View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by NASA Technical Reports Server

N66-17324

FACILITY FORM 602

(ACCESSION NUMBER) (THRU)

32 1

(PAGES) (CODE)

CR 70399 08

(NASA CR OR TMX OR AD NUMBER) (CATEGORY)

[redacted]

ORBITAL OPERATIONS STUDIES

GPO PRICE $

CFSTI PRICE(S) $

Hard copy (HC) 2.00

Microfiche (MF) .50

ff 653 July 65

Natural Resources Research Institute
in association with the
National Aeronautics and Space Administration

College of Engineering
University of Wyoming
Laramie, Wyoming

NATURAL RESOURCES RESEARCH INSTITUTE
ENGINEERING Education - Research - Service
Mineral - Road - Air - Orbital - Water OPERATIONS
UNIVERSITY OF WYOMING, LARAMIE

Information Circular No. 32

"SIPLIC" FORMS OF HOURLY PRECIPITATION DATA

Casper, Cheyenne, Lander, Sheridan: 1949-1961

Anton C. Munari
John C. Bellamy

August 1965

This report is one of a series on Informatic Data Research at the University of Wyoming. The purpose of this program is to establish the principles and practices of utilizing newly possible

informatic	ways of representing large sequences of numbers as concise complete "pictures" or portrayals of
information	which can be acquired, processed, recorded and re-processed in numerical detail only with appropriate
automatic	equipment if scientific and engineering operations are to become more economically effective.

The principal investigator for this project was Anton C. Munari under the participating direction of John C. Bellamy. His work was supported largely by Grant No. WBG-38 from the United States Weather Bureau for "Data Portrayal Research" on some of the data storage and utilization problems of the National Weather Record Center, the receipt of which is hereby gratefully acknowledged.

This work was also conducted in close conjunction with work under a National Aeronautics and Space Administration Grant No. NsG-658 for an "Orbital Operations Study" and U. S. Bureau of Reclamation Contracts for "Atmospheric Water Resources Research." Contributors to this project supported in part by those programs include Richard J. Jiacoletti, Dennis Kiser, A. L. Riemenschneider, Donald L. Veal and Merlin C. Williams.

"SIPLIC" FORMS OF
HOURLY PRECIPITATION DATA

List of Figures

"SIPLIC" FORMS OF
HOURLY PRECIPITATION DATA

1. Introduction

The work reported upon here is part of a long-range program of "Informatic Data Research" at the University of Wyoming.[1,2] The goal of this overall program is to develop newly possible automatic ways of acquiring and processing the large amounts of quantitative data required to depict the nature of occurrences throughout the Earth-centered part of the universe, or throughout the "geosphere." The approach to this problem is to experiment with newly practicable "informatic" forms of numerals with which:

- more complete geospheric data can be more readily acquired, processed and portrayed with potentially simple and inexpensive equipment, and
- the information contained in such data can be more readily and usefully interpreted manually.

The precipitation-gage data of interest here is being acquired with a nationwide network of continuously recording rain gages which was initiated in 1939 by the Corps of Engineers in cooperation with the Weather Bureau, the Bureau of Reclamation and others. This network contains more than 3,000 gages, and precipitation amounts at hourly intervals, or about 8,766 hourly data points per year, are obtained from each gage. The store of basic precipitation data is thus increasing at a rate of about 26,000,000 data points per year, and of the order of 650,000,000 data points have already been accumulated in the 25 year period from 1940 to 1965.

This data is currently being compiled in two basic ways. First, the Weather Bureau has been publishing monthly bulletins of hourly precipitation data for each state since October 1961. These bulletins (by virtue of utilizing small 3-point type and deleting all station-days in which precipitation amounts were less than 0.01 inches) typically tabulate all hourly precipitation amounts during a month for about 50 stations per state on three 8-1/2 by 11 inch printed pages. Second, all hourly precipitation amounts since July 1948 have been recorded on punched cards for some 2,500 to 3,000 gages. In this form, two 80 column 3-1/4 by 7-3/8 inch cards are required for each day for each gage and the stack of cards for one gage for one year is typically about two inches thick.

These two ways of compiling precipitation data leave much to be desired, however. Especially, neither of them convey a clear idea of the space-time distributions of precipitation. Rather, they both serve primarily as a store of basic data from which more graphical or pictorial representations can be, and almost invariably must be, formed. In contrast, the work reported upon here is predicated upon the postulate that this basic store of data can be compiled in a single, more concise, "informatic" form which also clearly portrays the space-time distributions of precipitation.

The first experimental test of this postulate for precipitation data was reported upon[3] in September 1962. A second test resulted in the development of the "SIPLIC" form of data to be use-tested here and was reported upon briefly[4] in August 1963. The third test is reported upon here and is specifically intended (1) to provide a larger sample of hourly precipitation data in this promising "SIPLIC" form and (2) to establish automatic procedures for producing it from the punched-card store of hourly precipitation data.

2. "SIPLIC" Notations

The name "SIPLIC", with which this form of notation is identified stands for a "Scaled Incremental, Periodically Labelled, Incrementally Continuous" kind of data. Briefly, "Incrementally Continuous" stands for a kind of data in which sequences of three and only three distinctive numerals are utilized to designate (1) that the value of the independent or ordinal variable such as time has increased by unity, and (2) that the value of the dependent variable has changed in one of three possible ways such as plus or minus unity or zero. "Scaled Incremental" refers to data in which similar numerals are utilized to indicate incremental changes of the values of the higher order digits of the dependent numbers. "Periodically Labelled" refers to data in which "full values" of both variables are explicitly identified at periodic intervals.

2.1 "Incrementally Continuous" Notations

The kind of "Incrementally Continuous" notation which is being tested here depicts hourly precipitation amounts as illustrated in Figure 1 for a one-month period. The existence of a mark of any size indicates that time has increased by one hour in a left-to-right succession of 24 marks for the 24 hourly intervals of each day, and in a top-to-bottom succession of horizontal lines for successive days. The three different sizes of these marks denote occurrences of precipitation in accordance with the following meanings.

<u>Large Mark</u>: At least 0.01 inches of precipitation occurred during this hour, and 0.01 inches of that occurrence is being accounted for with this mark.

<u>Medium Mark</u>: No precipitation occurred during this hour but 0.01 inches of precipitation has occurred during some previous hour, it has not previously been accounted for, and it is being accounted for with this mark.

<u>Small Mark</u>: No precipitation occurred during this hour and previous occurrences of precipitation have previously been accounted for.

For example, the large and medium marks at the position of the 6th and 7th hours in the line for the 11th day in Figure 1 denote an occurrence of 0.02 inches of precipitation on the 6th hour of that day. Similarly,

SHERIDAN WB AP

Jan. 1955

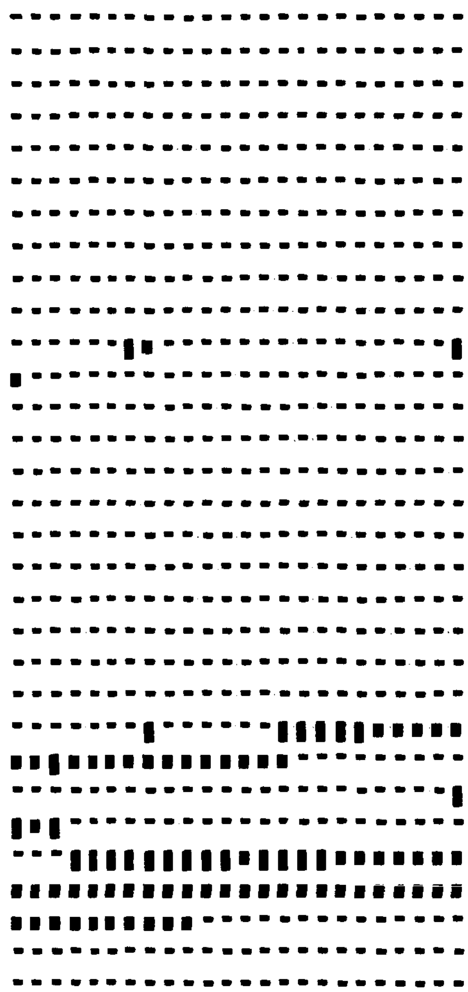


Fig. 1

0.02 inches are indicated as having occurred on the 24th hour of the 11th day and 0.01 inches occurred on the 8th hour of the 23rd day. Precipitation also occurred on the 15, 16, 17, 18 and 19th hours of the 23rd day and on the 3rd hour of the 24th day and (as indicated by a succession of 25 large and medium marks) the total accumulation of precipitation during this storm was 0.25 inches. Similarly, 0.03 inches of precipitation is indicated to have occurred on the 24th hour of the 26th day and the 1st hour of the 27th day; 0.01 inches occurred on the third hour of the 27th day; and a storm lasting from the 4th through the 17th hours of the 28th day let up during the 13th hour and produced a total of 0.55 inches of precipitation.

2.2 "Scaled Incremental" Notations

Such "Incrementally Continuous" notations in and of themselves suffer, however, from two major shortcomings. First, the manually counting of large numbers of marks is too difficult to permit convenient determination of numerical amounts of precipitation or of the times of their occurrence. Second, this kind of notation by itself provides no way of checking for possible errors in automatic readings of the data.

Both of these shortcomings can be largely eliminated, however, by utilizing a "Scaled Incremental" notation. As used here, a medium size "scaling" mark is inserted in the space following each incremental mark at which the accumulated amount of precipitation reaches 0.10 inches. For example, scaling marks of this kind in Figure 2 indicate that the amount of accumulated precipitation during the month reached 0.10 inches on the 19th hour of the 23rd day; that it reached 0.20 and 0.30 inches during the storm on the 23rd and 24th days; that it reached 0.40, 0.50, 0.60, 0.70 and 0.80 inches on the storm of the 27th day; and that the total accumulation during the month was 0.80 inches plus nine increments of 0.01 inches, or 0.89 inches.

In addition, every tenth one of these medium size scaling marks is replaced in subsequent illustrations by a large size scaling mark. These large scaling marks thus indicate directly those positions in the data at which accumulative amounts of precipitation first reach integral multiples of 1.00 inches.

SHERIDAN WB AP

Jan. 1955

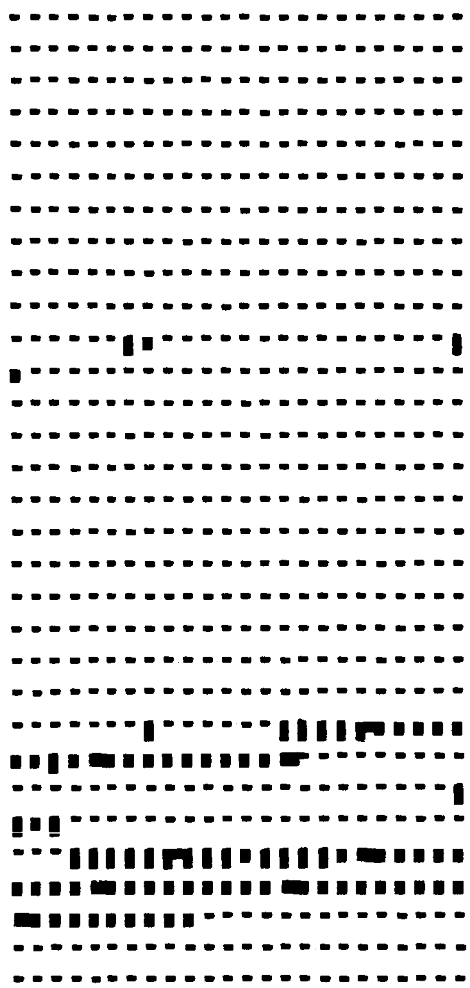


Fig. 2

Such scaling marks evidently provide a convenient means of checking for errors of automatic reading since ten occurrence and/or accounting increments should always be read and counted between successive scaling marks. They also evidently provide a convenient counting aid for manually determining the total amount of precipitation during any particular storm or during any other not-too-long period which might be of interest. Just as clearly, however, they do not of themselves provide as convenient a counting aid as might be desired for manually determining numerical values of large amounts of precipitation. Neither do they help to identify which specific days of the year correspond with particular horizontal lines of the incremental marks.

2.3 "Periodically Labelled" Notations

This shortcoming can be eliminated, however, by "Periodically Labelling" such "Scaled Incremental, Incrementally Continuous" data. A method of doing so is illustrated in Figure 3 in which numbers of days are labelled on the left and amounts of precipitation are labelled on the right.

Both of these labels utilize an "Iadic" or "Incrementally Alternating Dash" form of numerals. Specifically, accumulative amounts of precipitation are labelled on the right with "pentiadic" numerals which represent the five possible values of a radix-five numerical digit with five different thickness (including zero) of vertical lines called "iadic dashes." That is:

a zero-thickness	stands	for	0 or 5	in	the	numbers	0, 5, 10, 15,•••;
a single-thickness	"	"	1 or 6	"	"	"	1, 6, 11, 16,•••;
a double-thickness	"	"	2 or 7	"	"	"	2, 7, 12, 17,•••;
a triple-thicknesses	"	"	3 or 8	"	"	"	3, 8, 13, 18,•••;
a quadruple-thicknesses	"	"	4 or 9	"	"	"	4, 9, 14, 19,•••;

For example, the zero-thickness-dash indicated by the Arabic numeral 0 on the right of Figure 3 identifies those days in which the yearly accumulation of precipitation has not yet reached one inch; the single-thickness-dash indicated by the Arabic numeral 1 identifies those days in which the accumulation is one inch or more but has not yet reached two inches; the succeeding double-thickness-dash identifies days in which two but not yet three whole inches have been accumulated, and so forth. The "iadic" or "incrementally alternating dash" name for this kind of notation reflects the

SHERIDAN WB AP

1955

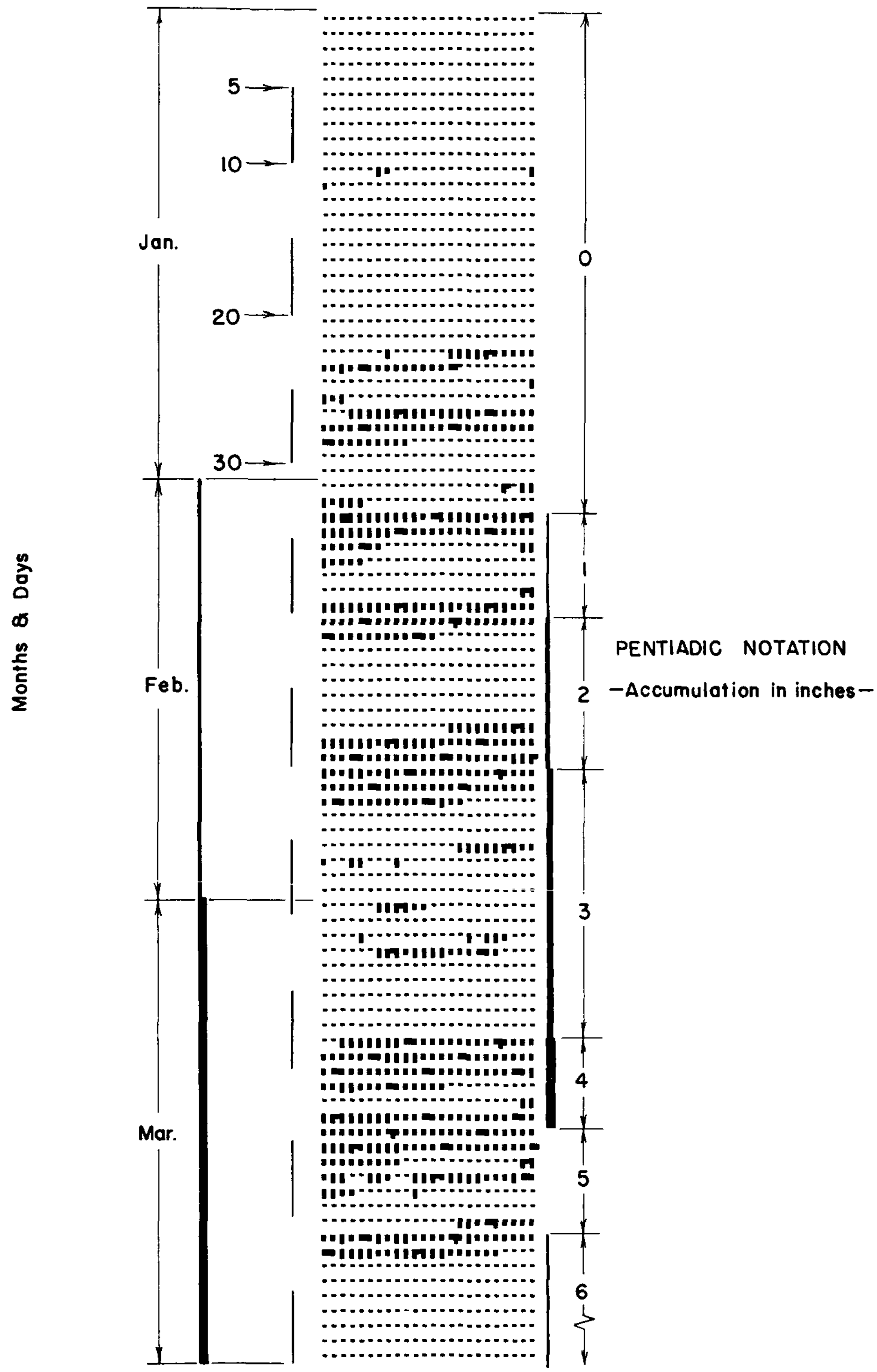


Fig. 3

fact that whole numbers of inches of accumulation can be determined most easily by counting the number of changes (or "alterations") of thickness of the "dashed" labelling line.

A similar "triadic" or "scale of three iadic" notation is used on the left of Figure 3 to label the months of the year. In this case:

- the zero-thickness of dash designates the "zeroth", third, sixth and ninth months of January, April, July and October;
- a single thickness of dash designates the first, fourth, seventh and tenth months of February, May, August and November; and
- a double thickness of dash designates the second, fifth, eighth and eleventh months of March, June, September and December.

Finally, a "biadic" or "scale-of-two iadic" notation is illustrated in Figure 3 for labelling the serial numbers of the days of the year. As used in Figure 3, the zero-thicknesses of this biadic numeral designate that the value of the units digit of such a serial number is 0, 1, 2, 3, or 4; and its single-thicknesses designate that the value of its units digit is 5, 6, 7, 8 or 9.

3. Examples

This kind of SIPLIC notation has been used to compile the hourly precipitation data throughout the thirteen year period from 1949 through 1961 for each of the four continuous precipitation gage stations in Casper, Cheyenne, Lander and Sheridan, Wyoming. These compilations are presented here as Figures 4, 5, 6 and 7, respectively. In addition, the hourly precipitation data produced previously for the four year period from 1958 through 1961 at Laramie, Wyoming has been inserted (but not labelled) as Figure 8 on the page following Figure 7.

All of these compilations have been produced by fitting a typewriter with custom-made type faces for each of the desired characters. Eleven different character keys were made by milling out the undesired portions of blank type faces which, if used in their blank form, would have completely blackened a typed page. These eleven characters were: the three sizes of increments; the four possible combinations of the larger two increments and the two sizes of succeeding incremental scaling marks; and the four possible thicknesses (other than zero) of the iadic labelling numerals.

The size of these compilations as originally typed are indicated by full size reproductions in Figures 1 and 2. Figure 3 is a half-size reduction of the original typing and Figures 4 through 8 have been reduced photographically to about one-eighth of their original size. The yearly columns of these figures as originally typed are more than five feet long.

The four-year compilation for Laramie (Figure 8) was produced by manually typing each of its more than 35,000 incremental data points. That experience clearly demonstrated one of the basic characteristics of the informatic forms of data; namely that the iterative process of forming them is well suited to simple-minded machines but is much too tedious for routine manual accomplishment. Consequently any future utilization of the promise offered by this original sample of SIPLIC data depended upon establishing automatic ways of forming it. Toward this end, the compilations of Figure 4 through 7 were typed with a modified electric typewriter at the output of an IBM 1620 computer which was programmed to utilize the National Weather Records Center's punched-card store of hourly precipitation data.

It was found that one of the most time consuming parts of the process of forming the following four illustrations was the need to re-sort the cards into proper chronological order and, especially, to check for duplications and/or missing cards in the punched-card decks. It was also found to be necessary to punch special "end of month" cards for those cases in which no precipitation occurred on the last day of the month. The cards for one year of data from one station were loaded in the IBM 1620 computer at a time, and it took it approximately one hour to automatically type out the corresponding yearly column of data in SIPLIC form.

HOURLY PRECIPITATION AMOUNTS

—SIPLIC NOTATION—

Casper W.B. A.P. 1949-1961

Casper, Wyoming

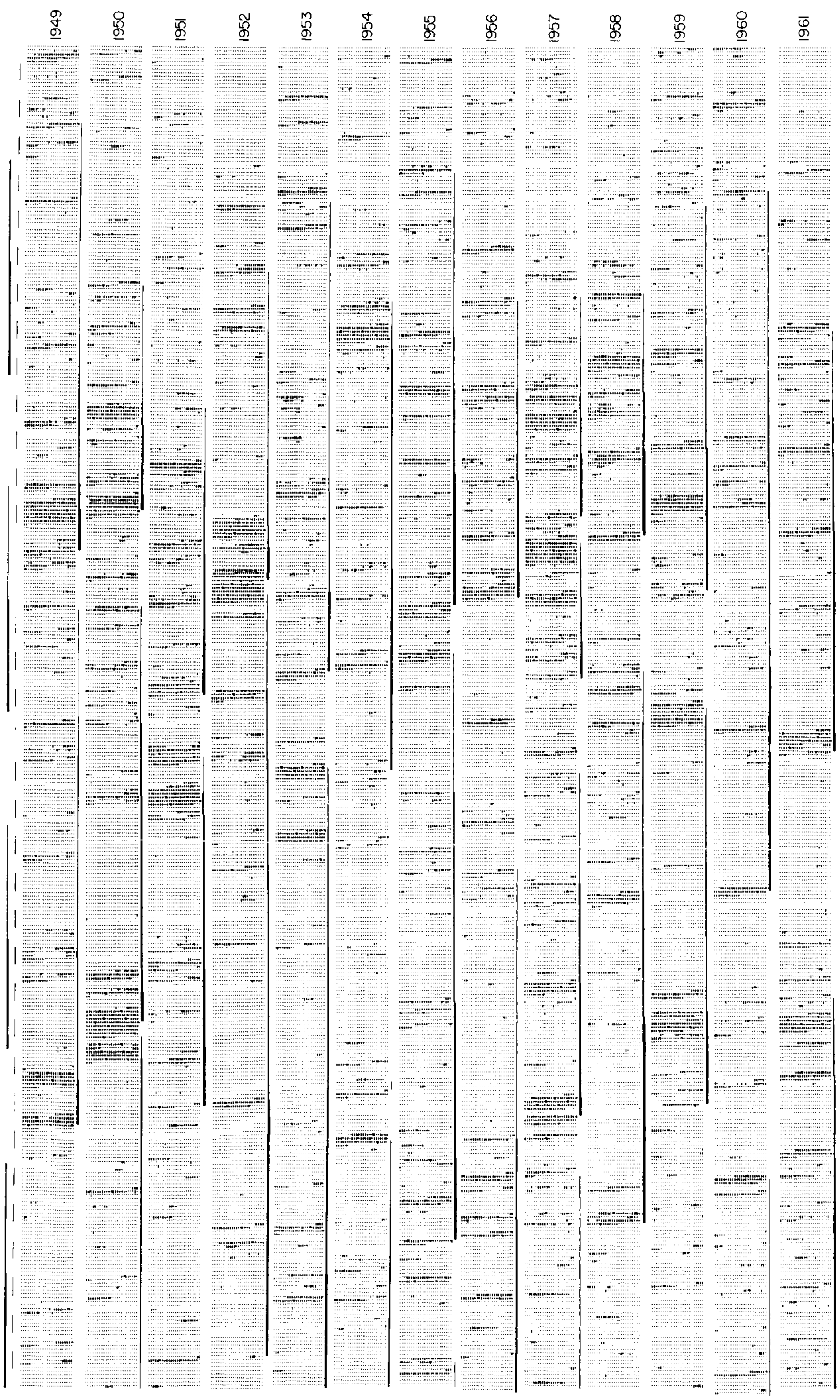


Fig. 4

HOURLY PRECIPITATION AMOUNTS

—SIPLIC NOTATION—

Cheyenne W.B. A.P. 1949-1961

Cheyenne, Wyoming

Fig. 5

HOURLY PRECIPITATION AMOUNTS

—SIPLIC NOTATION—

Lander W.B. A.P. 1949-1961

Lander, Wyoming

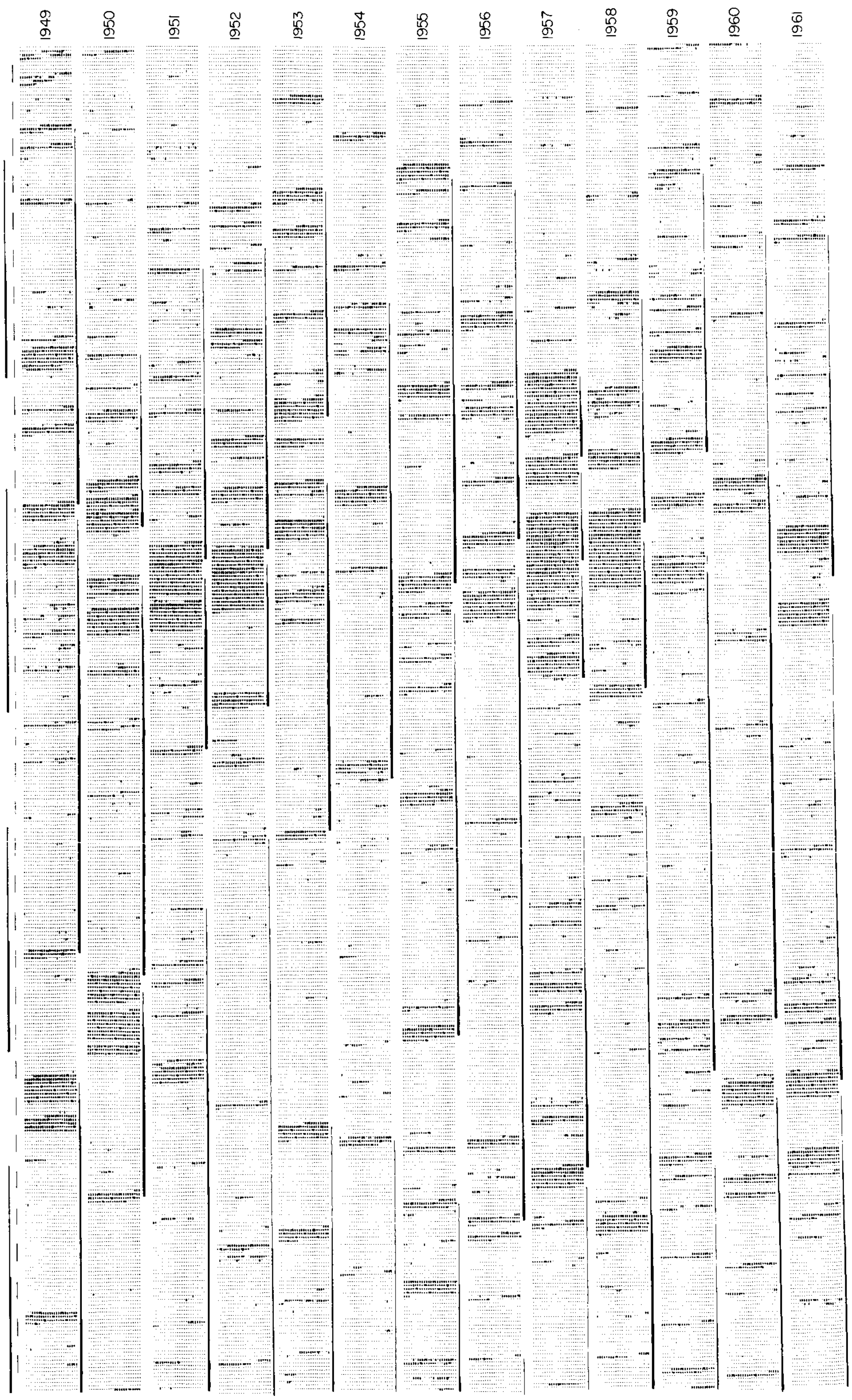


Fig. 6

HOURLY PRECIPITATION AMOUNTS

— SIPLIC NOTATION —

Sheridan W.B. A.P. 1949-1961

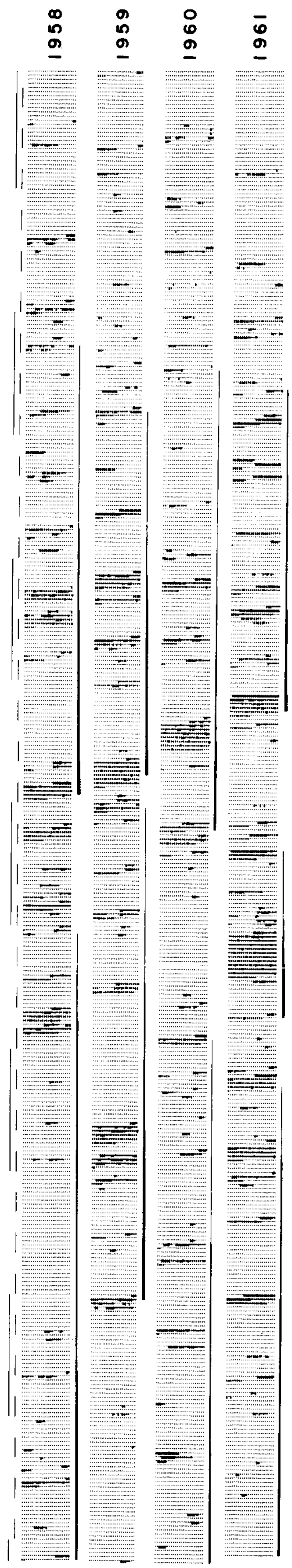
Sheridan, Wyoming

Fig. 7

HOURLY PRECIPITATION

Laramie, Wyoming

1958–1961



UNITS OF RESOLUTION:

Time – Horizontally	1	hour
Vertically	1	day
Precipitation – Horizontally	0.01	inches
Scaling	0.1	inches
Vertically	1.0	inches

4. Evaluation

These examples evidently verify the postulate that a SIPLIC kind of notation would be useful for compiling precipitation data. It especially provides a "shades and shadow" kind of portrayal in which periods of occurrence of precipitation appear as darkened areas and amounts of precipitation are proportional to the extent of darkening. In useful effect, the dark "shades" of these portrayals can be thought of as corresponding to the "shadows" which would be cast by pegs erected for each occurrence to a height above the paper in proportion to the amount of that occurrence.

The many advantages of conciseness of data are also provided as an inherent by-product of this "shades and shadows" characteristic. As with half-tone reproductions of photographs in newspapers and magazines, this characteristic is enhanced by reducing the sizes and spacing of individual marks to below the limit of resolution of the unaided eye. Consequently very large amounts of numerical data can very advantageously be presented in this way on single sheets of paper for, especially, the pattern-recognition kinds of interpretation at which man is most adept.

For example, little more than a glance at Figures 4 through 7 is required to determine things such as when the largest storms occurred in this thirteen year period, which of these years were the driest and wettest, what the general seasonal patterns of precipitation are at each station and how they vary from station to station and from year to year. As a specific example, much less precipitation is clearly seen to be associated with individual storms at Casper than at Cheyenne, Lander or Sheridan. It is also evident that singularities (or particular dates on which storms tend to be especially intense) are not a dominant characteristic of the precipitation pattern during these thirteen years at any of these four stations.

In addition to their utility for pattern-recognition, these kinds of portrayals can evidently also serve as a complete store of numerical precipitation-gage data for quantitative use by both man and machine. Such a data store would be exceptionally concise since only about 8(0.37) or about three square inches of paper are required for each station year of data in Figures 4 through 8. In comparison, nearly an entire 8-1/2 by 11 inch page, or about 93 square inches of paper, is required for each station year of data in the format of the monthly bulletins. This same amount of data requires, typically, about 200(3-1/4)(7-3/8) or nearly 4,800 square inches of punched cards, each of which is from three to five times as thick as usual pieces of paper. Indeed, the length of a one-year SIPLIC column of about eight inches is less than the length of magnetic tape which would be required to record the 8,766 hourly data points in a year even with an extreme lineal packing density of 1,000 characters per inch.

In this regard, every effort has been made to provide for as simple and convenient automatic processing of the SIPLIC form of data as practicable. It is only necessary that an optical scanning device be able to distinguish between three sizes of incremental marks in order (1) to detect the large-mark indications of times of occurrences, (2) to evaluate times of occurrences by counting marks without regard to size, and (3) to evaluate amounts of precipitation by counting the numbers of medium and large size marks. In addition, the forms of both the scaling marks and the iadic labelling notations have been selected largely for the potential convenience of automatic reading and error-checking. It is noteworthy in this regard that optical scanning with television-type cameras offers potentialities for exceptionally fast and flexible automatic processing of this kind of data.

Finally, the manual identification of particular numerical quantities seems exceptionally convenient for such a concise store of data with both automatic reading and pattern-recognition characteristics. For example, whole inch values of accumulations are readily determinable by counting first the five-inch and then the one-inch increments as indicated by the changes of thickness of the pentiadic labelling lines. Approximate numbers of 0.1 inch amounts can then be readily estimated by visually prorating the dark areas between those changes of labelling-line thickness. A magnifying glass can then be utilized to good advantage whenever specific numbers of days, hours and hundreths of inches of precipitation are required. In that case, for example, accumulative amounts throughout the year can readily be determined by (1) finding the nearest large or 1.0 inch scaling mark (which always occurs opposite a change of thickness of the labelling line), (2) counting the intervening number of medium or 0.1 inch scaling marks and (3) counting the remaining number of large and medium sized incremental marks.

5. Improvements

These examples also indicate, however, that the following kinds of improvements on this SIPLIC notation are needed and might well be made.

5.1 "Delayed Accounting" Notations

A major shortcoming of the previously described and illustrated notation is its lack of discrimination between individual hourly amounts whenever new amounts occur before previous occurrences have been completely accounted for. Subsequent to the preparation of these illustrations, however, a "Delayed Accounting" way of eliminating this shortcoming has come to light.

Briefly, the small incremental marks could also be utilized (in addition to their previously described use) to designate the end of individual accounts for each occurrence. Each such account would then consist of: (1) a large "occurrence" mark at the time of the occurrence; (2) the requisite number of medium "accounting" marks at the first available subsequent times of no occurrence; and (3) a small "closing" mark at the next available time of no occurrence. The meaning of the term "first available time of no occurrence" could well be defined by specifying that a "last-in, first-out" rule of accounting is to be used whenever the accounts of two or more occurrences overlap.

In accordance with this rule, for example, a sequence of marks such as

llıı.ııı.

would signify that:

- 0.04 inches of precipitation occurred at the time of the first large mark as indicated by the interrupted or "delayed account" lxxxxııı. of that "first-in" occurrence; and
- 0.03 inches of precipitation occurred at the time of the second large mark as indicated by the account xlıı.xxxx of that second or "last-in" occurrence.

5.2 Units of Resolution

Inspection of Figure 4 through 8 indicates that the interpretation of such "delayed accounting" of individual hourly accounts would be satisfactorily convenient for these five Wyoming stations. Their interpretation would become much more difficult, however, if normal yearly amounts of precipitation were much more than the ten to twenty inches typical of these stations. Indeed, if the yearly precipitation were forty inches or more nearly half of the incremental marks (as defined here) would be of medium or large size and it is doubtful that a very useful "shades and shadows" effect would be obtained.

The SIPLIC form of data can readily be adapted to wetter climates, however, by selecting appropriate "units of resolution" for each climatic regime. For example, the resolutions of amounts to the nearest hundreth of an inch has much less significance in wetter regimes, and it would then be logically practicable to signify an accumulation of 0.02, 0.03 or even 0.04 (rather than 0.01) inches of precipitation with each medium and large size of incremental mark.

Alternatively, it would also be possible to select - say - fifteen minutes rather than one hour as the unit of resolution of time. In that case the daily horizontal rows of marks would contain 96 rather than 24 incremental marks, thereby reducing by a factor of four the degree of overlapping of accounts of individual occurrences. But, thereby, the area of paper required for the store of precipitation data would also be increased by a factor of four, and clearly the choice between these two alternatives for other regions and purposes can be established only by much more detailed considerations than are warranted here.

5.3 "Uadic" Labelling

Another, relatively minor, shortcoming of the data illustrated in Figure 4 through 8 is a lack of sufficient differentiation between the various thicknesses of the pentiadic labelling lines. Subsequent informatic research has indicated, however, that this shortcoming could well be eliminated by using a "uadic" rather than an "iadic" notation for this purpose.

Briefly, the term "UADIC" stands for a "Unitary, Alternating Dash, Incrementally Continuous" kind of notation. By "Unitary" is meant the use of one mark for each unit in a number or, in this case, the use of zero, one, two, three or four short side-by-side "dashes" to represent, respectively, the five values of the scale-of-five labelling digit. The use of the term "Alternating Dash" in this context signifies that the thicknesses of these unitary marks and of the spaces between them are to be so small that, to the unaided eye, they appear as a single, variable thickness or "iadic", labelling line. Under a magnifying glass, however, it is only necessary to count the number of unitary marks (rather than to try to estimate the thickness of a single mark) to determine unambiguously what value of the labelling digit is being represented.

5.4 Time and Date Labels

The experimental portrayals in Figures 4 through 8 also clearly highlight a need to provide a more conveniently useful way of labelling the numbers of days. Especially, it is clearly desirable to label the numbers of days next to each yearly column of data. This would eliminate stringent requirements for registering each of the daily lines of data with respect to a single, remotely located, time-label. It would also make each yearly column of data self sufficient so that data strips for later years could easily be added as they become available, so that data strips for the same year but for different stations could easily be assembled next to each other, etc.

In this respect and contrary to the case of labelling the amounts of precipitation, the ordinal values of number-of-day digits change or "alter" at uniform intervals. Consequently an "iadic" notation would probably suffice for labelling the numbers of days. The use of an "iadic" notation for this purpose is especially desirable since it could thereby be distinctively thinner than the "uadic" lines to be used for labelling the accumulations of precipitation.

It also now seems desirable to number the days serially from the first of each month rather than from the first of the year. Of the many ways in which this might well be accomplished, it now seems that the following procedure is worthy of an early experimental use-test. First, each of the months of the year would be very clearly identified if a blank "day" space were to be left between the last day of each month and the first day of the succeeding month. (Incidentally, this would very advantageously provide for inserting the 29th day of leap-year Februaries in the end-of-February space). Second, a "biadic" notation such as illustrated in Figures 3 through 8 might then well be used to label the numbers of fives-of-days of each month in an especially distinctive way.

6. Conclusions

In summary, this work is deemed to have demonstrated that it is both practicable and desirable to compile complete stores of precipitation-gage data in SIPLIC form since:

- They can be compiled automatically from existing punched-card stores of hourly precipitation data;
- They would be extremely concise;
- They would provide complete "shades and shadows" portrayals of precipitation patterns;
- They would, at the same time, provide conveniently complete depictions of all available numerical values of times and amounts of precipitation; and
- They offer good potentialities for exceptionally fast and flexible automatic reading and quantitative reprocessing of precipitation data.

It is also concluded that the compilation of all available precipitation-gage data could well be initiated with the SIPLIC form of data illustrated here with the relatively minor exceptions that:

- A "delayed accounting" of individual occurrences should be utilized;
- "Uadic" rather than "iadic" notations should be used to label the accumulative amounts of precipitation; and
- An improved method of labelling the days of the months should be developed and used.

It is noteworthy in this respect that the pattern-interpretability of such a concisely complete kind of numerical data would evidently be very useful, even if automatic sensing for numerical processing were not also potentially possible. Consequently its compilation should proceed with whatever recording equipments might be available in parallel with, but not dependent upon, an active equipment development program. That development program should include the development of the recorders needed to produce the original precipitation-gage data in SIPLIC form at each of the observing stations in the future. Especially, it should include the development of those automatic playback and numerical processing equipments with which the full utility of SIPLIC stores of data can ultimately be realized.

Finally, this SIPLIC form of data is deemed to be a significant development in the general field of informatic data research, and it can be expected to be utilized for many kinds of data other than just the precipitation-gage kind of data with which it is illustrated here.

References

1. "Informatic Forms of Data, 1961" John C. Bellamy, Natural Resources Research Institute, Information Circular No. 12, University of Wyoming, November 1961, 11 pp.

2. "Status of Informatic Data Research, 1963" John C. Bellamy, Natural Resources Research Institute, Information Circular No. 23, University of Wyoming, August 1963, 17 pp.

3. "Informatic Precipitation Gage Data" Merlin C. Williams and Leonard B. Baldwin, Jr., Natural Resources Research Institute, Information Circular No. 18, University of Wyoming, September 1962, 14 pp.

4. "Data Display for Analysis" John C. Bellamy, Symposium on Environmental Measurements, U. S. Department of Health Education and Welfare, Public Health Service, July 1964, pp. 213-226.