduced to sea level will be in millibars, instead of inches, and punched thusly:

1026.8 = X over punch for the 1 and 4 entries  
are put in columns thusly, 0, 2, 6, 8.

926.8 = No X over punch and 4 entries would  
be 9, 2, 6, and 8.

- B. The AM relative humidity and the pressure will be found on page 2 in all months as each month has repeated identical numbering.
- C. The PM relative humidity will be found on page 3 of each month.
- D. The PM pressure reading will be on page 4 of each month,
- E. The column headings for these months will be indicated by a check mark to signify their location,

- III. The best method for punching would be to enter all data from individual daily sheets for a whole year, and then punch the pressures and relative humidity data by months in a second pass.

## 7. MONTHLY SUMMARY CARD EDITING INSTRUCTIONS

- I. Means will be computed from summations derived from total monthly daily card decks by dividing by the number of observations for each category.
- II. If more than five observations are missing in a month, the means will not be computed.
- III. Rounding figures is to be done as follows: Values greater than .05 are to be taken to the next higher tenth. Anything less than .05 taken to that tenth.
- IV. Columns 60-62 record deepest snow on ground in the month, but if more than 5 days are missing this entry is punched as missing.
- V. Do not punch these columns:  
22-24  
47-50
- VI. Columns 74-80 will summarize total "Days With" occurrences for the month.

74 - Thunder	78 - High Winds
75 - Hail	79 - Fog
76 - Sleet	80 - Drizzle
77 - Glaze	

## 8. MONTHLY SUMMARY CARD PUNCHING INSTRUCTIONS

(Machine Calculated)

Cols.	Item	Code	Code Definition	Remarks
1-7	Station Number	As punched in daily card		
8-9	Year	00-99 X X 00-99	1900-1999  1800-1899	
10-11	Month	01-12	Jan. thru Dec.	
12-15	Mean maximum temperature	X001-X999 0000-1999 Blank in 12-14, & X in 15	-0.1° to -99.9° 0° to 199.9°  Mean maximum is missing (if 5 days missing).	
16-18	Mean minimum temperature	X01-X 999 000-999 Blank in 16-17, & X in 18	-0.1° to -99.9°  0° thru 99.9°  Mean minimum is missing (if 5 days missing).	
19-21	Monthly mean temperature	X01-X 999 000-999 Blank in 19-20, & X in 21	-0.1° to -99.9°  0° to 99.9°  Monthly mean missing	Compute by averaging the mean maximum and mean minimum.  If either mean max- imum or mean minimum missing.
25-27	Highest temperature	000-199 Blank 25-27	0° to 199° Highest temp. missing	Punch highest no matter what is missing X over punch if any missing.



43-46	Total precipitation	0001-9999	.01 inch through 99.99 inches	
		X in col. 43, Blank 44-46	No precipitation	
		000X	Trace	
		Blank 43-46	Precipitation missing	If there are any missing (1 or more) observations, do not compute a total; and in punching leave columns blank.
51-54	Greatest observational day precipitation	0001-9999	.01 inch through 99.99 inches	
		X in col. 51, Blank 52-54	No precipitation	
		000X	Trace	
		Blank 51-54	Missing greatest amount	Missing if columns 43-46 are missing.
55-56	Date of greatest precipitation amount	01-31	Day of month	
		Blank 55-56	Missing greatest amount if any precip. missing at all	
		X in col. 55	Greatest amount also on later date	
57-59	Total snowfall	001-999	0.1" thru 99.9"	
		X in col. 57, Blank in 58-59	No snowfall	
		00X	Trace	
		Blank 57-59	Snowfall missing	If any day missing, enter as missing.
60-62	Greatest depth of snow on ground	001-99	1" thru 999"	
		X in 60, Blank in 61-62	No snow on ground	
		00X	Trace	
		Blank 60-62	Snow depth missing	If more than 5 days missing snow depth, punch as missing (evaluation by Editor).



## 9. SUPPLEMENTAL ILLINOIS EDITING PROCEDURES

- I. When it was necessary to enter an M (missing) in snow-depth column for either hail or sleet occurrence (per Editing Rules), the missing entry was not continued to another day unless conditions of temperature or the observer's remarks indicated any persistence.
- II. On the original 1009 forms, Weather Bureau temperature corrections had at times been made on the set maximum to correct it (usually lower it) in respect to actual maximum. If the Weather Bureau Editor had written in a new reading for the set maximum, it was left as it had been corrected. However, if only a red line had been drawn through it with no correction, the Editor altered the actual maximum or minimum, as the case may have been, according to the Weather Bureau punching rules. The rules state that the maximum temperature should = set maximum of that day and the previous day.
- III. If a day had snowfall and high winds were listed, the Editor did not edit blowing snow unless the observer indicated the specific occurrence or conditions were favorable for blowing snow.
- IV. Although glaze, as an event, does not require a snowfall and snow-depth entry, it was possible to have all three events on the same day if the weather conditions happened to occur.
- V. An editing procedure for missing snowdepth entries occurring from a trace of snowfall was developed. That is, on the first day of a maximum temperature  $\geq 40^{\circ}\text{F}$  after the day of a snowdepth of a trace, the snowdepth was edited as 0. This was necessary, as many early years had no snowdepth records except for the 15th and last day of each month. This procedure was especially helpful in the months of March, April, and November.
- VI. All snowdepth not recorded from snowfall was edited as missing if not entered. Interpolation of snowdepth entries was done solely in the form used by the South Dakota Cooperative Project<sup>(1)</sup>, whereby a positive snowdepth increase is entered in days between two days of snowdepth when no evidence of melting in relation to maximum temperatures occurs throughout the interpolated period of days.

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(1) South Dakota Cooperative Project In Climatology. 1952. South Dakota State College of Agriculture, First Annual Progress Report.



- VII. Each day was edited straight across with no adjustment of maximum temperature for 7 AM observations. This was by WRPC standards. This also related to all listings of "Days With" phenomena, which were most often recorded on midnight to midnight standards rather than the 7 PM to 7 PM observation day standards for temperature and precipitation,
- VIII. All evaporation was rounded off to hundredths by letting  $\geq .005$  increase the hundredth digit by one number.

10. RECORD OF EDITING PROBLEMS ENCOUNTERED IN THE ILLINOIS  
SUBSTATION RECORDS

- I. The set maximum occurred in some of the early years (1901-1906), but the entries were variable at the various stations. However, it began at all stations by 1915 and continued thereafter.
- II. Occasionally the Illinois stations had AM temperature observations in the period of 1915 through 1918, mainly in the April-September months, although AM observations did occur erratically during the 1901-1915 period.

However, after 1918 most station temperature observations were taken in the PM. The critical aspect of this occurrence was in relation to the set maximum condition described above. Although these records were adjusted in the published Weather Bureau records, they are not being adjusted for the card punching, as WRPC standards call for punching straight across the daily line. Although the Illinois machine techniques check the maximum and minimum readings on the day of occurrence and the following day against the set maximum on the given observation day (per Weather Bureau standards), this condition often was not met during the four year period, 1915-1918, when set maximums were entered with AM temperature observations. This condition moves the temperature data to be checked against a set maximum to the second day after the set maximum observation and this condition could not be checked by machine. Therefore, it was necessary for the Editor to hand check the maximum and minimum temperatures from AM observations against the set maximum occurring two days prior.

- III. When periods of AM precipitation observations occurred it was usually in the months of April through September at most Illinois stations during the 30 or 40 years extending from 1901 thru 1940. Often the AM precipitation observation was intermittent depending upon the station observer. On the Illinois project this occurrence was recorded by the Editor.
- IV. In adopting the WRPC standards of punching daily cards straight across the 1009 form daily line with no maximum temperature adjustment for AM observations, another problem was encountered. Almost every observer recorded "days with" remarks on a midnight to midnight basis while precipitation and snowfall were on some AM-to-AM (morning) or PM-to-PM (early evening) schedule. Therefore, actual date discrepancies in simultaneous occurrences were being edited in,



11. "EDIT-TESTS" PERFORMED EY THE TYPE 101 STATISTICAL  
MACHINE ON 1009 WEATHER CARDS

by

Leonard Staugas\*

It Is possible to wire the control panel on the Type 101 machine so that a number of "edit tests" are performed on the cards as they are being put through the machine to print a report. These "edit tests" are enumerated and described below. If a card did not meet all these tests, it was rejected for further examination. All column numbers are in parenthesis hereafter.

1. Correct relationship between maximum and minimum temperature and between a given day's set maximum and the maximum for the following day. (It is possible to cancel out this check for use on those years where set maximum was not recorded.) Maximum (14-16) equals or exceeds set maximum (20-22) which equals or exceeds minimum (17-19). Set maximum (20-22) equals or is less than maximum (14.-16) on following card. A possible negative temperature is taken into account on all temperatures. Cards that are blank in any temperature are rejected. •
2. Cards must be in ascending order on month and day (9-12) and there must be no duplicate cards.
3. There must be no double punch in the precipitation (23-26) or snowfall (27-29) columns.
4. Snowfall edit tests (27-29)
  - a. If column 27 has an "X" or is blank, then columns 28-29 must be blank.
  - b. If column 29 has an "X", then columns 27-28 must be punched 00.
  - c. If column 29 is not "X" and column 27 is punched other than "X", then column 28 must be punched with a digit, 0 thru 9.

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University of 'Illinois.

5. Precipitation (23-26)
  - a. If a trace or more of snowfall is recorded then column 25 must be punched.
  - b. If column 23 has an "X" or is blank, then columns 24-26 must be blank.
  - c. If column 26 has an "X", then columns 23-24 must be punched 00. (It would have been desirable to check column 25 also but panel capacity prevented this.)
  - d. If column 26 is not "X" and column 23 is punched other than "X", then columns 24-25 must be punched.
6. If a day with sleet or hail is recorded, then column 29 must be punched with any digit<sup>(1)</sup>.
7. If a day with drizzle is recorded, then column 26 must be punched with any digit<sup>(1)</sup>.
8. Minimum temperature (columns 17-20)
  - a. Column 17 must be punched X, 0, or 1.
  - b. If minimum temperature is equal to or less than 41 degrees, column 29 must be blank unless hail was recorded.
9. During months June, July, and August, columns 31-32 must not be punched (0-9).

(1) On the day of the event or the day following.

## 12. TYPE 101 PRINTOUT LISTINGS

by

Leonard Staugas

A more detailed description of the items counted on the 101 machine may be helpful to those planning to use the cards for research purposes. The left accumulator counter contains sums of snowfall and precipitation as shown. In addition, it was possible to sum the units and digits of maximum temperature. To compute an average maximum it is necessary to add the count in unit counter #1 to this total, and divide by the total number of cards (counter 3) minus the number of missing maximum temperatures (counter 4). It is also essential that counter 2 be blank, since the sum of maximum temperatures includes only positive values. Any negative maximum temperature is added to the total.

The conditions necessary for a tally to appear in the units counters are shown below:

Counter Number

1	Ones in column 14. Number of maximum temperatures over 99 degrees.
2	"X's" in column 14. Number of negative maximum temperatures.
3	Total card count.
4	Number of cards blank in column 14.
5	Number of cards blank in column 17.
6	Number of cards blank in column 20.
7	Number of cards blank in column 23.
8	Number of cards blank in column 27.
9	Number of cards blank in column 30.
10	Number of cards punched 0 thru 9 in column 26 and not "X" in column 23 and column 26.

Counter Number

11	Number of cards punched 0 thru 9 in column 23.
12	Count of cards with "X" or 0-9 in column 29.
13	Count of cards with 0-9 in columns 30-31.
14	Count of cards with "1" punched in column 35.
15	Count of cards with "1" punched In column 36.
16	Count of cards with "1" punched in column 37.
17	Count of cards with "1" punched in column 38.
18	Count of cards with "1" punched in column 39.
19	Count of cards with "1" punched in column 40.
20	Count of cards with "1" punched in column 41.
21	Count of cards with "1" punched in column 42.
22	Count of cards with "1" punched in column 43.
23	Count of cards with "1" punched in column 44.
24	Count of cards with "1" punched in column 45.