

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
WASHINGTON

April 26, 1957

IN REPLY, PLEASE ADDRESS
CHIEF, U. S. WEATHER BUREAU
WASHINGTON 25, D. C.
AND REFER TO

C-3.1

FILE: 922

MEMO

(Climatological Services Memorandum No. 59)

MEMORANDUM

TO : Area and State Climatologists, Substation Inspectors, Field Aides, WRPCs, River District Offices, and Area Engineers.
(With copies to cooperating Universities and State Agencies, Regional Administrative Offices, and First Order Stations for information)

FROM : Office of Climatology

SUBJECT: Climatological Services Memorandum No. 59

COOPERATIVE PROJECTS IN CLIMATOLOGY

This issue of Climatological Services Memorandum is devoted to an extensive report on cooperative projects carried on by universities and state agencies in cooperation with the United States Weather Bureau.

This report, compiled by Mrs. Esther K. Grabill of the Office of Climatology, will serve as a progress report on cooperative activities (as of January 1, 1957) and will emphasize the unique arrangements whereby various groups work toward a common goal, the better utilization of historical weather data. It will also show for which substations longer records have been punched and are available at the National Weather Records Center for analysis.

H. E. Landsberg

H. E. Landsberg
Director, Office of Climatology

WASHINGTON, D. C.
4-26-57



INTRODUCTION

Weather Bureau-State cooperative projects in climatology have been effected for the most part through Agricultural Experiment Stations. Many other groups are affected, e.g., water surveys and natural resources councils, engineering interests, medical and recreational agencies and highway commissions, but agriculture has been most active in contributing to the cooperation. This is in accord with the feeling that bigger businesses can be served economically by private meteorologists, while the small individual operator, typified by the one family farm enterprise, must rely on public agencies for information and advice concerning his weather problems.

Agriculture is becoming more and more dependent on technical information and this includes weather. The farmer must inventory his weather resources - in numbers, not generalities. We must describe and map weather environment as we do soils - for its production capacity. This means we must know how weather affects a given crop or other farm activity. Agricultural Experiment Stations have been studying these problems for years; for some of them they have the answers - for some not.

Defining the effect of weather is only part of the approach to efficient operation. What is the risk involved? Will this weather condition occur one year in ten or six years in ten? Often the agricultural research worker has halted here in the face of mountains of weather records - 60 years of daily observations, or 20 years of hourly readings - too voluminous to handle manually. And some of his unsolved problems were dropped from consideration for the same reason - no way to cope with the numbers of observations involved.

The Weather Bureau was faced with the need for mass handling of data too; and switched to punch cards and electrical tabulation in 1948, after a few years experience in the Bureau and in one or two colleges on a contract basis.

In the past five years many colleges and universities have initiated weather punch card projects for the simple reason that this method makes past weather work for them. It makes it possible for the researcher:

1. to define weather conditions affecting problems he previously could not solve.
2. to compute a probability of occurrence for these conditions.
3. to determine if conditions can be altered economically, avoided entirely, or utilized to better advantage in some other enterprise.

Punch cards alone do not do any of these things - but they make it possible for a busy research worker to analyze data he previously could not approach. To establish relationships with the responses of living plants and animals and to bring order to records of highly variable weather elements he must utilize these long records. Machine tabulation gives him a workable tool.

The above paragraph states the basic reason that Agricultural Experiment Stations have represented the greatest proportion of climatological punch card projects. There are several others:

1. With high rates of planting and fertilizer application in recent years, water has become more of a limiting factor - hence more interest in rainfall amounts and reliability.
2. Development of more and better herbicides and pesticides has increased the need for weather information concerning incidence of threatening organisms, favorable conditions for application and when satisfactory results will be obtained.
3. The economy of machine reproduction of cards allows the cooperating state agency to assure its workers of a punch card record subsequent to 1948 equal to the record prior to 1948 which the state punches. The Weather Bureau also benefits by receipt of a duplicate file of the cards punched by the state. Though small in comparison with direct research benefits possible from the cards, this economy of exchanging duplicates is immediately obvious to administrators. By providing all blank cards without cost to the cooperator the Weather Bureau not only insures the uniformity necessary to nationwide integration of weather studies, but shows the efficient executive where he can save a little money right now.

The foregoing outlines some of the reasons agricultural workers enter into cooperative climatological work with the Weather Bureau.

It is hoped that the following report on the development of our cooperative projects, of which we now have 29, may prove useful to other universities and state agencies seeking information as to the scope of projected studies and also suggest the types of problems which may be usefully explored by IBM punch card methods. Results come from a combination of usable data and trained people.

ARIZONA, TUCSON - UNIVERSITY OF ARIZONA

Started 11-15-54

The basic interest has been centered around Arizona's precipitation characteristics. Overall program of the Institute of Atmospheric Physics concerns studies of all aspects of the weather and climate of Arizona and of the entire southwestern United States. Particular attention is being given to problems concerned with the role of the atmosphere in the water economy of the arid region.

The general objectives of this entire program bear not only on the atmospheric physical researches of the Institute but also on a number of practical problems of great importance in allied fields such as agriculture, hydrology, industry and commerce.

During the first year of this program a total of 600 station years of Arizona climatological records had been transferred to punch cards.

A number of proposed studies outlined below represent only a portion of those projects which are already fairly well formulated for later attention by the Institute.

1. Precipitation variability by months and by geographical areas.
To know in full detail all that can be discovered about the variability of the water supply in arid regions is essential to the economy of such regions.
2. Winter/summer precipitation ratios.
To ascertain the detailed distribution of and the physical factors responsible for such differences in the winter-to-summer precipitation ratio will be one of the many objectives of the punched card program.
3. Interseasonal precipitation and temperature correlations.
Lag-correlations between precipitation and temperature anomalies in one season and those in the following season.
4. Mean-calendar-date precipitation amounts.
Related statistical tests are contemplated as part of this study.
5. Duration-frequencies of wet and dry spells.
To gain keener appreciation of the time-scale of the atmospheric circulation in a given region.
6. Duration-frequencies of hot and cold spells.
Analyses of temperature data similar to those for precipitation will be carried out both for their basic meteorological information and for their agricultural and hydrologic implications.
7. Moving-average precipitation and temperature values.
Various types of running-mean tabulations will be carried through with averaging periods ranging probably from 10 years down to about 3 years in length. When this is done for selected representative stations distributed over the state, a sensitive test of long-term trends in shifts of precipi-

tation patterns will be available.

8. Long-term trends in average precipitation per storm and in seasonal distribution of precipitation.

The assessment of the statistical significance of seasonal changes necessitates a number of auxiliary variability studies.

9. Regional homogeneity studies.

Carry through a detailed analysis of the entire state's climatic data with the objective of delineating areas within which the climatic variables are essentially homogeneous.

10. Cloud types and amounts.

The first actual research conducted by the Institute was a study of the types and amounts of clouds reported by the Weather Bureau for Tucson, Arizona and classified in that study according to diurnal, seasonal, and inter-yearly variation. This study, conducted by R. B. DesJardins, involved some 25,000 cloud observations for approximately the last decade of observations at the Tucson WBAS. Somewhat over 8 man-months of time went into this tabulation, which was done by manual means. So many interesting characteristics of the cloud distribution for Tucson were discovered in this study that it was early regarded as desirable to continue it by IBM methods and to extend it to other first order stations within the state.

11. Relation between cirrus cloud occurrence and rain.

Test the hypothesis that some rainfall may be produced as a result of natural seeding of supercooled clouds by ice crystals falling into those clouds from cirrus decks overhead.

12. Frost frequency statistics.

The Institute will examine a number of frost-frequency problems with the objective in mind of providing vegetable and fruit growers with a more extended background of information on frost risks in various parts of the state.

13. Duration frequencies of excessively hot and excessively cold temperatures.

Studies will be made of the statistical distribution of duration frequencies of those periods of hot and cold weather, where the criteria defining "hot and cold" will be varied from one crop problem to another.

14. Plant pathological problems.

Probabilities of occurrence of those climatic factors which promote epidemic spread of pathogens.

15. Agricultural operational problems.

Determination of the frequency with which the proper conditions may be expected to occur in any given growing area.

16. Entomological problems.

17. Climatic factors in agricultural economics.

18. Evapotranspiration studies.
19. Tables of characteristic standard errors of estimate.
20. Meteorological factors contributing to interannual runoff variability in Arizona.
21. Atmospheric water vapor transport.
22. Long-term changes in Arizona precipitation characteristics.
23. Water supply forecast studies.
24. Rainfall intensity studies.
25. Basic hydrological statistics for Arizona.
26. Precipitation efficiency.
27. Heating degree-days.
28. Cooling degree-days.
29. Humidity data.
30. Weather risks in shipping and transportation.
31. Solar radiation data.
32. Climate as a health and tourism factor.

ARIZONA, University of (Cont.)

*1009 Cards punched by the University.

<u>STATION</u>	<u>PERIOD</u>	<u>STATION</u>	<u>PERIOD</u>
Aguila	1/24-6/48	Ajo	1/14-6/48
Alpine	10/04-12/04; 1/12-6/48	Apache Powder Co.	7/23-6/48
Blue	11/03-12/30	Bowie	1/99-12/45; 1/47-6/48
Buckeye	3/93-1/48	Casa Grande	6/98-12/14; 1/17-12/23; 1/25-6/48
Casa Grande Ruins	3/06-12/06; 1/08-12/16; 1/31-6/48	Cibecue	6/27-6/48
Clifton	1/93-6/48	Dudleyville	1/93-5/25
Duncan	5/01-12/39; 1/41-6/48	Eagle Creek	1/28-6/48
Ft. Apache	1/1900-6/48	Florence	12/92-6/48
Granite Reef Dam	1/93-6/48	Fort Grant	1/1900-12/05; 1/18-12/44; 1/46-6/48
Litchfield Park	8/17-6/48	McNary	8/33-6/48
Maricopa	6/98-12/08; 1/11-6/48	Mesa	3/96-12/12; 1/15-6/48
Montezuma Castle	10/38-6/48	Oracle	1/93-12/19; 1/23-6/48
Mormon Flat	8/23-6/48	Ruby	4/95-12/01; 1/16-12/18; 1/30-6/48
Paradise	1/06-8/37	Sansimon	3/98-12/1900; 1/03-12/16; 1/21-6/48
Red Rock	1/93-12/95; 1/08-12/35	Silverbell	2/06-12/20
Sacaton	4/08-6/48	Sycamore	7/19-6/48
Safford	8/98-6/48	Tempe Date Farm	1/05-6/48
Santa Marguerita	6/17-6/48	Wickenburg	3/08-6/48
Sierra Ancha	11/13-12/18; 1/35-6/48		
Superior	7/20-6/48		
Tempe	1/26-6/48		
Tucson	9/94-6/48		
Wilcox	6/98-6/48		

524,795 Daily cards
17,285 Monthly cards

* Weather Bureau Form 1009 is the monthly form used by substation observers to record weather data. Entries are transferred to the "Daily 1009 card".

ARIZONA, University of (Cont.)

Cards reproduced by the Weather Bureau and furnished to the University.

<u>STATION</u>	<u>Constant Pressure</u>	<u>Winds Aloft</u>	<u>WBAN #1</u>	<u>WBAN #3</u>
Albuquerque, N.M.	1/46-12/55	1/48-12/55		
Dodge City, Kans.	1/46-12/55			
El Paso, Tex.	1/46-12/55	1/48-12/55		
Ely, Nev.	1/46-12/55	1/48 -12/55		
Flagstaff 03103			1/48-1/50 1/50-12/55	1/48-1/50 1/50-12/55
Glasgow, Mont.	1/46-12/55			
Grand Junction, Col.	1/46-12/55	1/48-12/55		
Great Falls, Mont.	1/46-12/55			
Las Vegas, Nev.	1/46-12/48; 1/50-7/52	1-12/48		
23169	1-12/48; 7-12/49; 8/52-12/55	12/48-8/53; 2/54-12/55		
23112		8/50-2/54		
Phoenix	1/46-12/55	1/48-12/55	1/48-12/55	1/48-12/55
Prescott			1/48-12/55	1/48-12/55
Tucson	9/51;4/52; 7/52-12/55	1/48-12/55		
23193			1-10/48	1-10/48
23160			9/48; 11/48-12/55	10/48-12/55
Winslow			1/48-12/55	1/48-12/55
Yuma			1/48-12/55	1/48-12/55

332,560	Constant Pressure cards
172,280	Winds Aloft cards
420,480	WBAN #1 cards
17,520	WBAN #3 cards

ARIZONA, University of (Cont.)

Cards reproduced by the Weather Bureau and furnished to the University.

<u>STATION</u>	<u>1009 Cards</u>	<u>Solar Radiation Cards</u>	
		<u>Hourly</u>	<u>Summary of Day</u>
Benson	6-11/94; 6/98-6/48		
Bisbee	12/92-5/05; 1/06-5/13; 12/13-6/48		
Canelo	1/10-8/21; 5/23-6/48		
Chiricahua	1/09-7/19; 4/48-6/48		
Cochise	2/99-5/25; 12/43-6/48		
Cochise Stronghold	6/25-11/43		
Douglas	12/03-6/48		
Elgin	10/12-6/48		
Fairbank	7/09-6/48		
Ft. Huachuca	2/1900-3/20; 12/39-5/40		
Leslie Canyon	5/16-6/48		
Nogales	12/92; 1/93; 12/94-8/95; 9/99-3/04; 6/09-2/10; 12/13-6/48		
Patagonia	7/21; 6/22-6/48		
Portal	1/14-3/24; 11/24-5/44; 3/45-6/48		
Rucker Canyon	1/93-8/97; 5/17-6/48		
San Rafael Ranch	12/92-1/93; 10/93-11/99; 7/23-6/48		
Santa Rita	6/16-8/20; 7/21-6/48		
Stephens Ranch	12/28-6/48		
Tombstone	7/93-8/93; 2/97-9/99; 7/1900-6/48		
Y Lightning Ranch	1/39-6/48		
Albuquerque, N.M.		7/52-6/55	7/52-5/55
Phoenix		7/52-6/55	7/52-1/55

226,300 1009 Cards
 30,660 Solar Radiation - Hourly cards
 2,130 Solar Radiation - Summary of Day cards

1,201,930 Total number of cards reproduced by the Weather Bureau
 and furnished to the University of Arizona.
 542,080 Total number of cards punched by the University.

ARKANSAS, FAYETTEVILLE - UNIVERSITY OF ARKANSASStarted 12-13-51

Tabulations were prepared of the monthly rainfall totals for each year, from 1937 through 1954, in order to obtain an average monthly rainfall for the 18 year period. Tabulations were made for the following stations: Portland, Pine Bluff, Stuttgart, Marianna, Jonesboro and Batesville. This information supplements that found in the U.S.D.A. Yearbook, "Climate and Man". Tabulations have been made as to the number of dry periods exceeding 14 consecutive days with .25 inches precipitation in any one day. This was tabulated for the above stations.

They propose to analyze the above information and attempt to arrive at some figure relative to the expected frequency of dry periods of 14 consecutive days or more, with .25 inches of rainfall in any one day. This will be used (if developed satisfactory) to gain some insight as to the amount of irrigation water that might be needed each year.

Making a detailed analysis of the precipitation, and temperature data for the Fayetteville Experiment Station.

Duplicate 1009 cards reproduced by the University of Missouri and furnished to the University of Arkansas

STATIONPERIOD

Cassville Ranger Stn., Mo.	1-10/18; 12/18-4/19; 6/19-11/19; 2-3/20
Seligman, Mo.	11/21-9/23; 12/23-8/26; 11/26-1/31; 3/31-12/48

10,467 1009 Cards

ARKANSAS, University of (Cont.)

<u>STATION</u>	<u>Period</u>	<u>Punched by Univ.</u>	<u>1009 CARDS</u>	
			<u>Duplicates Furnished W.B. by University</u>	<u>Duplicates furnished Univ. by Wea. Bur.</u>
Batesville Livestock Conway	7/41-12/55; 8-10/90;	5,204	1,887	3,317
Fayetteville Fayetteville Exp.Stn.	1/92-12/55	23,406	19,996	3,410
	12/37-12/55	6,605	none	none
Hope	1/92-8/04;	23,253	19,813	3,440
	1/05-12/55			
	3-9/92; 11/92- 3/93; 11/06-5/08			
Jonesboro	6/15-12/55	15,767	14,306	1,461
	4-5/93; 12/94; 1/95; 2-10/96;	21,914	18,474	3,440
1/97-12/55				
Marianna	3/99-5/03;	15,703	12,294	3,409
	8/16-3/21;			
Morrilton	9/21-12/55	12,635	9,195	3,440
	7/19-2/20;			
	5/21-10/24; 1-8/25;			
Mountain Home	3/26-12/55	14,881	11,441	3,440
	3/02-6/03; 5/04;			
	5/05-4/06;			
Pine Bluff	9-10/06; 2/17- 11/29; 2/30-12/55	23,929	20,480	3,440
	6-10/87; 6-11/89;			
	5-11/90; 5-11/91;			
	1/92-12/93;			
	5-11/94;			
Portland Stuttgart	3/95-12/55	16,977	13,568	3,409
	4/09-12/55	14,793	11,353	3,440
	8-10/90; 1/92- 12/12;			
	10/36-12/55			
TOTALS		195,067	152,816	35,646

205,534 Cards in files at University of Arkansas.

FLORIDA, GAINESVILLE - UNIVERSITY OF FLORIDAStarted 2-10-54

They are interested in agricultural experiments, especially in citrus.

Proposed project - Agroclimatic characterization of Florida with respect to crop production hazards. To determine the expected frequency of occurrence of temperature and moisture factors critical to crop production.

<u>STATION</u>	<u>1009 Cards Punched by the University</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Belle Glade	?	1/48-12/53
Gainesville	?	"
Lake Alfred	?	"
Quincy	?	"
Brewton, Ala.		6/48-12/55

10,950 Cards reproduced by the Weather Bureau and furnished to the University.

ILLINOIS, URBANA - ILLINOIS STATE WATER SURVEYStarted 11-20-54

Planning of this 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. 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 cards prepared by the Weather Bureau subsequent to 1948, resulted in weather records covering the past 50 years.

During the first seven months of this program, eight Climatological Sub-stations and two First Order Stations have been completely punched. This resulted in the production of 158,034 punched cards.

Monthly summary cards were produced completely by machine methods for four stations whose data had previously been entered on daily cards. By this procedure 53 years of daily card data were rapidly compiled and put on monthly summary cards with a simultaneous IBM tabulator printout of the data. 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 the monthly cards. These brochures are similar to the Weather Bureau "LCD" 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. 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 IBM 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.

The cost production of cards in the Illinois project for the period covered by this report average 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.

ILLINOIS STATE WATER SURVEY (Cont.)

<u>STATION</u>	<u>1009 Cards Punched by State Water Survey</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Anna	1/01-12/48	1/49-12/54
Aurora	* "	"
Belleville	-	"
Bloomington	1/01-12/48	"
Carbondale	2/10-12/48	"
Carlinville	* 1/01-12/48	"
Danville	* 1/01-12/04; 1/11-12/48	"
DuQuoin	1/01-12/48	"
Greenville	"	"
Griggsville	"	"
Havana	"	"
Harrisburg	"	6/48-12/53
Kankakee	* 1/17-12/48	1/49-12/54
Hoopeston	6/02-12/48	-
McLeansboro	1/01-12/48	1/49-12/54
Minonk	"	6/48-12/53
Mt. Carmel	1/02-12/48	-
Mt. Carroll	1/01-12/48	1/49-12/54
Monmouth	"	6/48-12/53
Mt. Vernon	"	"
New Burnside	* "	1/49-12/54
Olney	"	"
Ottawa	"	"
Palestine	"	"
Paris	"	"
Rockford	4/05-12/48	6/48-12/53
Rushville	* 1/01-12/48	1/49-12/54
Sparta	* "	"
Urbana	1/03-12/48	6/48-12/53
Walnut	1/01-12/48	1/49-12/54
White Hall	4/02-12/48	"
Windsor	1/04-12/48	"
	<u>WBAN #3</u>	<u>WBAN #3</u>
Chicago		1/48-12/53
Effingham		1/48-3/51
Springfield	*1/01-12/48	1/48-12/53
St. Louis, Mo.		1/08-12/53

ILLINOIS STATE WATER SURVEY (Cont.)

Cards reproduced by the Weather Bureau.

<u>STATION</u>	<u>WBAN #1</u>	<u>STATION</u>	<u>RADIOSONDE</u>
Chicago	1/49-6/55	Columbia, Mo.	3/53-12/55
Evansville, Ind.	1/48-12/55	Green Bay, Wis.	"
Moline	"	Nashville, Tenn.	"
Peoria	"	Rantoul, Ill.	"
Springfield	1/49-6/55		
Terre Haute, Ind.	1/48-12/55		

Cards punched by State Water Survey

<u>STATION</u>	<u>MONTHLY SUMMARY</u>
Monmouth	1/01-12/53
Mt. Vernon	"
Rockford	1/06-12/53
Urbana	1/03-12/53

Cards reproduced and furnished State Water Survey by University of Missouri.

Cairo, Ill.	WBAN #3	1/08-12/52
Chicago, Ill.	"	* 1/01-12/48
St. Louis, Mo.	"	1/08-12/52

Total number of cards - 50,370

<u>Card Type</u>	<u>Punched by State Water Survey</u>	<u>Duplicates Furnished Weather Bureau by State Water Survey</u>	<u>Reproduced by the Weather Bureau and and furnished State Water Survey</u>
1009	527,220	114,610	65,700
WBAN #1	none	none	394,200
WBAN #3	35,040	35,040	22,350
Monthly Summary	74,825	none	none
Radiosonde Data	none	none	43,000
TOTALS	637,085	149,650	525,250

INDIANA, LAFAYETTE - PURDUE UNIVERSITYStarted 3-7-55

Statistical analyses are planned after 25 stations have been punched. Frequency studies will be made in detail for precipitation, temperature and to a lesser degree other climatic factors recorded. Additional stations will be punched later as statistical analyses points out the need.

1009 cards punched by the University.

<u>STATION</u>	<u>Period</u>	<u>Amount</u>
Albion	12/16-4/48	11,465
Berne	2/10-4/48	13,960
Farmland	1/93-4/48	20,195
Oolitic (formerly Bedford)	5/18-4/48	10,950
Marion	1/93-4/48	20,195
Moore's Hill	2/02-4/48	16,880
Paoli	3/98-4/48	18,310
Plymouth	4/94-3/95; 12/05-4/48	15,845
Princeton	1/93-4/48	20,195
Richmond	1/96-4/48	19,100
Rockville	1/93-4/48	20,195
Rushville (formerly Mauzy)	1/81-4/48	24,210
Scottsburg	5/94-4/48	19,710
West Lafayette (formerly Lafayette)	1/94-4/48	19,830
Wheatfield	10/16-4/48	11,525
Whitestown	3/96-4/48	19,040

281,605 Total number of cards punched by the University.

No exchange of cards as yet.

IOWA, AMES - IOWA STATE COLLEGEStarted February 1944

The original purpose of the program was the development of analytical principles and techniques applicable to the field of meteorology generally and to the solution of practical problems in agriculture, industry and commerce.

1. Climate of Iowa

Published in several parts, each of which treats, in some detail, a specific weather element or problem. The weather condition affecting a given activity is defined briefly and the probability of occurrence of this condition (the risk involved) is estimated for several localities in Iowa, and for different seasons. When practical, suggestions are offered for improving or utilizing unfavorable weather conditions.

2. Soil Moisture Situation - August 1, 1954

The soil moisture data for August 1 may provide some information of use in determining how severely the corn may have suffered from lack of moisture.

3. Drought Occurrence in Iowa

4. Soil Temperature Data

5. Final Report on the Statistical Analysis of Freeze Data

6. Final Report on a Study of Normals in Climatology

7. The Influence of Location on the Length of the Freeze-Free Season in Iowa

8. Climatological Summary - Waterloo, Iowa

9. Temperature Duration Relationships for Selected Iowa Meteorological Stations

10. Iowa Corn Moisture Study

11. Climatological Summary - Cedar Rapids, Iowa

12. Soil Moisture as Influenced by Cropping Practices and Meteorological Conditions

NOTE: Most of the cards listed on the following page were produced several years ago under Weather Bureau Contracts. The Weather Bureau has no obligation to match card for card except for those punched since our Memorandum of Understanding was executed January 4, 1955.

IOWA STATE COLLEGE (Cont.)

<u>STATION</u>	<u>Punched by the College</u>	<u>1009 Cards</u>	<u>Reproduced by Weather Bureau</u>
Rock Rapids	1/93-6/48		7/48-12/55
Spencer	1/95-6/48		"
Le Mars	1/94-6/48		"
Storm Lake	1/93-6/48		"
Mason City	1/96-6/48		"
Algona	1/93-6/48		"
Hampton	"		"
Fayette	1/96-6/48		"
New Hampton	1/97-6/48		"
Waterloo	1/95-6/48		"
Delaware	1/93-6/48		"
Denison	"		"
Logan	"		"
Rockwell City	1/97-6/48		"
Onawa	1/99-6/48		"
Guthrie Center	1/95-6/48		"
Ames	1/93-6/48		"
Webster City	"		"
Marshalltown	"		"
Grinnell	"		"
Cedar Rapids	1/95-6/48		"
Clinton	1/21-12/45		-
Maquoketa	1/97-6/48		7/48-12/55
Tipton (Clarence)	1/02-6/48		"
Corning	1/96-6/48		"
Clarinda	1/93-6/48		"
Glenwood	"		"
Atlantic	"		"
Corydon (Millerton)	"		"
Albia	1/29-12/30; 1/42-12/46		-
Indianola	1/97-6/48		-
Mt. Ayr	1/93-6/48		7/48-12/55
Washington	"		"
Oskaloosa	"		"
Fairfield	1/96-6/48		"
Keosauqua	1/93-6/48		"

681,455 Cards punched by the College and furnished the Weather Bureau.
93,075 Cards reproduced by the Weather Bureau and furnished the
College.

KANSAS, MANHATTAN - KANSAS STATE COLLEGEStarted 8-6-55

Weather in relation to Kansas agriculture.

In studies of weather, climatic types and seasonal characteristics have been shown. Studies have also demonstrated certain relationships between weather conditions and degrees of success or lack of success of certain crop production and livestock management practices. Much more information is needed on the degree to which weather influences the success of farming and how practices may be modified or changed to obtain better results.

Analysis and interpretation of Kansas weather data will show the climatic characteristics of areas such as frequencies, probabilities and times of occurrence of drought, excessive precipitation, high temperatures, and low temperatures, and will facilitate making agricultural studies on both state and regional bases.

A number of projects have been contemplated but nothing major done yet.

1009 Cards punched by the College

<u>STATION</u>	<u>Period</u>	<u>Amount</u>
Hays	1900-1948	17,885
Manhattan	"	17,885
Columbus		4,000

39,770 Cards punched by the College.

No exchange of cards as yet.

MARYLAND, BALTIMORE - UNIVERSITY OF MARYLAND, UNIVERSITY OF DELAWARE,
MARYLAND STATE WEATHER SERVICE Started 6-25-55

Dr. Fieldhouse, University of Delaware, is working on some outlines for climatological summarizations required from the punched cards for use in connection with agricultural problems.

A committee on climatology was appointed to serve in relation to the climatological program at the University of Maryland.

<u>MARYLAND</u> <u>STATION</u>	<u>Punched by</u> <u>University</u>	<u>Reproduced by</u> <u>Weather Bureau</u>
	<u>1009 Cards</u>	
Salisbury	1/20-6/48	
Cheltenham	1/21-6/36	
Woodstock	1/01-7/48	
Keedysville	11/04-7/48	
College Park	1/04-12/20	
Baltimore	1/05-6/06; 1/30-5/30; 9-12/1906-1947	
Easton	1/14-12/15 1/30-3/36	
Oakland	1/04-7/48	
Princess Anne	1/00-12/44	
 <u>DELAWARE</u>		
Georgetown	9/46-7/48	8/48-12/55
Lewes	2/45-7/48	"
Milford	1/10-7/48	"
Newark Col Farm	1/00; 1/02-6/05; 1/41-6/48	"
Dover	1/20-7/48	"
Bridgeville	9/24-6/48	"
Wilmington Porter Res.	1/32-6/48	"
Middletown		8/52-12/55
Selbyville		1/54-12/55

144,506 1009 Cards punched by the University.
20,620 1009 Cards reproduced by the Weather Bureau and furnished
the University.

MICHIGAN, EAST LANSING - MICHIGAN STATE COLLEGEStarted 10-2-52A Summary of Weather Conditions at East Lansing, Michigan - Prior to 1950

This study was undertaken because of frequent requests for information concerning cumulative weather information as an aid in the interpretation of data from agricultural research and also to form a background for recommendations to producers of agricultural crops. The queries pertain to such matters as temperatures in certain weeks during the growing seasons; rainfall for particular short intervals during mid-summer; humidities and night temperatures during fruit-setting periods for various vegetables; night temperatures and percentages of sunshine during the sap-flowing period of maple trees; solar radiation and evaporation data for various times of the year; drought durations; soil temperatures at various depths.

A Summary of Weather Conditions at South Haven, Michigan from 1926-1952.A Summary of Weather Conditions at the Upper Peninsula Experiment Station, Chatham, Michigan from 1901-1952.

<u>STATION</u>	<u>1009 Cards</u>	
	<u>Punched by the College</u>	<u>Reproduced by Weather Bureau</u>
East Lansing	* 1/10-12/48	1/48-12/55
South Haven	* 1/26-12/48	"
Chatham	* 1/01-12/15; * 1/26-12/48	"
Monroe	* 1/31-12/48	"
Coldwater	1/98-12/48	5/48-6/55

61,320 Cards punched by the College.

* 43,070 Duplicate cards furnished the Weather Bureau by the College.

14,235 Cards reproduced by the Weather Bureau and furnished the College.

MINNESOTA, MINNEAPOLIS - UNIVERSITY OF MINNESOTAStarted 5-22-52

Use of the punched card data by the University has been quite limited.

One preliminary report has been printed on a study of rainfall and temperature against the need of irrigation at Minneapolis. Similar data are being worked up for other stations.

<u>STATION</u>	<u>1009 cards punched by University</u>	<u>Reproduced by Weather Bureau</u>
Minneapolis	* 1/91-6/49	1949-1952
Morris	* 1/86-12/48	
Crookston	* 1/90-12/48	
Waseca	* 1/15-12/48	
Cloquet	1/11-12/48	
Itasca	1/12-12/48	
Grand Rapids	1/15-12/48	
Worthington	1/94-12/48	

138,200 Cards punched by the University.
 * 78,300 Duplicate cards furnished the Weather Bureau by the University.
 36,300 Cards reproduced by the Weather Bureau and furnished the
 University. 34,840 - Hourly cards
 1,460 - Daily summary cards

Weather records from 56 locations in Missouri have now been processed. These locations represent one weather station for every 1250 square miles of area. This density of weather stations may adequately describe the climate of the State.

Probabilities of dry periods and severe drouths in different regions of the state - These data will be of value to farmers in general and also in connection with the supplemental irrigation studies and programs in progress or anticipated.

All the dry periods beginning between May 1 through August 31 for Columbia, Missouri have been tabulated over a 64 year period, extending from 1890 through 1953. These dry periods have been tabulated by semi-monthly periods.

Microclimatic Variations within Different Covers

The system of observation employed was designed to investigate the temperatures and humidities within and above different types of cover simultaneously. The types of cover investigated were pasture, corn soybeans and wheat stubble.

Study of Winter Injury to Winter Barley

The purpose of this experimental work is to study the extent and nature of winter injury and to relate this injury to the specific weather conditions causing it.

Determination of Dry Period Expectancies

Method described for determining the likelihood of dry periods of varying lengths. The expectancies for 19 locations have been computed.

Determinations of Variations in the Micro-Climates under Missouri's Agricultural Conditions

During the summer of 1954 temperature and humidity observations were taken within adjacent irrigated and unirrigated corn plots. These observations were taken to determine whether high temperature damage was occurring during the flowering period of the plant.

Soil Temperatures in Missouri

Data have been obtained for the regression analysis to determine the effectiveness of meteorological parameters in estimating the temperature of the soil. The data which have been compiled are:

- a. Daily incoming solar energy
- b. Daily air temperature upstream from Columbia

UNIVERSITY OF MISSOURI (Cont.)

- c. The average daily wind velocity
- d. The average night cloudiness and type of cloud
- e. The moisture content of the soil

Using IBM methods, a correlation analysis on soil temperature increase will be completed.

PUBLICATIONS

1. Monthly Precipitation in Missouri
2. Late Spring and Early Fall Killing Freezes in Missouri
3. Probability of Killing Freezes in Missouri

<u>STATION</u>	<u>WBAN #3</u>	
	<u>Punched by University</u>	<u>Reproduced by Weather Bureau</u>
St. Joseph	*1/10-12/48	1/49-12/52
St. Louis	*1/08-12/48	"
Springfield	*1/08-12/48	"
Cairo, Illinois	*1/08-12/48	"
Columbia	*1/90-12/53	1/51-12/52
Kansas City	*1/08-12/48	1/49-12/52
Hannibal	*1/08-12/48	

<u>WBAN #1</u>	
Columbia, Missouri	1/48-7/56

112,420 WBAN #3 punched by the University .
 7,845 WBAN #3 reproduced by the Weather Bureau.
 74,800 WBAN #1 reproduced by the Weather Bureau.

UNIVERSITY OF MISSOURI (Cont.)

<u>STATION</u>	<u>1009 Cards</u>	
	<u>Punched by the University</u>	<u>Reproduced by Weather Bureau</u>
Arcadia	1/18-12/48	1/49-12/52
Bethany	* "	"
Birch Tree	* "	"
Bolivar	"	"
Brunswick	* "	"
Campbell	"	-
Caruthersville	* "	1/49-12/52
Cassville	* 1/18-3/20	-
Chillicothe	* 1/18-12/48	1/49-12/52
Clinton	* "	"
Eldon	* "	"
Elsberry	"	-
Farmington	* "	1/49-12/52
Fayette	1/27-12/48	-
Fulton	1/18-12/48	1/49-12/52
Greenville	1/22-12/48	"
Hannibal	"	"
Harrisonville	* 1/18-12/48	"
Jackson	* "	"
Jefferson City	* "	1/49-12/55
Kidder	* "	1/49-12/52
Kirksville	* "	"
Koshkonong	* "	"
Lamar	"	-
Lebanon	* "	1/49-12/52
Lexington	* "	"
Lockwood	* "	"
Louisiana	* "	"
Macon	* "	"
Marshall	* "	"
Maryville	* "	"
Mexico	* "	"
Moberly	1/36-12/48	1/49-12/55
Morehouse	* 11/25-3/36	-
Mountain Grove	* 1/18-12/48	1/49-12/52
Mount Vernon	1/38-12/48	"
Neosho	* 1/18-12/48	"
Nevada	* "	"
Poplar Bluff	* "	"
Rolla Sch. of Mines	* "	"
St. Charles	"	"
Salem	* "	"
Sedalia	4/37-12/48	"
Seligman	* 11/21-12/48	"
Sikeston	* 4/26-12/48	"
Steffanville	* 1/18-12/48	"

UNIVERSITY OF MISSOURI (Cont.)

<u>STATION</u>	<u>1009 Cards</u>	
	<u>Punched by the University</u>	<u>Reproduced by Weather Bureau</u>
Tarkio	* 1/18-12/48	1/49-12/52
Trenton	"	"
Unionville	*	"
Vanduser	* 10/20-10/25	-
Warrensburg	* 1/18-12/48	1/49-12/52
Warrenton	*	"
Warsaw	*	"

484,355 1009 cards punched by the University.
70,810 1009 cards reproduced by the Weather Bureau.

643,495 Total number of cards punched by the University.
* 521,950 Duplicate cards furnished the Weather Bureau by the University.
153,455 Total number of cards reproduced by the Weather Bureau and
furnished the University.

MONTANA, BOZEMAN - MONTANA STATE COLLEGEStarted 2-27-52

Approximately 506 station years of records have been punched since the beginning of this project. Some of the cards have already been used for research purposes.

It was their desire to set up pilot project for the study of climate relative to agriculture in the Great Plains with particular emphasis on developing more intelligent land use from the calculation of climatic risks involved in the various agricultural operations.

Montana Agricultural Experiment Station Research Project M. S. No. 968, entitled, "Climatic Patterns and Their Effect on Montana Agriculture" provides for the continuation of the card punching program. The objectives of this project are:

1. To record and tabulate weather data from 20 selected climatological sub-stations on coded cards so as to reveal climatic patterns significant to Montana Agriculture.
2. To develop methods of applying tabulated data to agricultural problems in Montana.

1009 Cards punched by the University

<u>STATION</u>	<u>Period</u>	<u>STATION</u>	<u>Period</u>
Havre	* 1/93-12/22	Belgrade	* 1/41-12/48
Trident	* 1/37-12/48	Columbia Falls	* 1/93-12/48
Stevensville	* 1/11-12/48	Culbertson	* 1/00-12/48
Ballantine	* 1/09-12/48	Bigfork	1/38-12/48
Hamilton	1/95-12/48	Lewistown	1/96-12/48
Savage	1/96-12/48	Stanford	1/27-12/48
Bozeman	1/92-12/48		
Ft. Assinniboine	*1/17-12/48		
Huntley Exp. Station	* 1/11-12/48		
Moccasin Exp. Station	* 1/09-12/48		

Reproduced by
Weather Bureau

Bozeman	1/48-12/54
Ft. Assinniboine	4/48-12/54
Huntley Exp. Station	1/48-12/54
Moccasin Exp. Station	1/48-12/54

- 215,450 Total number of cards punched by the University.
 * 124,200 Duplicate cards furnished the Weather Bureau by the University.
 10,220 Reproduced and furnished the University by the Weather Bureau.

NEBRASKA, LINCOLN - UNIVERSITY OF NEBRASKAStarted 8-5-55

Climatology as applied to agriculture and other uses in the State of Nebraska. The University has not made any studies since not enough punched card data are yet available.

<u>STATION</u>	<u>Period</u>
Albion	1/93-12/48
Alliance	1/90-12/48
Broken Bow	1/94-12/48
Culbertson	1/93-12/48
Hartington	1/90-12/48
Lincoln,	
Agronomy Farm	1/21-12/48
Mitchell	1/09-12/48

128,850 1009 cards punched by the University.

No exchange of cards as yet.

NEW HAMPSHIRE, DURHAM - UNIVERSITY OF NEW HAMPSHIREStarted 2-9-56

Analysis of the punched card data in connection with an irrigation research program.

<u>STATION</u>	<u>Punched by the University</u>	<u>Reproduced and furnished the University by the Weather Bureau</u>
	<u>1009 Cards</u>	
Eastport, Me.	1/26-5/48	6/48-12/55
Farmington, Me.	"	"
Presque Isle, Me.	"	"
Adams, Mass.	"	"
Blue Hill, Mass.	"	"
Hyannis, Mass.	"	"
Springfield, Mass.	"	"
Berlin, N. H.	"	"
Durham, N. H.	"	"
Hanover, N. H.	"	"
Keene, N. H.	"	"
Newport, Vt.	"	"
Kingston, R. I.	"	"
Burlington, Vt.		1/20-12/55
Norwalk, Conn.		1/26-12/55

106,765 Cards punched by the University.
60,075 Cards furnished the University by the Weather Bureau.

NORTH CAROLINA, RALEIGH - NORTH CAROLINA STATE COLLEGE
(This is inactive)

1. Climatic Factors Affecting Plant Growth and Crop Production in the Southwest Piedmont of North Carolina.

To characterize the area with respect to climatic factors which limit or enhance crop production; to indicate methods of utilizing such data in adjusting agricultural production in this area.

2. A study of Weather Factors Affecting Cotton Yields

Progress has been made in the examination of four crops - cotton, corn, alfalfa, and crimson clover.

Publication - "Weather and Climate in North Carolina"

<u>STATION</u>	<u>Period</u> <u>Daily Obs.</u>	<u>STATION</u>	<u>Period</u> <u>Daily Obs.</u>
Beaufort	1896,1897 1/04-12/46	Caroleen	1/06-12/44
Durham	1/21-12/45	Charlotte	1/93-12/45
Goldsboro	1/04-12/45	Gastonia	1/30-12/44
Mount Airy	1/93-12/48	Lumberton	1/03-12/45
Raleigh Airport	1/21-12/45	Raleigh	1/92-12/43
Shelby	1/93-12/95; 1/24-12/44	Salisbury	1/93-12/45
Winston Salem	1/04-12/45	Statesville	1/02-12/45
		Weldon	1/03-12/45
		Waynesville	1894-1947 - (Aug. only)
	<u>Hourly Obs.</u>		
	(2 obs. on each card - 6 months apart)		
Greensboro	1/34-12/44		
Charlotte	1/34-12/44		
Raleigh	1/35-12/45		

219,000 Punched by the College.

80,000 Reproduced and furnished the College by the Weather Bureau.

NOTE: These cards were punched on a contractual basis; therefore, the Weather Bureau does not have an obligation to exchange card for card.

NORTH DAKOTA, FARGO - NORTH DAKOTA AGRICULTURAL COLLEGE Started 2-24-55

A survey and informal discussions have been carried out in a preliminary attempt to determine researchers' needs for climatic information.

It is planned to obtain probabilities of given amounts of rain during certain periods. A study of some of the statistical difficulties involved in obtaining such probabilities is also planned.

<u>STATION</u>	<u>1009 Cards</u>	
	<u>Punched by</u> <u>the University</u>	<u>Reproduced by</u> <u>Weather Bureau</u>
Dickinson Exp. Station	? - 1947	1/48-6/55
Crosby	"	"
Edgeley Exp. Farm	"	"
Langdon Exp. Farm	"	"
Mandan Exp. Station	"	"
Mayville	"	"
Missing record - Dickinson - 8 months		
Edgeley - 1 month		

16,150 Reproduced and furnished the University by the Weather Bureau.
? Punched by the University.

OHIO, WOOSTER - OHIO AGRICULTURAL EXPERIMENT STATION Started 2-17-56

<u>STATION</u>	<u>Punched by the University</u>	<u>Reproduced by the Weather Bureau</u>
	<u>1009 Cards</u>	
Wooster	1/94-6/48	5/48-12/55

29,710 Punched by the University
2,770 Reproduced and furnished the University by the Weather Bureau.

OKLAHOMA, STILLWATER - OKLAHOMA A & M COLLEGEStarted 3-30-54

Computation of cooling degree days for Stillwater for the 30 most recent years of record.

<u>STATION</u>	<u>1009 Cards Punched by the College</u>	<u>1009 Cards Reproduced by the Weather Bureau</u>
Ada	1/07-7/47	
Ardmore	* 8/01-6/47	7/47-12/54
Bristow	* 11/15-7/47	
Chickasha	* 1/10-7/47	
Durant	8/01-7/47	
Enid	* 1/94-7/47	
Holdenville	9/1900-7/47	
Jefferson	* 7/97-7/46	7/47-12/54
Kingfisher	* 4/97-7/46	"
Okemah	* 4/12-7/47	
Stillwater	* 7/93-6/47	7/47-12/54
Tishomingo	7/25-7/47	
Waurika	* 1/10-7/47	
Marlow	1/07-7/47	
Chandler	1/01-7/47	

232,140 Punched by the College.

* 143,810 Duplicates furnished the Weather Bureau.

10,950 Furnished the College by the Weather Bureau.

SOUTH DAKOTA, BROOKINGS - SOUTH DAKOTA STATE COLLEGEStarted 12-3-51

A statewide investigation of freeze hazards for fruit, truck crops and other crops was undertaken.

The bulletin "Likelihood of Damaging Low Temperatures During the Growing Season" has been printed. This was an investigation of low temperatures in the spring and fall for representative areas over the state. Final results are shown both in tabular and graphical form.

A good example of the uses of punched card information was presented in a study by V. A. Dirks. The frequency of various winter conditions was analyzed in his study of the causes of winter injury of fall-sown grain.

"Analysis of Crop Season Precipitation in South Dakota". This special study has been made because the major climatic limiting factor in the development of agriculture in South Dakota has been rainfall and because of increasing demands of both agricultural and business interests for information on the character of South Dakota's precipitation.

<u>STATION</u>	<u>WBAN #3</u> <u>Punched by</u> <u>the College</u>	<u>WBAN #3</u> <u>Reproduced by</u> <u>Weather Bureau</u>
Aberdeen	1/96-12/47	5/48-12/54
Huron	1/81-12/47	
Huron	* 1/40-12/47	5/48-12/55
Pierre	1/92-12/47	"
Sioux Falls	1/96-12/47	"
Watertown	"	5/48-12/54
Yankton	1/87-12/47	5/48-12/55
Rapid City	1/89-4/48	"
	<u>WBAN #1</u>	<u>WBAN #1</u>
Huron	* 1/40-12/47	1/48-12/55
Pierre		"
Rapid City		"

68,875 Punched by the College - WBAN #3
18,855 Reproduced by the Weather Bureau - WBAN #3

70,080 Punched by the College - WBAN #1
210,240 Reproduced by the Weather Bureau - WBAN #1

SOUTH DAKOTA STATE COLLEGE (Cont.)

<u>STATION</u>	<u>1009 Cards Punched by the College</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Academy	* 1/98-4/48	5/48-12/55
Angostura Dam		"
Armour	* 1/96-4/48	"
Bison	1/16-12/21; 1/31-12/47	"
Britton	* 1/13-4/48	"
Brookings	* 1/93-4/48	"
Camp Crook	* 1/96-6/48	"
Centerville	* 1/97-12/47	"
Clark	* 1/96-4/48	"
Cottonwood	* 9/01-4/48	"
Custer	* 1/26-4/48	"
Deerfield Dam		1/49-12/55
Dupree	* 1/22-4/48	5/48-12/55
Eureka	* 1/08-4/48	"
Fairfax	* 9/02-4/48	"
Faith	1/13-12/47	"
Faith	* 1/26-4/48	"
Faulkton	* 1/96-12/47	"
Forestburg	* 1/96-4/48	"
Gann Valley	1/03-4/48	"
Gann Valley	* 1/20-4/48	"
Gettysburg		"
Gregory	* 1/26-12/47	"
Highmore	* 1/96-4/48	"
Hilland		"
Hopewell		1/50-12/55
Hot Springs	1/97-12/1900	
Hot Springs	* 1/08-4/48	5/48-12/55
Howard	1/96-12/47	"
Kennebec	1/06-12/47	"
Lead	1/09-12/47	"
Longvalley	1/27-12/47	1/49-12/55
Lemmon	1/20-12/47	5/48-12/55
Marion	1/01-12/47	"
McIntosh	1/15-12/47	"
Mellette	* 1/96-12/47	"
Menno	"	1/49-12/55
Martin	1/34-12/47	1/48-12/55
Milbank	1/93-12/47	5/48-12/55
Miller	1/02-12/47	"
Mitchell	* 1/96-12/47	"
Mobridge	1/26-12/47	"
Murdo	1/20-12/47	"

SOUTH DAKOTA STATE COLLEGE (Cont.)

<u>STATION</u>	<u>1009 Cards Punched by the College</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Newell	1/20-12/47	5/48-12/55
Oelrichs	1/96-12/47	"
Pickstown		1/48-12/55
Pine Ridge	1/28-12/47	5/48-12/55
Pollock	1/20-12/47	"
Redfield	1/97-12/47	"
Redfield 6 E		1/49-12/55
Redig	1/20-12/47	5/48-12/55
Roscoe	1/35-12/47	1/48-12/55
Shadehill Dam		1/50-12/55
Sisseton	1/31-12/47	5/48-12/55
Spearfish	"	"
Timber Lake	1/26-12/47	"
Tyndall	1/93-12/47	"
Vale	1/20-12/47	"
Vermillion	1/97-12/47	"
Vivian	1/20-12/47	"
Wasta		1/49-12/55
Webster		1/48-12/55
Wentworth	1/96-12/47	5/48-12/55
White Lake	1/20-12/47	"
Winner	1/24-12/47	"
Wood	1/20-12/47	"
Yankton		1/48-12/55

422,060 1009 cards punched by the College.
 175,440 1009 cards reproduced by the Weather Bureau.

527,925 Total number of cards punched by the College.
 * 403,020 Total number of duplicate cards furnished the Weather Bureau.
 404,535 Total number of cards reproduced and furnished the College.

TEXAS, AUSTIN - TEXAS BOARD OF WATER ENGINEERSStarted 3-23-54

They are planning an extension of a rainfall frequency and intensity study entitled "Excessive Rainfall in Texas".

Contemplated studies are slanted toward maximum design requirements of water retaining structures in the state.

<u>STATION</u>	<u>1009 Cards Punched by the Board</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Albany	1/96-12/53	
Ballinger	1/97-12/46	1/46-12/53
Borger	1/44-12/47	
Bridgeport	* 1/15-12/46	
Childress	1/91-12/19; 1/23-12/46	
Clarendon	1/04-12/46	
Claude	1/04-12/47	
Dalhart	* 1/05-12/47	
Stamford	1/11-12/20; 1/26-12/53	1/46-12/53

133,700	Punched by the Texas Board of Water Engineers.
* 27,300	Duplicates furnished the Weather Bureau.
11,650	Reproduced and furnished the Board by the Weather Bureau.

UTAH, SALT LAKE CITY - UNIVERSITY OF UTAHStarted 4-3-53

The 1009 cards were used for selected stations to determine average number of days with specified temperature and precipitation limits in preparation of substation climatological summaries. They were also used to a limited extent in the evaluation of the cloud seeding project in southern Utah.

It is tentatively planned by the University to use the upper air data in connection with some synoptic studies.

<u>STATION</u>	<u>1009 Cards Punched by the University</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
<u>UTAH</u>		
Alton	1/28-12/47	
Blanding	"	
Bluff	"	
Cedar City	"	
Deseret	"	
Duchesne	"	
Emery	"	
Escalante	"	
Hiawatha	"	
Logan	"	7/48-12/52
Milford	"	
Moab	"	
Orderville	"	
Richmond	"	
St. George	"	
Snake Creek	"	
Zion Natl. Park	"	
Corinne	* "	7/48-12/52
Fillmore	* "	"
Levan	* "	"
Manti	* "	"
Modena	"	"
Oak City	* "	"
Salt Lake City	"	"
Scipio	* "	"

UNIVERSITY OF UTAH (Cont.)

<u>STATION</u>	<u>1009 Cards Punched by the University</u>	<u>RAOB Cards Reproduced by Weather Bureau</u>
<u>NEVADA</u>		
Adaven	1/28-12/47	
Caliente	"	
Las Vegas	"	
<u>UTAH</u>		
Ogden, Hill Field		1-8/48; 3/50-3/51 7/52-12/54

197,100 Punched by the University.
 * 43,800 Duplicates furnished the Weather Bureau by the University.
 40,785 Reproduced and furnished the University by the Weather Bureau.

WASHINGTON, SEATTLE - UNIVERSITY OF WASHINGTON

Started 4-1-56

The actual work on this project was not started until November 1956.

18,250 1009 cards have been punched by the University for

Vancouver 5/1898-5/1948

Results and contemplated studies:

1. Hourly temperature studies for Wausau and Madison.
2. Wisconsin rainfall computed using the contingency table approach.
3. Computed the third order polynomial twice daily using the 4-station grid of 500 mb data from St. Cloud, Joliet, International Falls, and Saulte Ste. Marie. From this a rainfall correlation study for Wisconsin was done for the period 1948 through 1953. Convergence and vorticity computation.
4. Punched running 3, 7, 14 and 21 day precipitation sums for Madison, Cloquet, Minnesota, Hancock, Wisconsin; Storm Lake and Ames, Iowa and the southern third of the Wisconsin River valley and from that computed the basic probabilities of rainfall within several limits.
5. Triangular network from Joliet, St. Cloud, and Sault Ste. Marie for the six levels 950, 900, 850, 750 and 700 with computations made for specific humidity, divergence, spar moisture divergence, vertical motion, specific humidity deficit and integrated moisture divergence at all levels and stations.
6. From the above parameters in item 5, correlation was run with daily rainfall; northern one third, central one third and southern third of the Wisconsin Valley, the southern two thirds and the whole Wisconsin Valley.
7. Study was made correlating Wisconsin Valley rainfall with the St. Cloud wind components, relative humidity, pressure and temperature at 50 mb intervals from 950 to 500 millibars.
8. Have punched and analyzed a Grosswetter Lagen deck 1881-1956.
9. Studies on the Lorenz End Square Index as a hemispheric circulation index. They are currently constructing an atlas of 5-day mean maps for the Northern Hemisphere, latitudes 30 - 65 degrees.
10. A study using an AROWA deck was also made to compute 500 mb polynomials from 10 to 70 degree latitude October 1945 through January 1953 daily.
11. The daily sunspot data from 1880 to the present is being punched on cards (geomagnetic index is also punched) to use in weather correlations.

NOTE: A portion of the above studies were carried out under other contracts.

UNIVERSITY OF WISCONSIN (Cont.)

<u>STATION</u>	<u>1009 Cards Punched by the University</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Burnett	1/24-12/48	
Darlington	3/01-12/05; 1/10-12/51	
Hancock	1/03-12/48	
Madison	1/05-12/50	
Marshfield	1/24-12/47	
Plymouth	1/24-12/49	
Spooner	1/11-12/48	
Watertown	1/24-12/48	
West Bend	1/24-12/49	
Cloquet, Minnesota		1/48-12/54

	<u>Psychometric Data</u>	<u>WBAN #1</u>
Madison	1/18-12/51	6/48-6/53
Wausau		11/49-6/53

	<u>WBAN #3</u>
Madison	1/48-6/53
Wausau	11/49-6/53

110,535	1009 Cards punched by the University
<u>12,650</u>	Surface psychometric data cards punched by the University.

123,185 Total number of cards punched by the University and duplicates furnished the Weather Bureau.

2,555	1009 Cards reproduced by the Weather Bureau.
76,660	WBAN #1
<u>3,580</u>	WBAN #3

82,795 Total number of cards reproduced and furnished the University by the Weather Bureau.

WYOMING, LARAMIE - UNIVERSITY OF WYOMINGStarted 2-24-56

It is planned to correlate precipitation figures with crop yields and also to work up data on last and first freezing temperatures.

Two projects using the punched cards have been outlined. One of these is an effort to determine the most effective and efficient method of hay harvest. The other project involved has to do with yield of alfalfa seed. This crop is an important factor in the agricultural economy of a segment of the state.

<u>STATION</u>	<u>1009 Cards Punched by the University</u>	<u>1009 Cards Reproduced by Weather Bureau</u>
Archer	Period unknown	8/48-12/55
Gillette		"
Laramie		"
Riverton		"
Sheridan Field		"
Pavillion		"
Sundance		"
Torrington Exp. Farm		"
Wheatland		"

Approximately 90,000 cards have been punched by the University.

24,390 Reproduced and furnished the University by the Weather Bureau.

COOPERATIVE AGREEMENTS EFFECTED IN 1956

<u>UNIVERSITY</u>	<u>DATE STARTED</u>
Massachusetts, E. Wareham University of Massachusetts Cranberry Experiment Station	8-28-56
New Jersey, New Brunswick Rutgers University	7-30-56
New York, Ithaca Cornell University	8-1-56
Pennsylvania, University Park Pennsylvania State University Commonwealth of Pennsylvania	10-5-56
West Virginia, Morgantown West Virginia University Agricultural Experiment Station	-56
Connecticut, Storrs University of Connecticut	-56

WEATHER BUREAU - STATE UNIVERSITY COOPERATION

<u>UNIVERSITY OR AGENCY</u>	<u>CARDS PUNCHED BY THE UNIVERSITY</u>	<u>CARDS REPRODUCED BY THE WEATHER BUREAU AND FUR- NISHED THE UNIV.</u>
ARIZONA, UNIVERSITY OF	542,000	1,201,900
ARKANSAS, UNIVERSITY OF	195,000	35,600
FLORIDA, UNIVERSITY	?	10,950
ILLINOIS STATE WATER SURVEY	637,085	525,200
INDIANA - PURDUE UNIVERSITY	281,600	0
IOWA STATE COLLEGE	681,450	93,000
KANSAS STATE COLLEGE	39,700	0
MARYLAND, UNIVERSITY OF	144,500	20,600
MICHIGAN STATE COLLEGE	61,300	14,200
MINNESOTA, UNIVERSITY OF	138,200	36,300
MISSOURI, UNIVERSITY OF	643,500	153,450
MONTANA STATE COLLEGE	215,450	10,200
NEBRASKA, UNIVERSITY OF	128,850	0
NEW HAMPSHIRE, UNIVERSITY OF	106,800	60,100
NORTH CAROLINA STATE COLLEGE	219,000	80,000
NORTH DAKOTA AGRICULTURAL COLLEGE	?	16,150
OHIO AGRICULTURAL EXP. STATION	29,700	2,800
OKLAHOMA A & M COLLEGE	232,100	10,950
SOUTH DAKOTA STATE COLLEGE	527,900	404,500
TEXAS BOARD OF WATER ENGINEERS	133,700	11,650
UTAH, UNIVERSITY OF	197,100	40,800
WASHINGTON, UNIVERSITY OF	18,250	0
WISCONSIN, UNIVERSITY OF	123,200	82,800
WYOMING AGRICULTURAL EXP STATION	90,000	24,400
	<hr/>	<hr/>
TOTAL	5,386,385	2,835,550

REFERENCES

- McDonald, James E. First Annual Progress Report. University of Arizona. November 1955. 56 pages.
- Changnon, Stanley A., Jr. First Progress Report. Illinois State Water Survey. July 1955. 44 pages.
- Changnon, Stanley A., Jr. Second Progress Report. Illinois State Water Survey. July 1956. 24 pages.
- Decker, Wayne L. University of Missouri. Eight Annual Progress Reports. 1950 - 1956.
- Caprio, Joseph M. and Dightman, Richard A. Interim Progress Report. Montana State College. December 1955.
- Pengra, Ray F. and Magnuson, M. D. Four Annual Progress Reports. South Dakota State College. 1952 - 1955.
- Pengra, Ray F. and Hodge, William T. Fifth Annual Progress Report. South Dakota State College. July 1956.

