

AN OBJECTIVE STUDY OF THE  
INFLUENCE OF MOISTURE DISTRIBUTION AND LAPSE RATE  
UPON VERTICAL STABILITY

BY  
ELSTON WYATT

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AN OBJECTIVE STUDY OF THE  
INFLUENCE OF MOISTURE DISTRIBUTION AND LAPSE RATE  
UPON VERTICAL STABILITY

by

Elston Wyatt  
Lieutenant, United States Navy

Submitted in partial fulfillment  
of the requirements  
for the degree of  
MASTER OF SCIENCE  
IN AEROLOGY

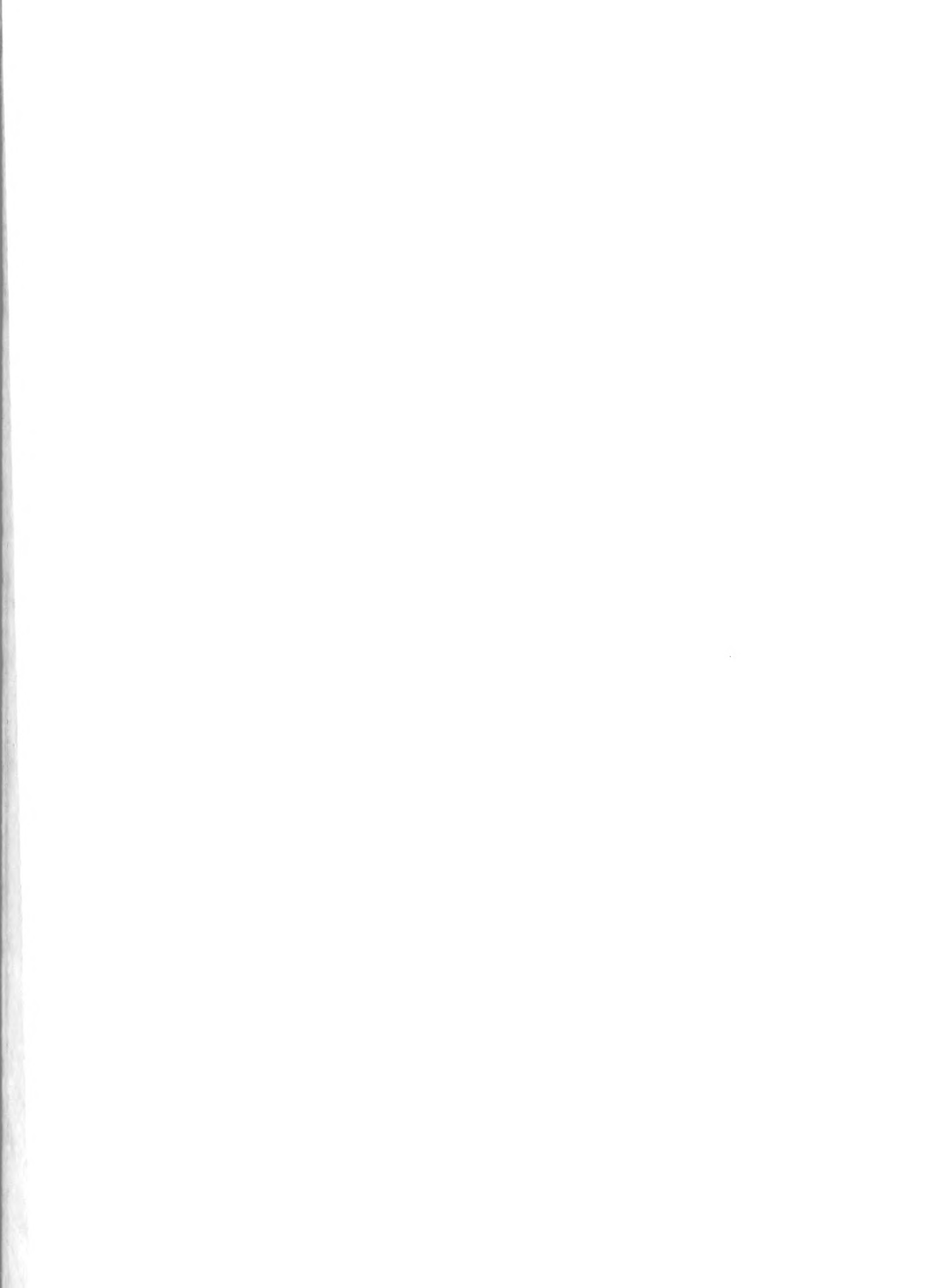
United States Naval Postgraduate School  
Monterey, California  
1950





This work is accepted as fulfilling  
the thesis requirements for the degree of  
Master of Science in Aerology

from the  
United States Naval Postgraduate School



## PREFACE

"An Objective Study of the Influence of Moisture Distribution and Lapse Rate Upon Vertical Stability" is a paper designed for use in aerology as a stability analysis of the atmosphere. The work was done at the U. S. Naval Postgraduate School, Monterey, California, as a partial requirement for the degree of Master of Science in Aerology.

The author wishes to acknowledge the help and guidance of Professor W. D. Duthie of the Postgraduate School.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is essential for ensuring the integrity of the financial statements and for providing a clear audit trail.

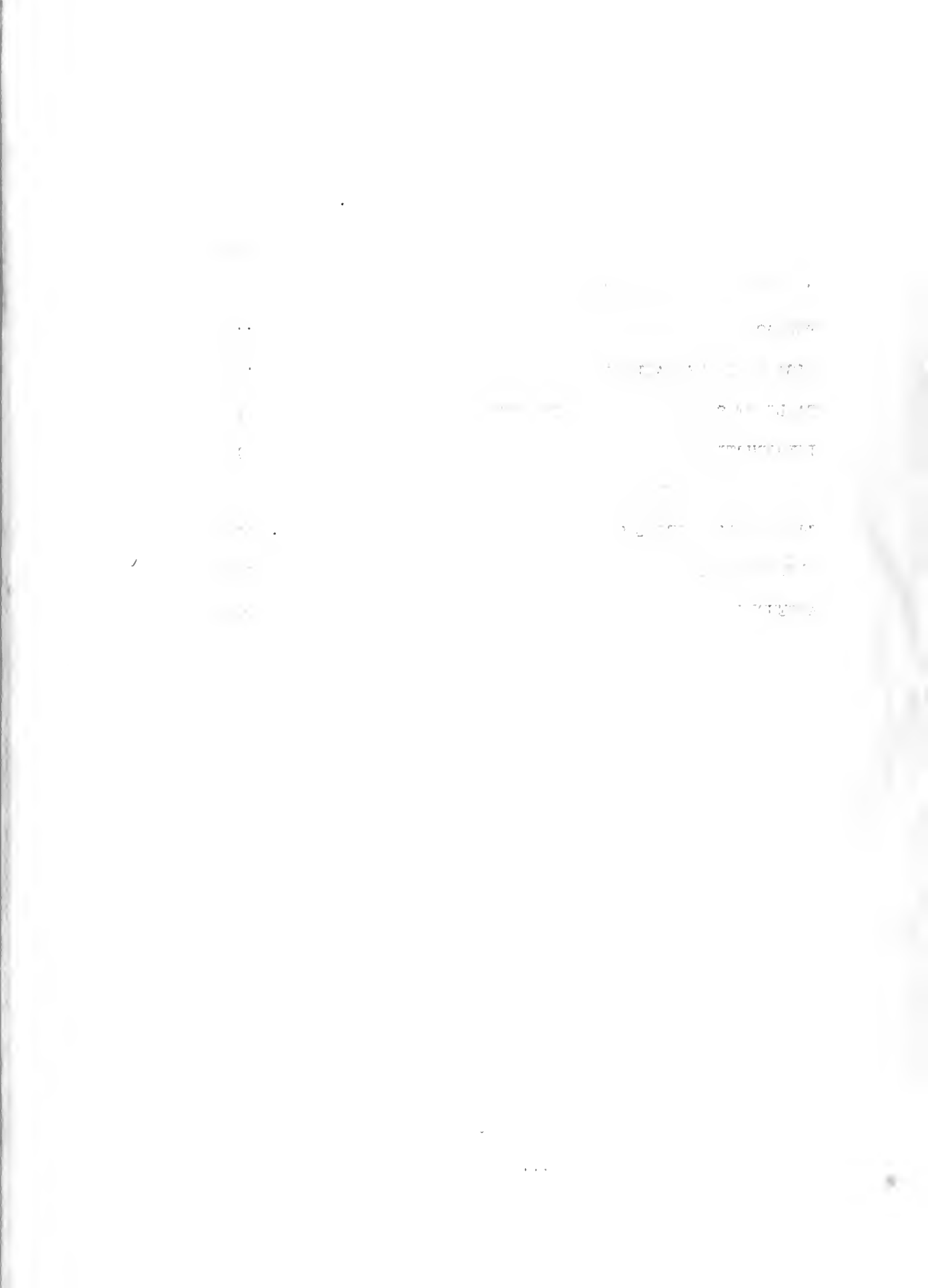
2. The second part of the document outlines the various methods used to collect and analyze data. It includes a detailed description of the sampling process and the statistical techniques employed to interpret the results.

3. The third part of the document provides a comprehensive overview of the findings. It highlights the key areas where discrepancies were identified and discusses the potential causes of these issues.

4. The final part of the document offers recommendations for improving the internal control system. It suggests several practical measures that can be implemented to reduce the risk of errors and to enhance the overall reliability of the financial reporting process.

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1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is essential for the proper management of the organization's finances and for ensuring compliance with relevant laws and regulations.

2. The second part of the document outlines the specific procedures that should be followed when recording transactions. This includes details on how to handle receipts, invoices, and other financial documents, as well as the frequency and timing of record-keeping activities.

3. The third part of the document provides a detailed overview of the various types of transactions that must be recorded. This includes sales, purchases, transfers, and other financial activities, and explains how each type should be properly documented and categorized.

4. The fourth part of the document discusses the role of the accounting department in ensuring that all transactions are accurately recorded and reported. It highlights the importance of regular audits and reviews to identify any discrepancies or errors in the records.

5. The fifth part of the document provides a summary of the key points discussed in the previous sections and offers some final thoughts on the importance of maintaining accurate financial records for the long-term success of the organization.



TABLE OF SYMBOLS AND ABBREVIATIONS

$T$	temperature
$f$	relative humidity
$\overline{RH}$	mean relative humidity
mb	millibars
$\mathcal{B}$	thunderstorm
$\mathcal{C}$	cumulo nimbus cloud
$\mathcal{L}$	lightning
$z$	height
No. $\mathcal{B}$	no thunderstorm
$\rho$	density
$M$	mass
$t$	time
$p$	pressure
$\alpha$	specific volume
$v$	vertical velocity
$R$	gas constant
$\dot{C}$	circulation acceleration
$\gamma$	lapse rate
$\gamma_d$	dry adiabatic lapse rate
$\gamma_m$	saturated adiabatic lapse rate
$V$	velocity
$A$	area

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## INTRODUCTION

The analysis of the vertical stability of the atmosphere by means of the upper air sounding is a standard procedure employed by aerologists as a forecasting aid. The two methods of analysis presently employed most frequently are the slice method and the parcel method.

Evidence has recently been accumulated, particularly by the U. S. government thunderstorm projects of 1946 and 1947, to suggest that lateral mixing between ascending cloud air and environment influences the vertical development of cumulus clouds. Investigations of Austin [1] [2] and Stommel [11] indicate graphical methods for determining the effect of entrainment (lateral mixing) upon lapse rate. Byers and Braham [6], in their report of the results of the thunderstorm projects, give estimated values of entrainment rates.

The slice method as established by Bjerknes [4] [5] and Petterssen [10] and modified by Beers [3] is noteworthy in that it provides a numerical index of vertical stability. As presently employed, however, this method assumes that there is no mixing between ascending cloud air and the environment. Furthermore, Gressman [8], by a modification of the slice method, has shown the qualitative influence of the field of horizontal divergence upon convective activity. To modify the Beers' slice method of stability analysis so as to include both the effects of entrainment and of divergence would provide an improved tool for studying the vertical stability of an air mass and for forecasting the development of cumulus activity. To this end the efforts of the

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research were initially directed. The approach taken was theoretical. The effect of mass divergence was introduced into the slice method equations, as was a factor of entrainment rate. It was anticipated that the inclusion into the slice method equations of mathematic expressions for divergence and entrainment would introduce complexities; however it was thought that some clear estimation of the effect of these factors in combination could be obtained. Such was not the case. The primary difficulty encountered was that of analytical representation of the mixing process.

As a different approach, a statistical study of vertical stability was undertaken for a single station, with especial emphasis upon the effect of vertical distribution of moisture. By a comparison of the upper air variates of relative humidity and temperature with the observed weather, an objective technique for stability analysis was developed. This technique indicates the influence of vertical moisture distribution upon cumulus activity and is applicable to stations other than the one investigated.



## CHAPTER I

### PROCEDURES

The investigation of the slice method of stability analysis as modified by the introduction of expressions for divergence and entrainment was purely theoretical and mathematical. This development is set forth in the appendix to the thesis.

The variates employed in establishing an objective technique for forecasting the stability of an air mass are temperature and relative humidity. The lapse rate of temperature within an air mass is an obvious measure of the vertical stability of the air. The vertical distribution of moisture influences convective stability in such a way that a given layer, if dry above and moist below, will be convectively unstable, and if moist above and dry below will be convectively stable. Hence, an objective technique based upon vertical distribution of temperature and relative humidity should provide a measure of the vertical stability of an air mass.

For the purposes of this study, the upper air soundings for the Weather Bureau station at Dodge City, Kansas were used. Data were taken from the Upper Air Bulletins for the months of August and September, 1949, and surface observations were obtained from the daily surface weather maps of the Postgraduate School.

Soundings were plotted from the upper air data for 0300Z and 1500Z of each day of August and September 1949. From these, relative humidities at standard and significant levels were computed. The relative humidities and temperatures at 850, 700, and 500 millibars were the principal

The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in the financial management of the organization. The second part of the document details the various methods and procedures used to collect and analyze data. This includes the use of surveys, interviews, and focus groups to gather information from stakeholders. The third part of the document describes the results of the data analysis and the key findings of the study. It highlights the significant trends and patterns observed in the data and discusses the implications of these findings for the organization. The final part of the document provides a summary of the conclusions and recommendations based on the research. It offers practical suggestions for improving the organization's performance and achieving its strategic goals.



variates employed. These were recorded for each sounding and differences were computed as indicated in Table I.

As an aid in determining suitable combinations of variates for use in an objective technique, graphs were drawn plotting variates against time and weather conditions; and scatter diagrams were prepared.

From the graphs of  $\Delta f_3$  against time, it is apparent that while vertical distribution of moisture influences stability, this influence is not independent of other variates. In particular, the influence of moisture distribution upon vertical stability varies with different lapse rates of temperature.  $\Delta T_3$ , the difference between the 850 and 500 mb. temperatures, is a measure of lapse rate; it was observed that whenever  $\Delta T_3$  was extreme (large or small), lapse rate and mean relative humidity appeared to be in themselves adequate measures of stability and the effect upon stability of moisture distribution in the vertical was negligible. On the other hand, for intermediate values of  $\Delta T_3$  the effect of moisture distribution upon stability was marked.

Accordingly, as a preliminary step in obtaining objective criteria for use in evaluation of the soundings, limits for four different  $\Delta T_3$  groups were selected. For each  $\Delta T_3$  group, moisture criteria were discovered (on the basis of the two months' data) for forecasting the occurrence or non-occurrence of thunderstorm at Dodge City during the  $21\frac{1}{2}$  hours subsequent to each sounding. The  $\Delta T_3$  classifications, together with their individual objective moisture criteria are given in Table 2.



TABLE 1

$T_{850}$  temperature at 850 mb. level in °F.

$f_{850}$  relative humidity at 850 mb. level in %.

$$\Delta T_1 = T_{850} - T_{700}$$

$$\Delta T_2 = T_{700} - T_{500}$$

$$\Delta T_3 = T_{850} - T_{500}$$

$$\Delta f_1 = f_{850} - f_{700}$$

$$\Delta f_2 = f_{700} - f_{500}$$

$$\Delta f_3 = f_{850} - f_{500}$$

$\Delta f \text{ max}$  the most positive of the three variates  $\Delta f_1, \Delta f_2, \Delta f_3$ .

$$RH = \frac{f_{850} + f_{700} + f_{500}}{3} = \text{mean relative humidity for } 850 - 500 \text{ mb. layer.}$$

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TABLE 2

Classification of Soundings According to  $\Delta T_3$  value:

Case I:  $\Delta T_3 < 20$

Case II:  $\Delta T_3 \quad 20 - 25$

Case IIIA:  $\Delta T_3 \quad 26 - 30, \overline{RH} < 53\%$

Case IIIB:  $\Delta T_3 \quad 26 - 30, \overline{RH} > 52\%$

Case IV:  $\Delta T_3 > 30$

Year	1950	1951	1952	1953
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Subdivision of actual thunderstorm occurrences into "frontal" and "air mass" types was not made. Only three cases of frontal thunderstorms were identified from the surface data for the period under study. It should be pointed out, however, that most of the thunderstorm occurrences observed were during periods when Dodge City was situated on the western side of a high pressure cell. Dodge City was, therefore, located within a field of convergence which resulted from southerly flow and which was fully as capable of releasing convective instability as a frontal passage would have been. Accordingly, a distinction between "frontal" and "air mass" thunderstorm types was not considered essential.

From examination of the individual soundings after classification into  $\Delta T_3$  groups, moisture criteria were established for predicting the occurrence or non-occurrence of thunderstorm or cumulo-nimbus development. These moisture criteria vary among the different  $\Delta T_3$  groups. For Case I ( $\Delta T_3 < 20$ ), which occurred only seven times, it appears that absolute stability is great enough so that neither moisture content nor distribution of moisture is likely to be sufficiently influential to produce thunderstorm activity. At the other extreme with Case IV ( $\Delta T_3 > 30$ ), the investigation indicates that thunderstorm activity is probable whenever the mean relative humidity is not extremely low and that vertical distribution of moisture is not of great significance. Cases II and III indicate the importance of distribution of moisture in a consideration of stability. In both

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these cases many different combinations of variates were investigated with regard to their influence upon stability. It was discovered that mean relative humidity and the distribution of relative humidity among the standard levels were the most satisfactory variates for use in forecasting the possibility of thunderstorm development.

In order to indicate clearly the results of this investigation, forecasting "rules" for the different  $\Delta T_3$  cases were established and applied to each sounding. The "rules", based solely upon the upper air data and surface observations at Dodge City for two months, are presented in Table 3.

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TABLE 3

Forecast Rules

Case I:  $\Delta T_3 < 20$

Rule: forecast "no thunderstorm" during next period ( $21\frac{1}{2}$  hrs.).

Case II:  $19 < \Delta T_3 < 26$

Rule: forecast "thunderstorm" if  $\overline{RH} > 37$  and  $\Delta f_{\max} > 24$ , and both are larger than at sounding 12 hours previous. Otherwise forecast "no thunderstorm".

Case IIIA:  $25 < \Delta T_3 < 31$ ,  $\overline{RH} < 53\%$

Rule: forecast "thunderstorm" if  $\overline{RH} > 36$  and  $\Delta f_1 > \Delta f_2 > \Delta f_3$  with both  $\Delta f_1$  and  $\Delta f_2 < 21$ . Otherwise forecast "no thunderstorm."

Case IIIB:  $25 < \Delta T_3 < 31$ ,  $\overline{RH} > 52\%$

Rule: forecast "thunderstorm".

Case IV:  $\Delta T_3 > 30$

Rule: forecast "thunderstorm" if  $\overline{RH} > 30$ ; otherwise forecast "no thunderstorm".

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is essential for ensuring transparency and accountability in the organization's operations.

2. The second part of the document outlines the various methods and tools used to collect and analyze data. It highlights the need for consistent data collection procedures and the use of advanced analytical techniques to derive meaningful insights from the data.

3. The third part of the document focuses on the role of technology in data management and analysis. It discusses how modern software solutions can streamline data collection, storage, and processing, thereby improving efficiency and accuracy.

4. The fourth part of the document addresses the challenges associated with data management, such as data quality, security, and privacy. It provides strategies to mitigate these risks and ensure that the data remains reliable and secure throughout its lifecycle.

5. The fifth part of the document concludes by summarizing the key findings and recommendations. It stresses the importance of a data-driven approach in decision-making and the need for continuous monitoring and improvement of the data management process.

## CHAPTER II

### RESULTS

Since the "forecast rules" were established as a result of comprehensive examination of the upper air soundings at Dodge City, it is to be expected that, when applied to these same soundings, they should give accurate results. Such is the case. For the "verification" of a forecast, the weather as plotted on the 0030 Z and 1230 Z surface maps on file at the Postgraduate School was used. A forecast of "thunderstorm" was considered "verified" whenever either the 0030 Z or the 1230 Z surface maps subsequent to the upper air sounding (upon which the forecast was based) indicated thunderstorm or cumulo nimbus development at Dodge City or at stations 450, 463, and 465 which are nearby Dodge City. Lightning and showers when accompanied by cumulus activity were also considered to verify a "thunderstorm" forecast. During the period under investigation there occurred at these surface stations seventeen thunderstorms, five cases of cumulo nimbus development without thunder, one case of lightning and one case of showers accompanied by cumulus development.

It is unfortunate that hourly surface data were not available. The actual weather conditions were known only at 12 hour periods, obviating the possibility of investigating with any accuracy the precise time of thunderstorm occurrence. Furthermore, since past weather is reported only for a period of six hours prior to each surface map, there is a gap of six hours between surface maps during which thunderstorm might have occur-

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. The second part covers the process of reconciling bank statements with the company's ledger to ensure that all entries are correctly recorded. The third part details the monthly closing process, including the preparation of financial statements and the review of these statements by management. The fourth part discusses the annual audit process, highlighting the role of external auditors in verifying the accuracy of the financial statements. The final part of the document provides a summary of the key points discussed and offers recommendations for improving the accounting system.

red without being noted in this investigation. Accordingly, it is possible that, had complete surface observations been available, a higher percentage of correct forecasts would have resulted. The results obtained when the forecast rules were applied to Dodge City for August and September 1949 are given in Table 4. Percentage correct forecasts and skill scores are indicated for the five different cases. It should be noted that a perfect "fit" between observed thunderstorm occurrence (or non-occurrence) and the developed moisture and lapse rate criteria would result in a percentage correct forecasts of 100 and a skill score of one.

Since sufficient surface data for Dodge City was not available for use as test data, the accuracy of the forecast rules could not be adequately evaluated. It is not imagined that an objective technique based upon a mere two months' data and upon such an arbitrarily limited number of variates as the scope of this investigation permitted would meet a strict test of accuracy when applied to independent data. In particular, it is almost certain that, because of the small size of the sample tested, limits of the humidity and moisture distribution criteria were fixed much too rigidly in order to "forecast" successfully the highest possible number of occurrences and non-occurrences of thunderstorm. It is highly possible that several "freak" cases within the small two months' sample which was tested cast a disproportionate weight in the establishment of criteria and limits.

Table 4 indicates the results of a test made on upper air data at Oklahoma City for the month of August 1949. This test indicates that

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This not only helps in tracking expenses but also ensures compliance with tax regulations.

In the second section, the author provides a detailed breakdown of the company's financial performance over the last quarter. This includes a comparison of actual results against the budget and a discussion on the reasons for any variances. The analysis shows that while revenue was slightly below target, operating expenses were well-controlled, leading to a marginally better profit than expected.

The third part of the report focuses on the company's strategic initiatives for the upcoming year. It outlines key areas for growth, such as expanding into new markets and investing in research and development. The author also discusses the challenges that may be encountered and proposes proactive measures to mitigate these risks.

Finally, the document concludes with a summary of the overall financial health and a call to action for the management team. It stresses the need for continued vigilance and a commitment to transparency in all financial reporting. The author expresses confidence in the company's ability to achieve its long-term goals through diligent financial management.



TABLE 4

Dodge City		Number of $R_s$ Occurrences	Number of No- $R_s$ Occurrences	Percentage Correct Forecasts	Skill Score
Case I	Forecast $R_s$	0	0	100	
	Forecast No $R_s$	0	7		
Case II	Forecast $R_s$	6	3	89	0.68
	Forecast No $R_s$	1	26		
Case IIIA	Forecast $R_s$	4	0	100	1.00
	Forecast No $R_s$	0	25		
Case IIIB	Forecast $R_s$	15	3	83	
	Forecast No $R_s$	0	0		
Case IV	Forecast $R_s$	11	1	92	
	Forecast No $R_s$	0	0		
<u>Total</u>	Forecast $R_s$	36	7	92	0.84
	Forecast No $R_s$	1	5 <sup>a</sup>		
Oklahoma City					
<u>Total</u>	Forecast $R_s$	14	8	75	0.49
	Forecast No $R_s$	4	22		



the "forecast rules" established for Dodge City are not sufficiently embracing to be used without modification at other stations. The effects of divergence and of advection and the factors of lapse rate and of moisture distribution at other than standard levels should certainly be included in a comprehensive application of an objective stability analysis. These effects and factors were of necessity omitted in this study.

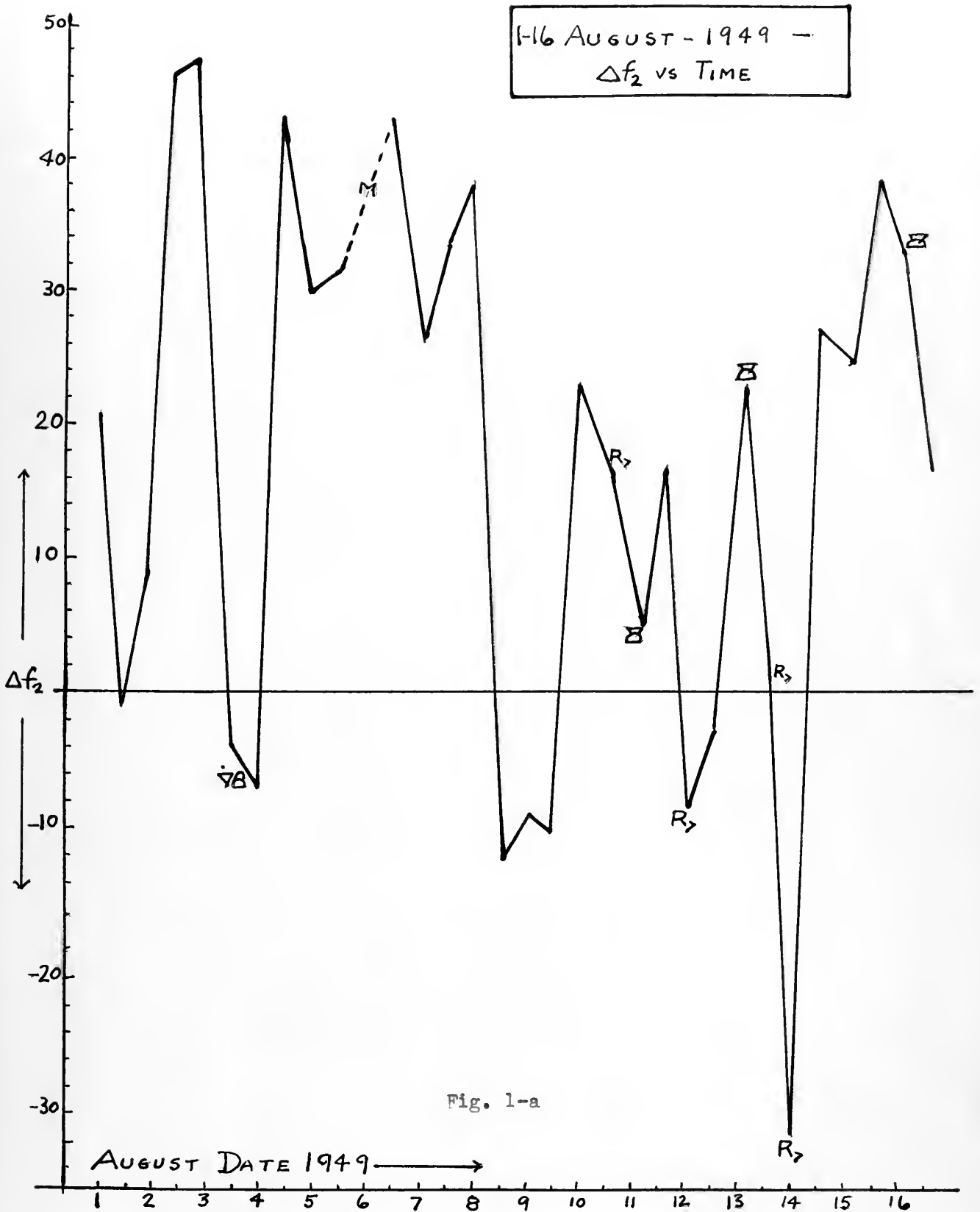
Nevertheless, the investigation indicates a method for obtaining rapidly and objectively a measure of the stability of an air mass and for assisting the forecaster in solving the difficult thunderstorm case.

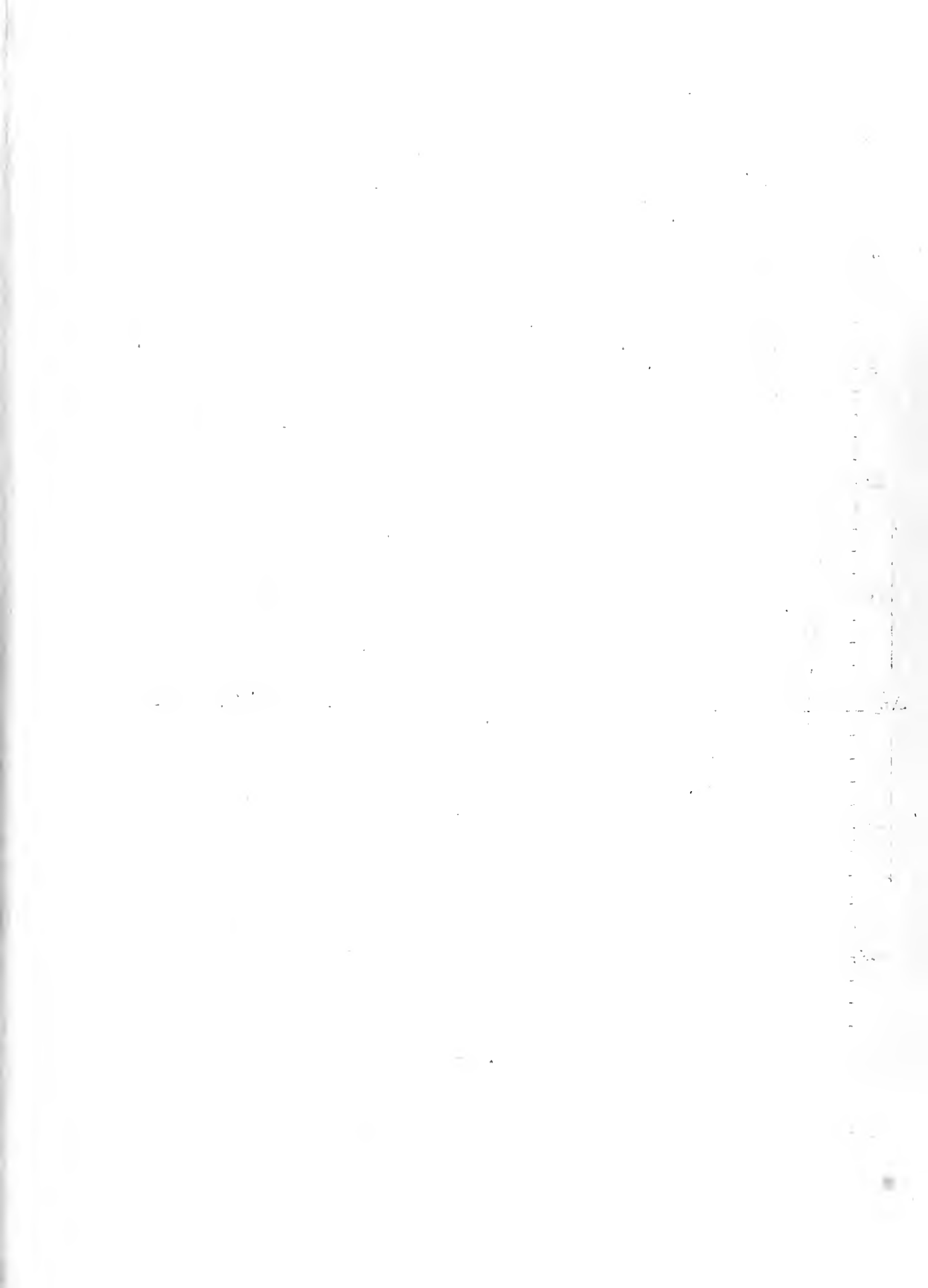
1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is essential for ensuring the integrity of the financial statements and for providing a clear audit trail. The text notes that any discrepancies or errors in the records can lead to significant complications during an audit and may result in the disallowance of certain expenses.

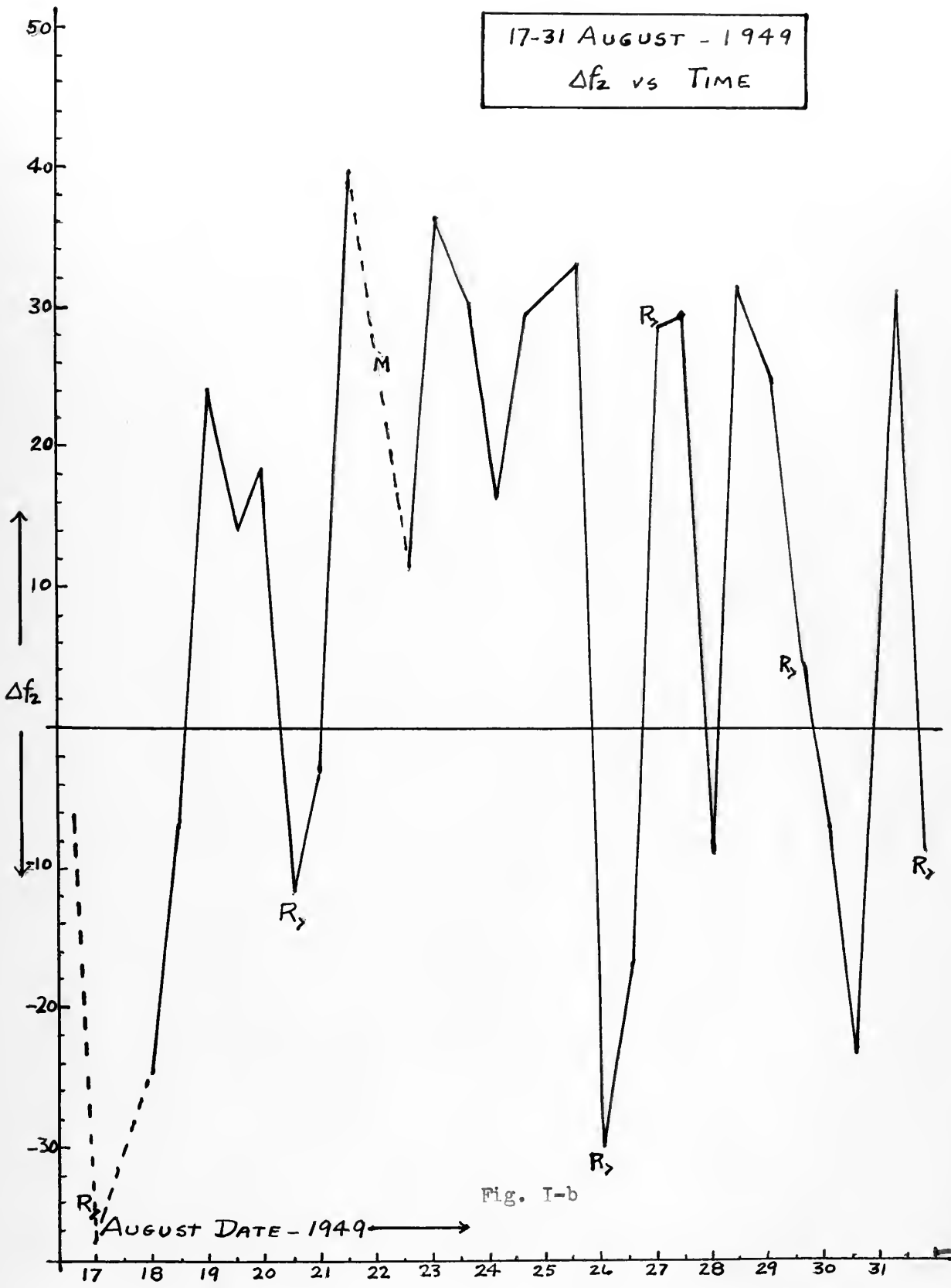
2. The second part of the document outlines the specific requirements for record-keeping. It states that all receipts, invoices, and other supporting documents must be retained for a minimum of three years. Furthermore, it is required that these records be organized in a systematic and accessible manner, such as by date or by category, to facilitate the audit process. The document also mentions that digital records are acceptable, provided they are secure and can be easily retrieved.

3. The third part of the document addresses the consequences of non-compliance with these record-keeping requirements. It explains that failure to maintain proper records can lead to the denial of tax deductions and credits, which can significantly impact the taxpayer's overall tax liability. Additionally, it notes that such non-compliance may result in penalties and interest charges imposed by the tax authorities. The text encourages taxpayers to take proactive steps to ensure they are meeting all the necessary record-keeping obligations.

4. The final part of the document provides some practical advice for taxpayers. It suggests that keeping a dedicated folder or binder for all financial records is a helpful way to stay organized. It also recommends regularly reviewing the records to ensure they are up-to-date and accurate. Finally, it advises taxpayers to consult with a professional advisor, such as a CPA or tax attorney, if they have any questions or concerns regarding their record-keeping practices.











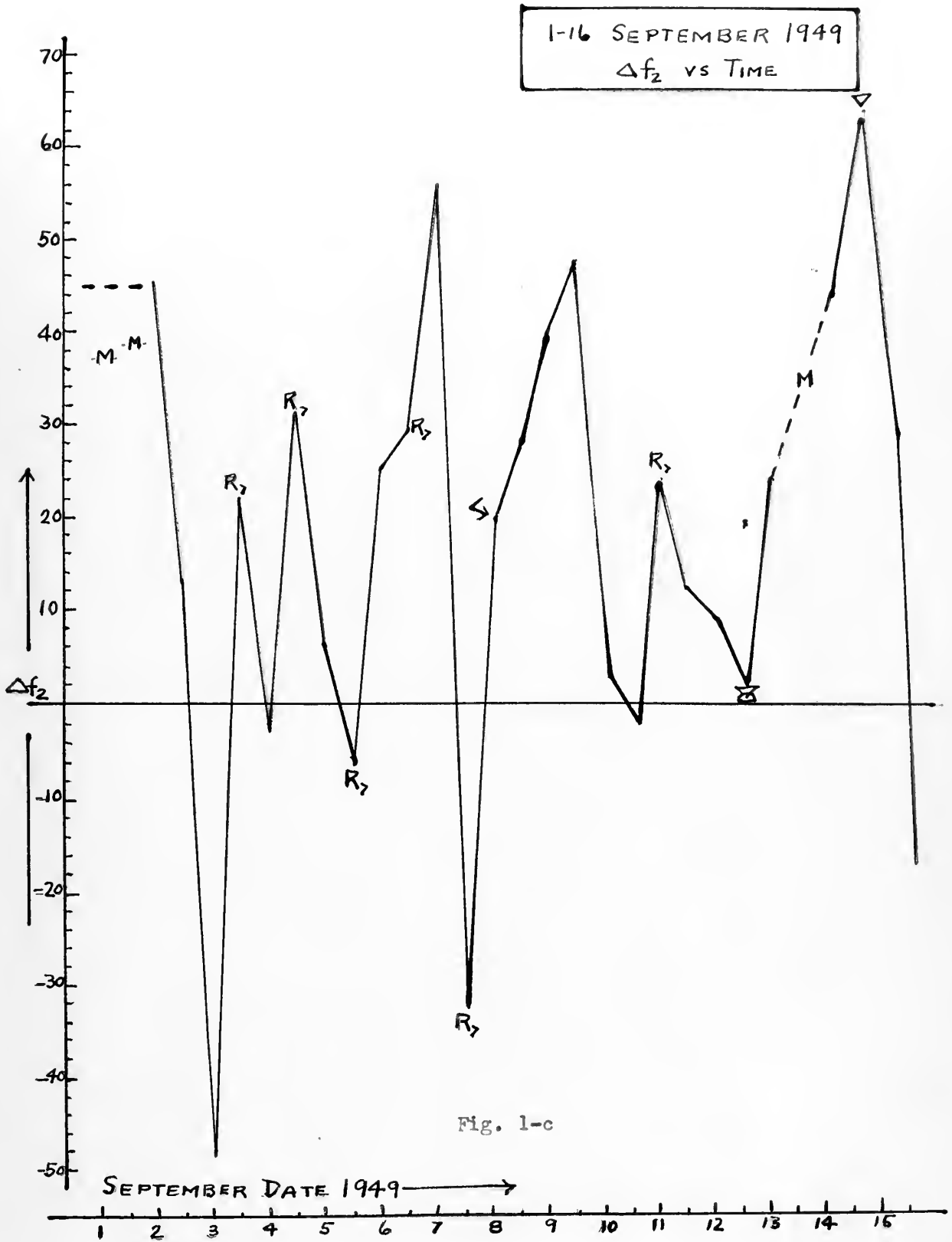
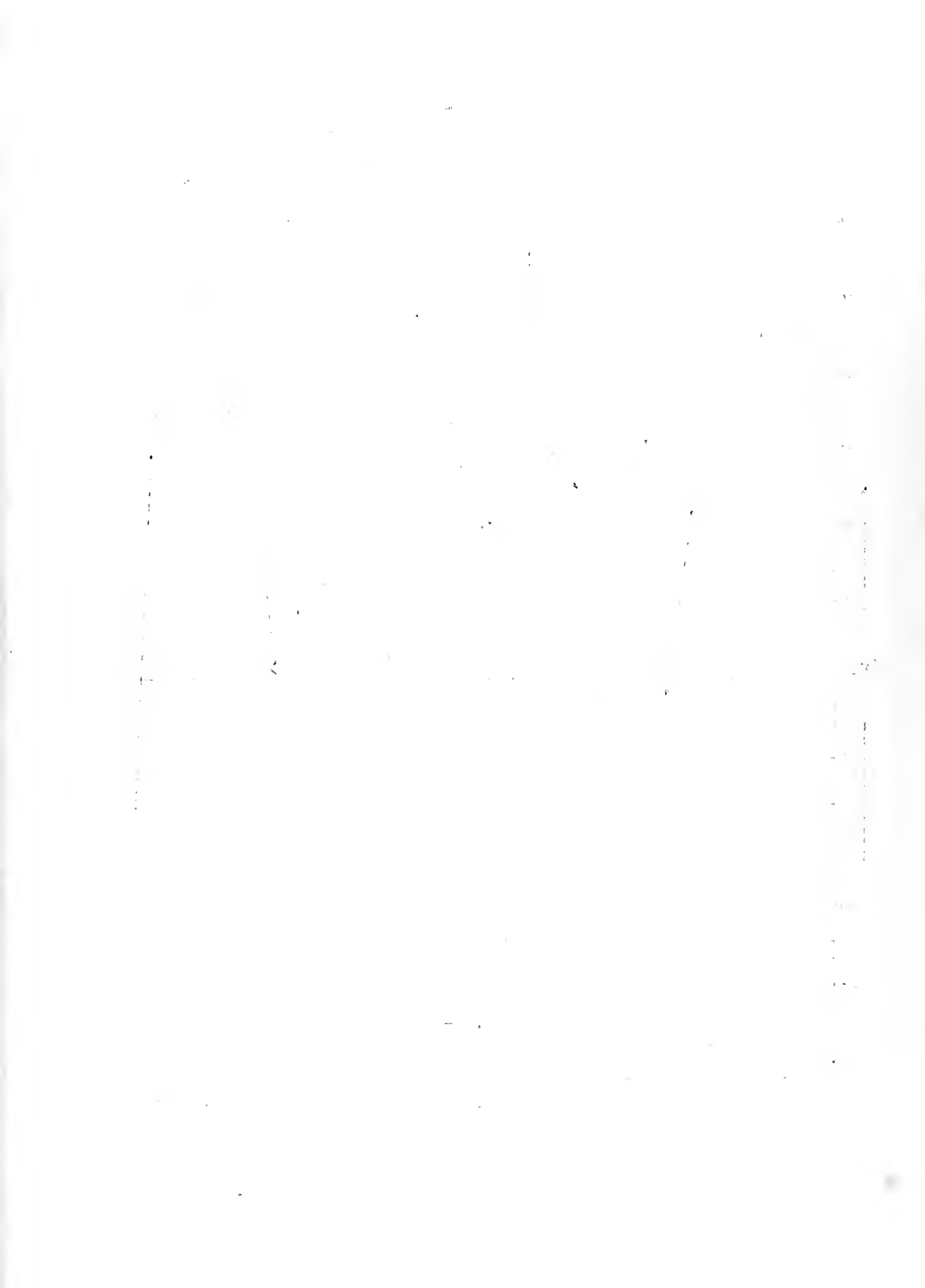
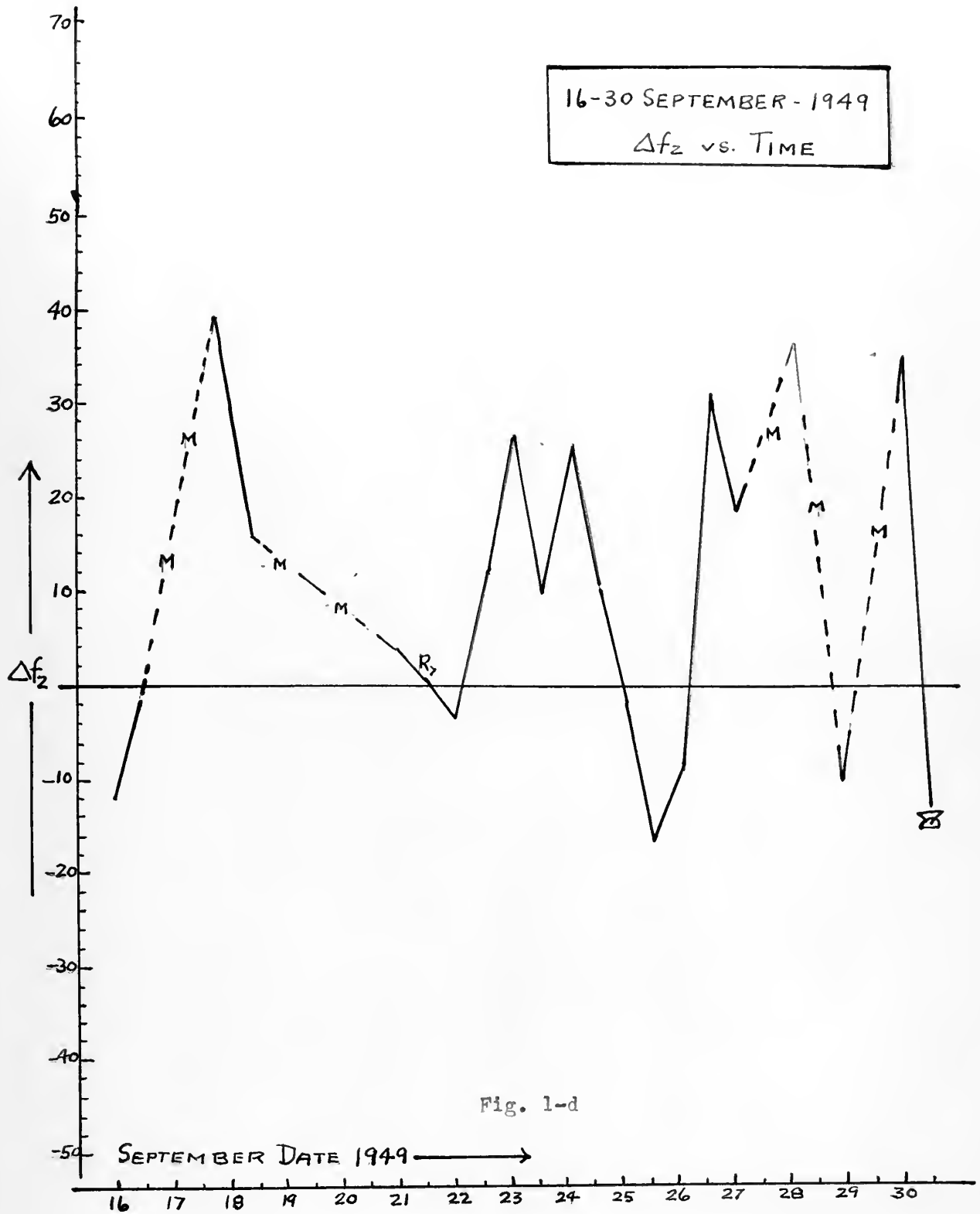
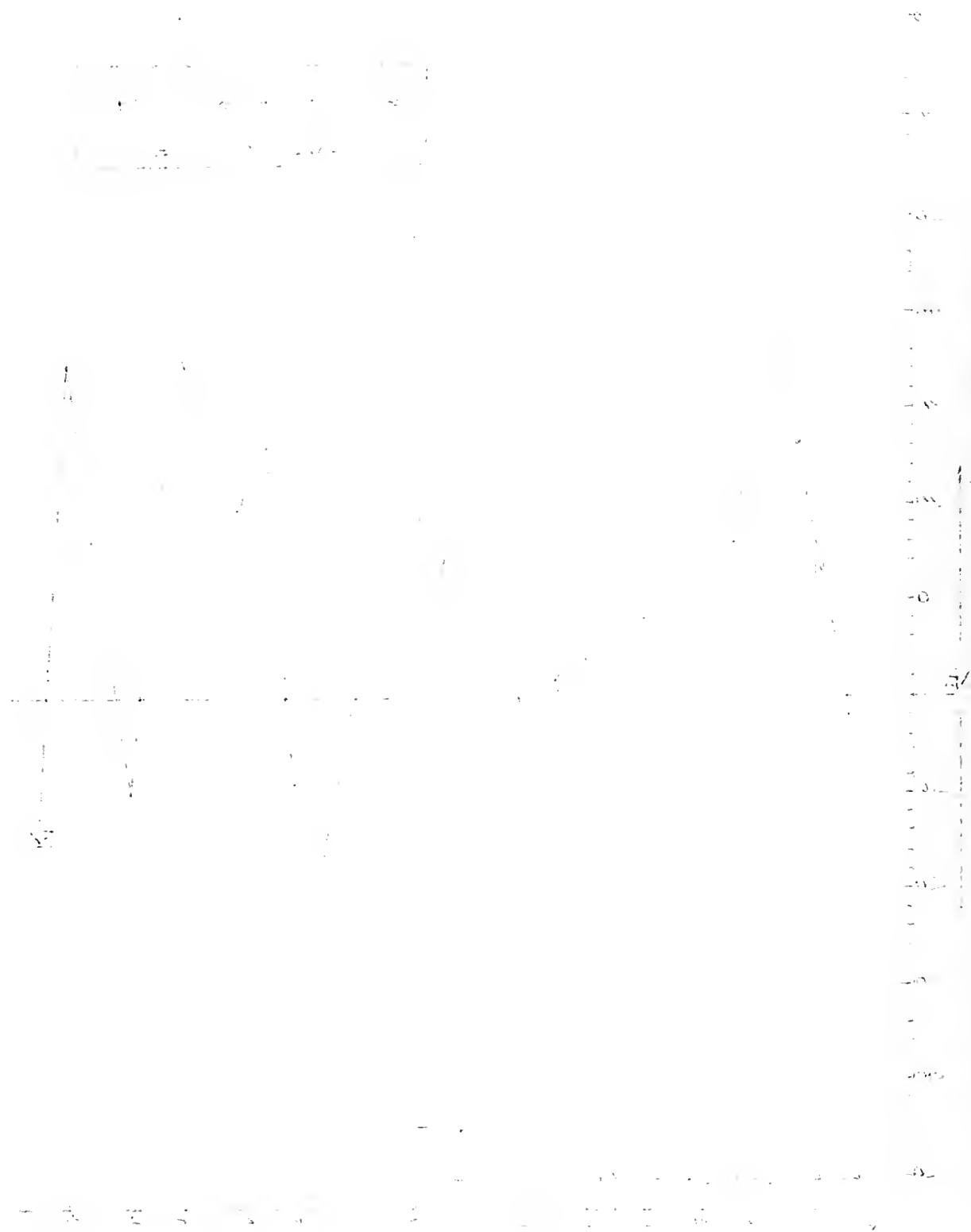


Fig. 1-c







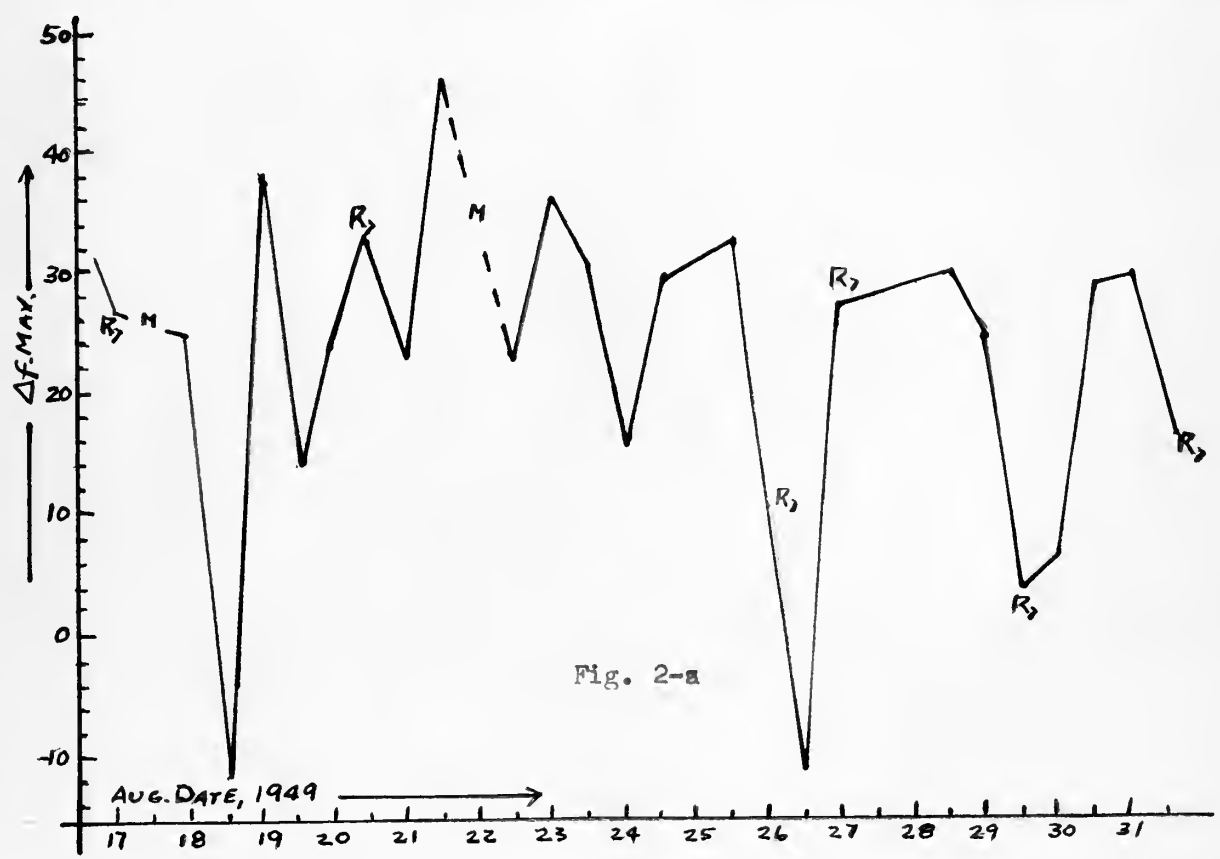
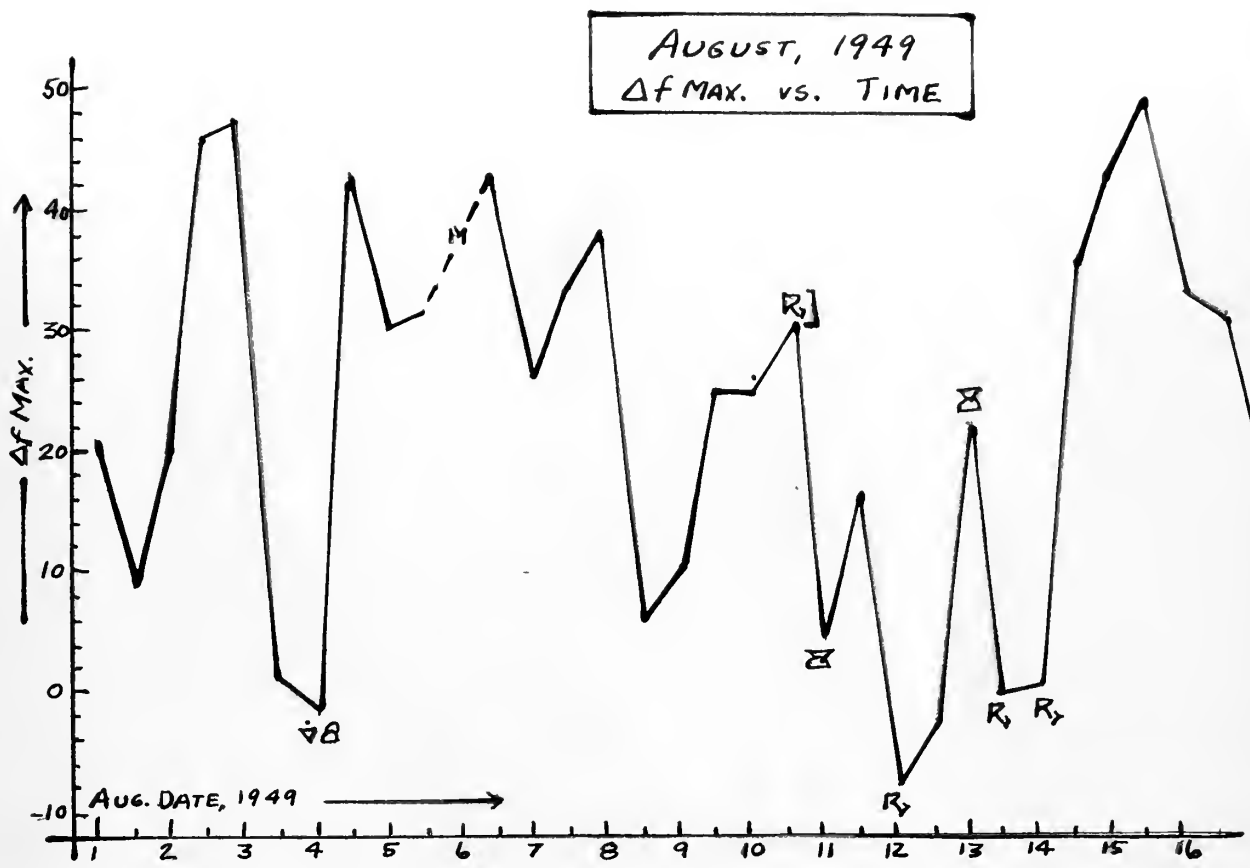


Fig. 2-a



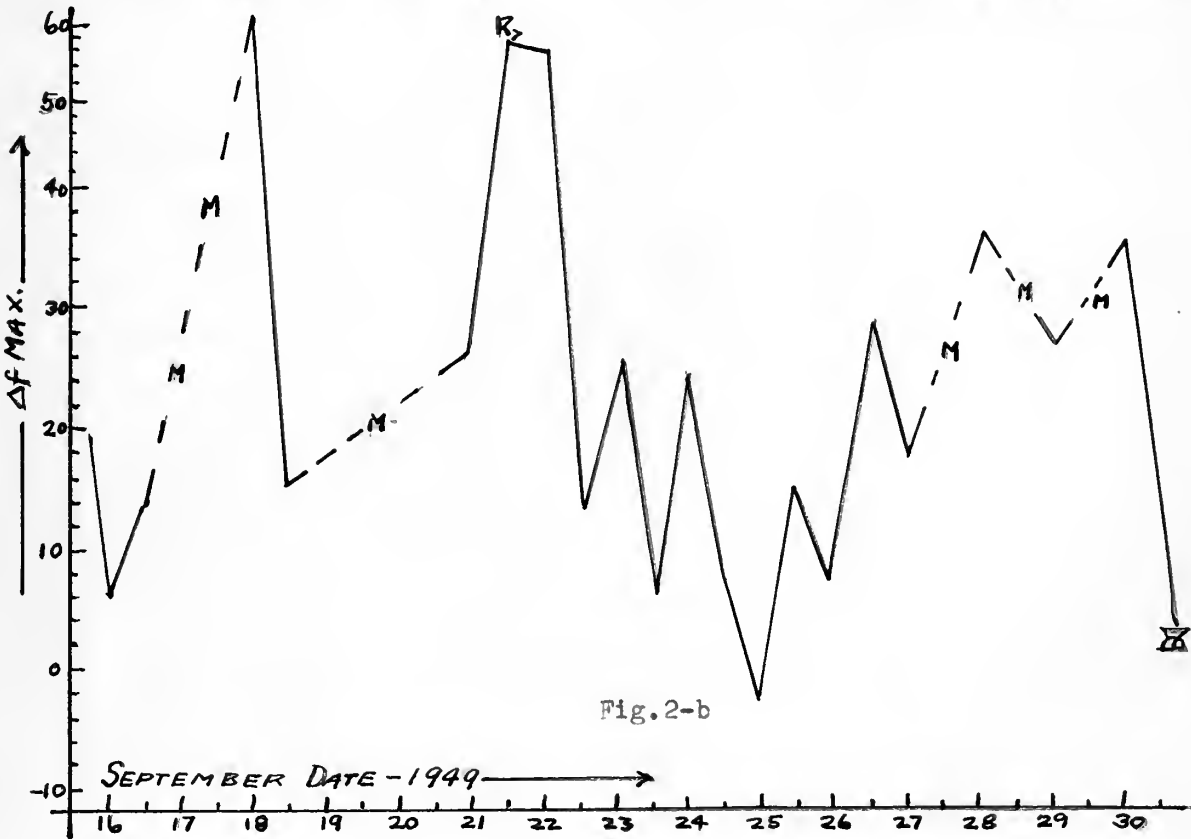
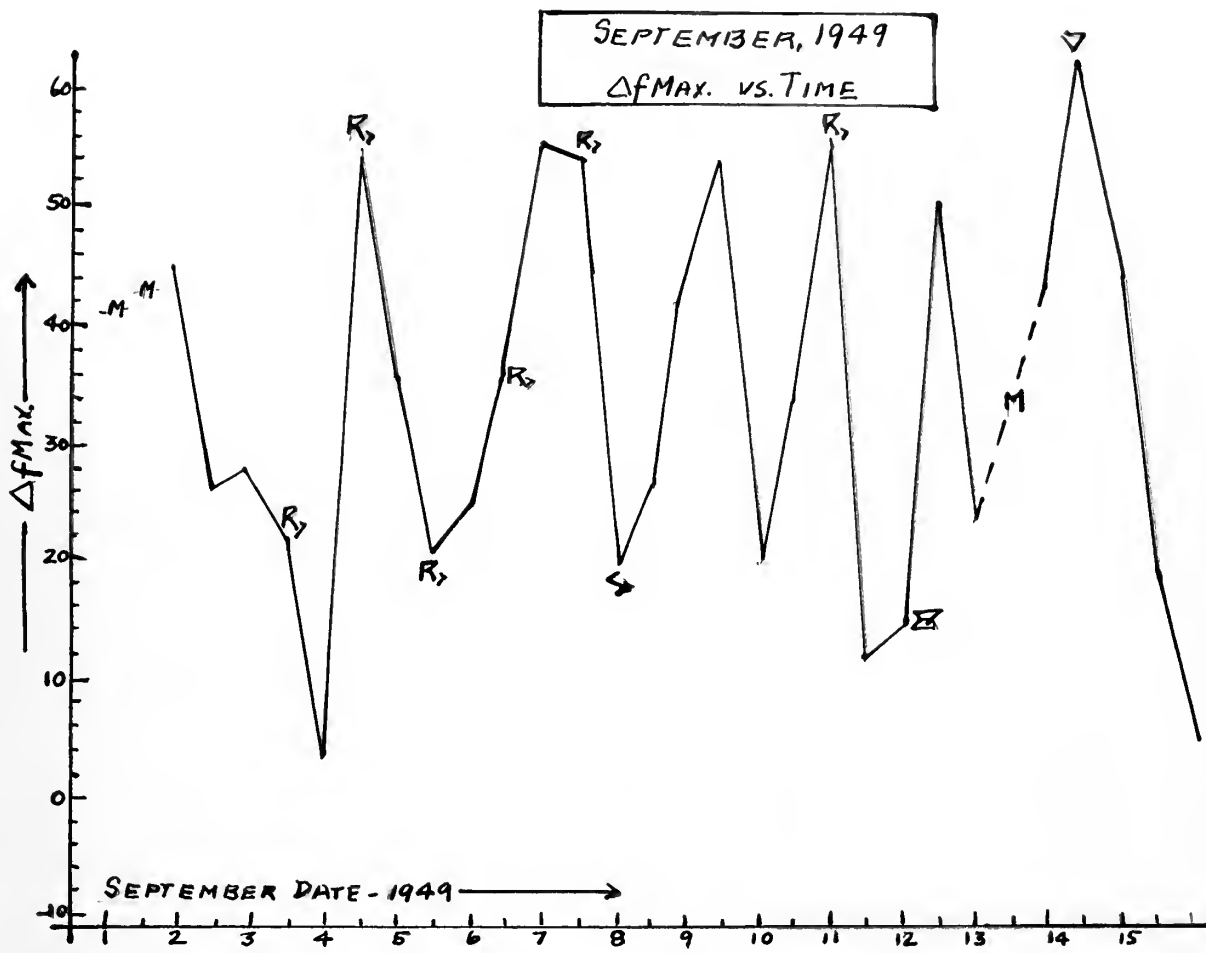


Fig. 2-b





AUGUST 1-16, 1949 -  
MEAN R. H. vs. TIME

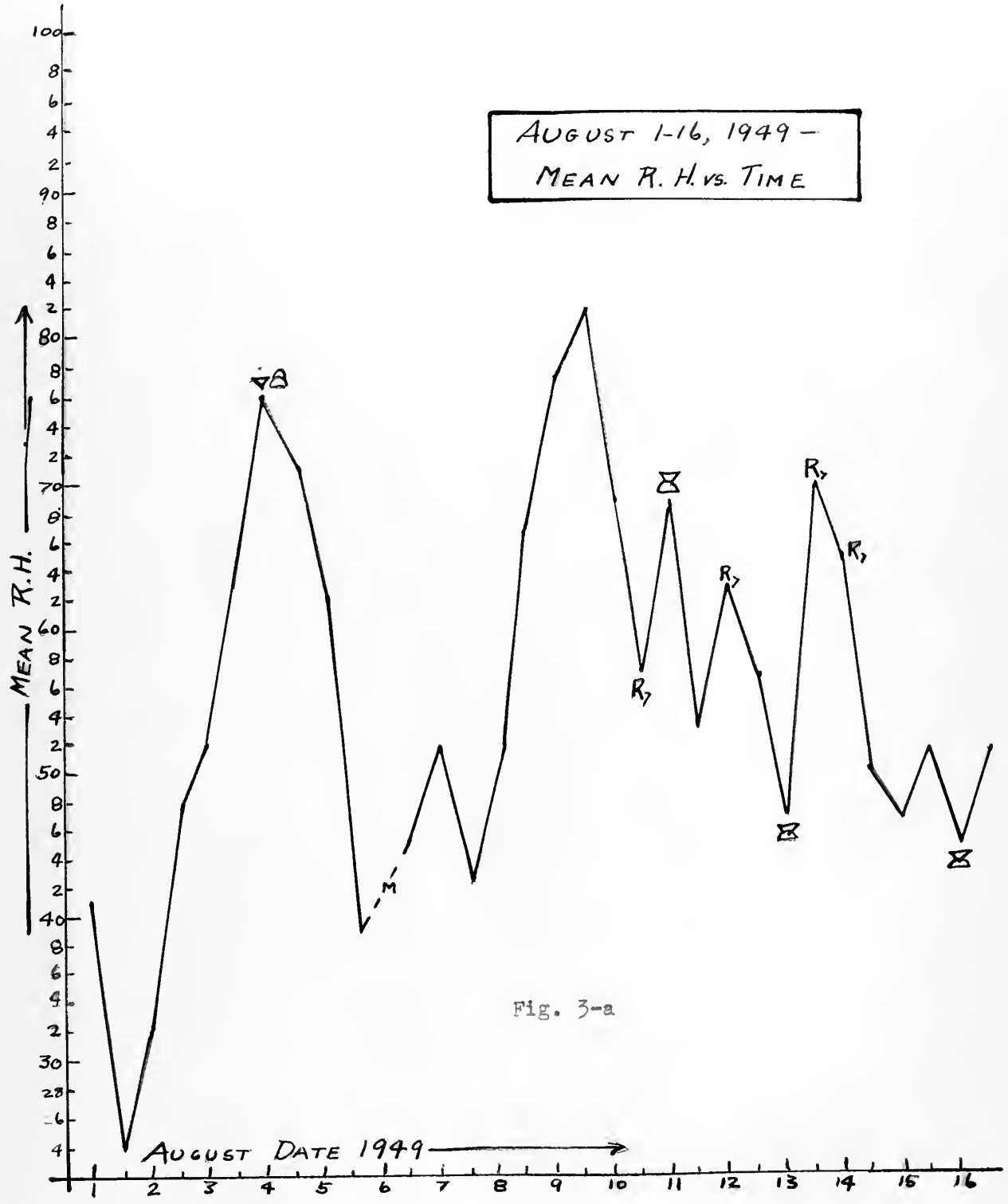


Fig. 3-a

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AUGUST 16-31, 1949  
 MEAN R. H. VS. TIME

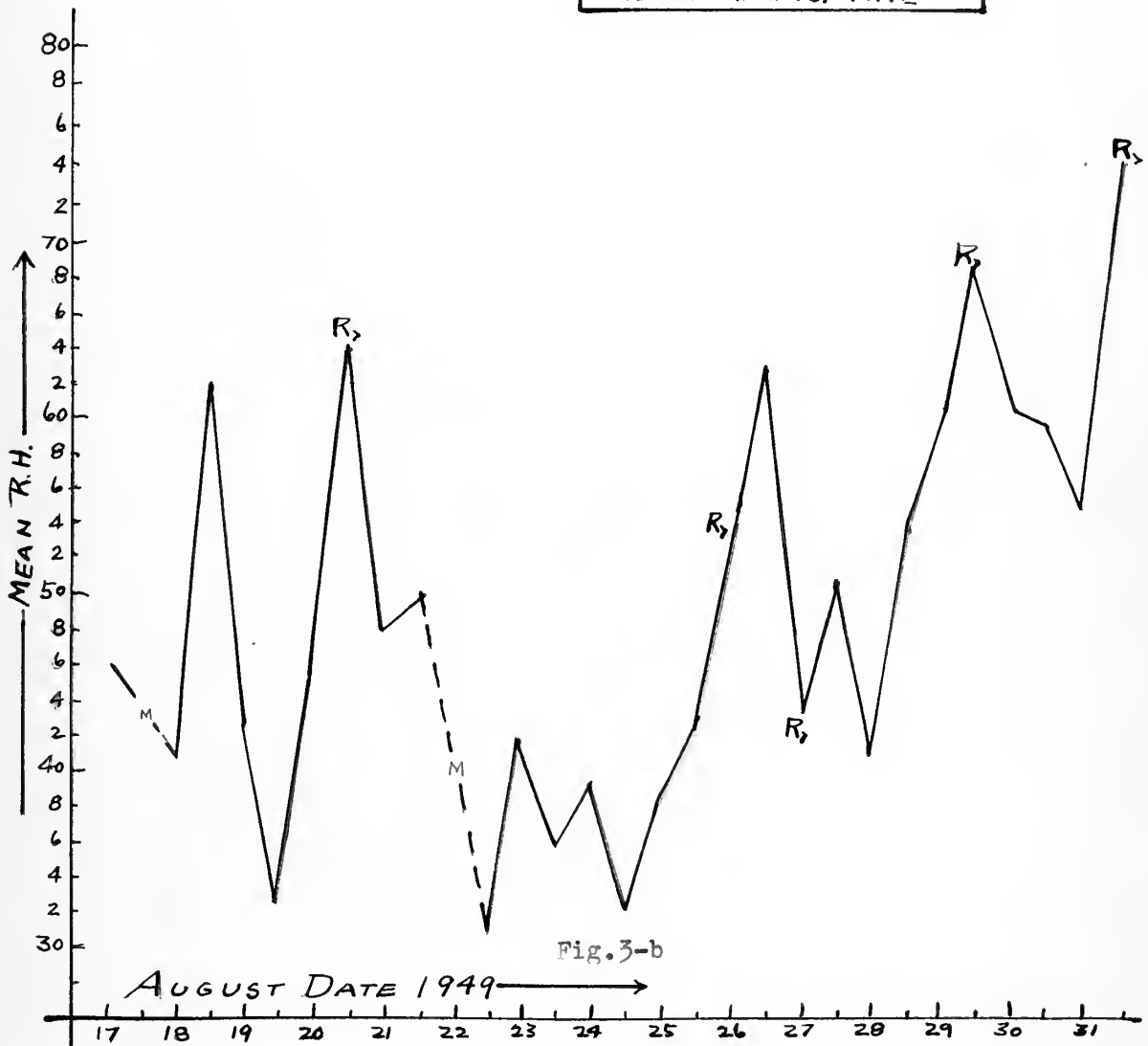


Fig. 3-b

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SEPTEMBER 1-16, 1949  
 MEAN R. H. VS. TIME

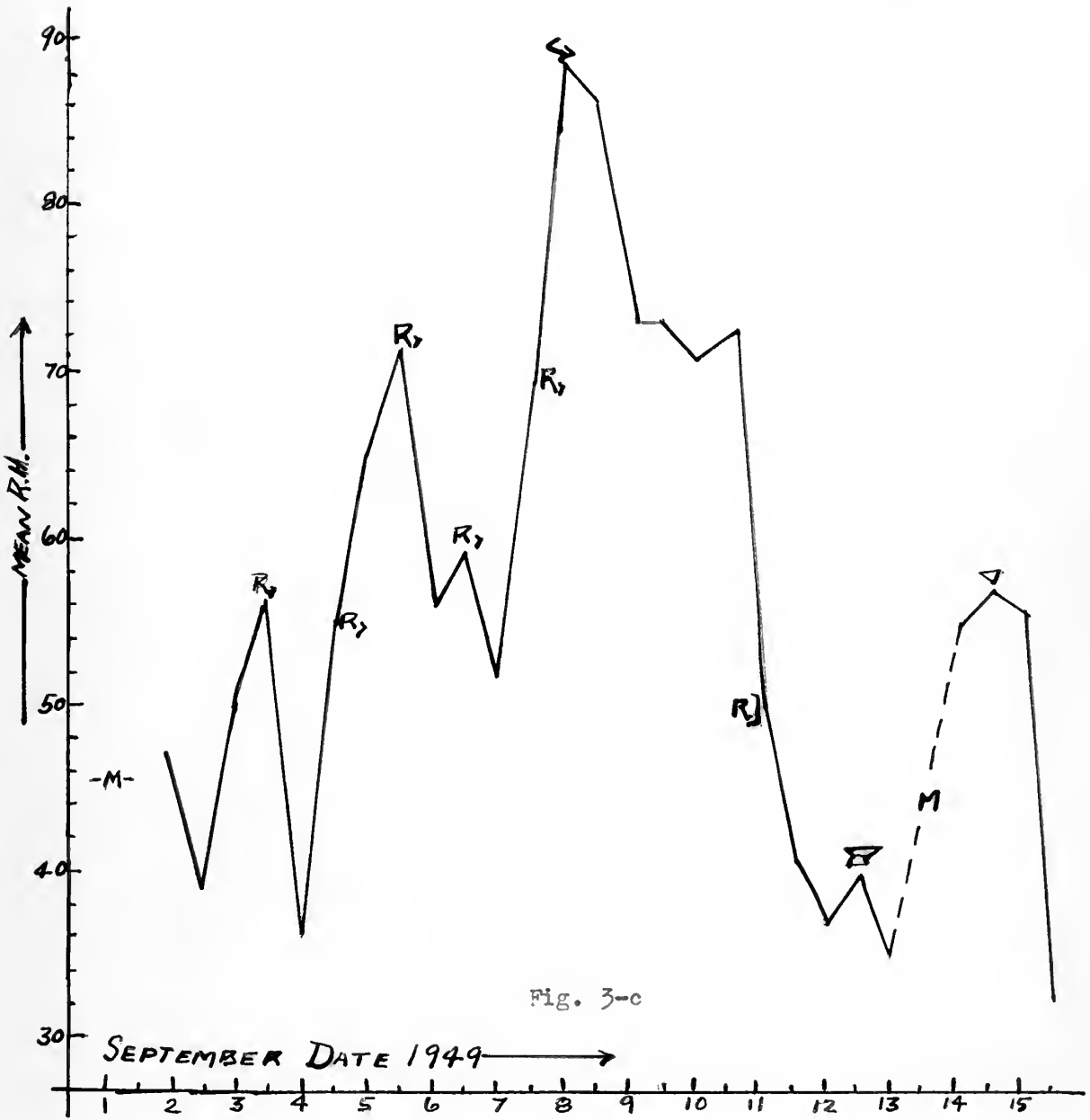


Fig. 3-c



16-31 SEPTEMBER, 1949  
MEAN R.H. vs. TIME

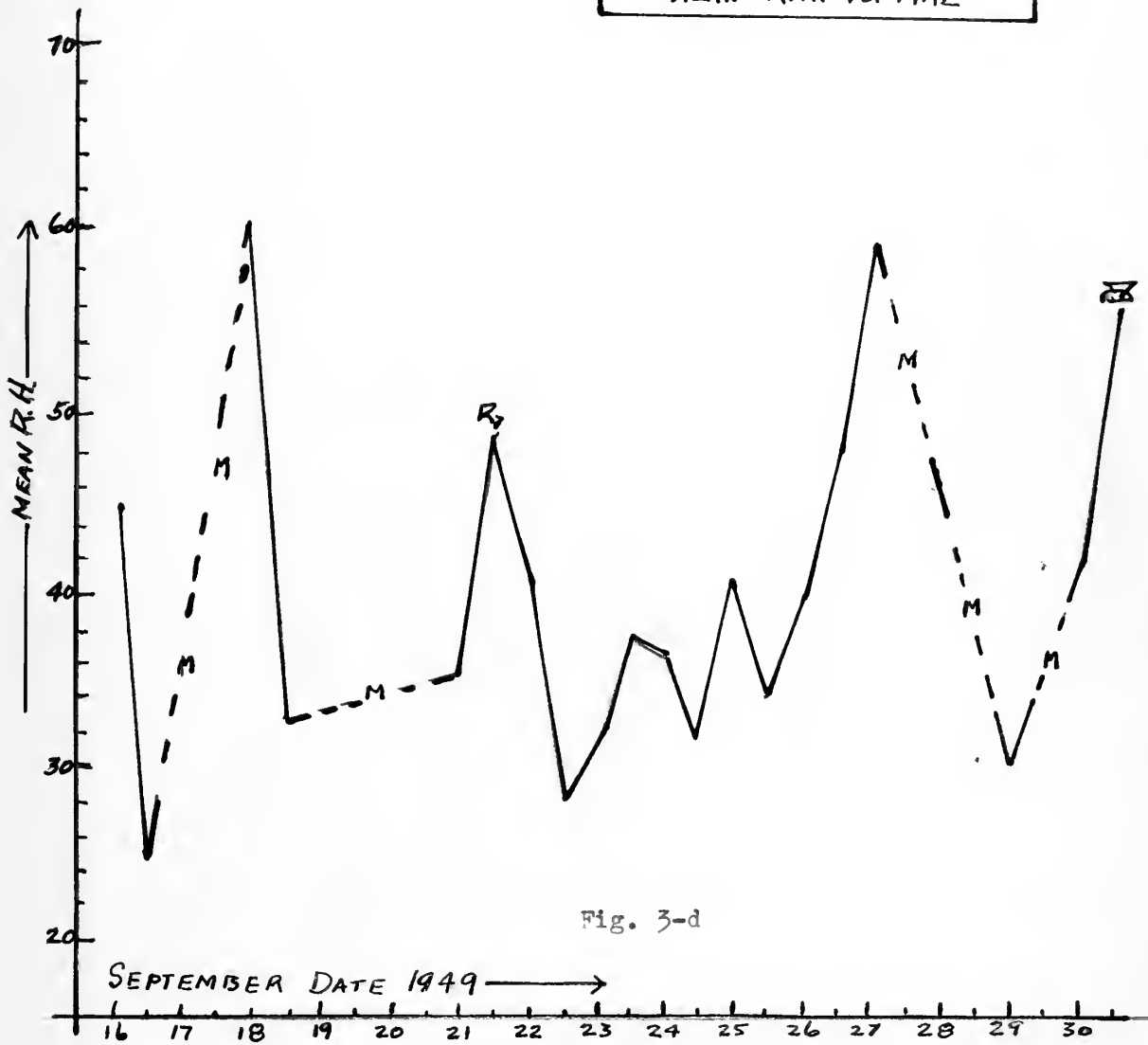


Fig. 3-d

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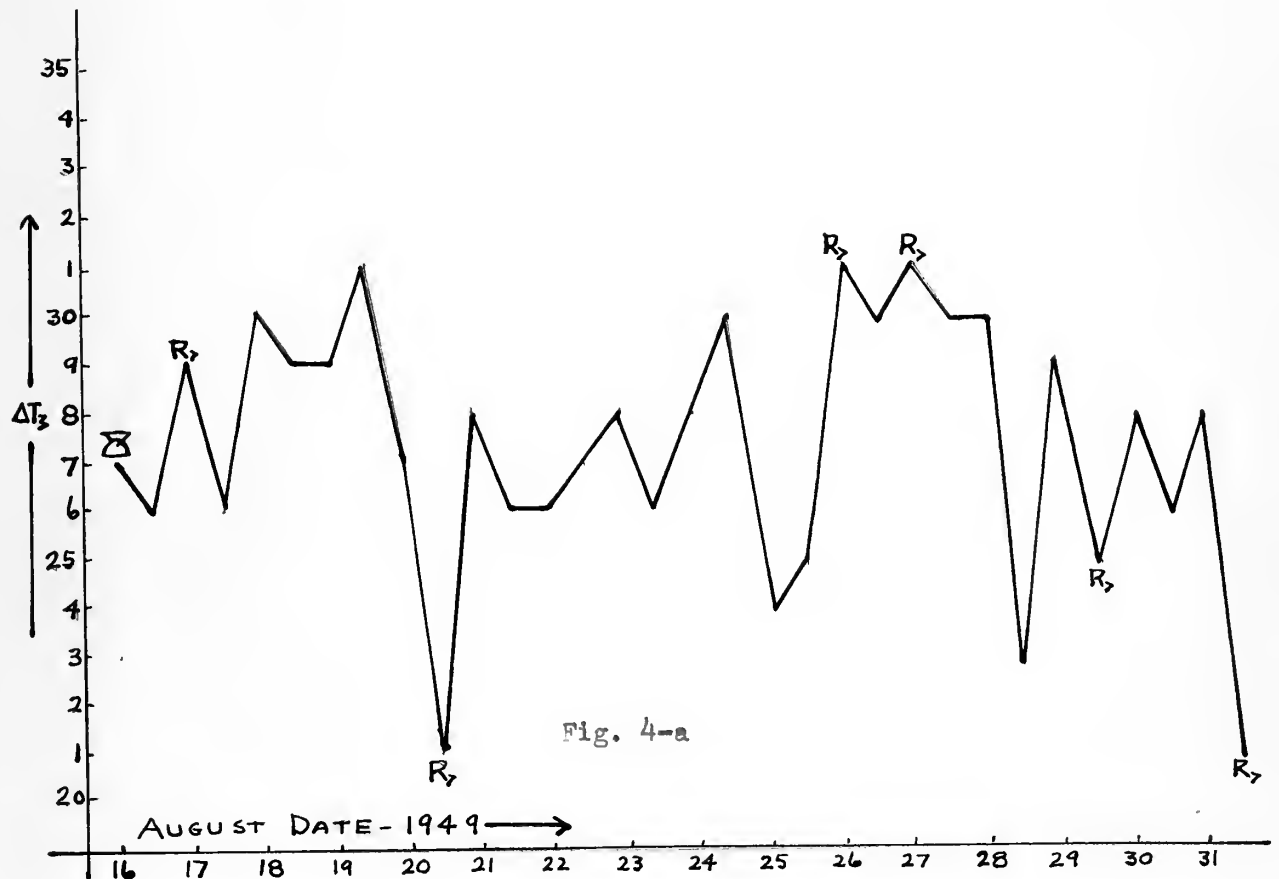
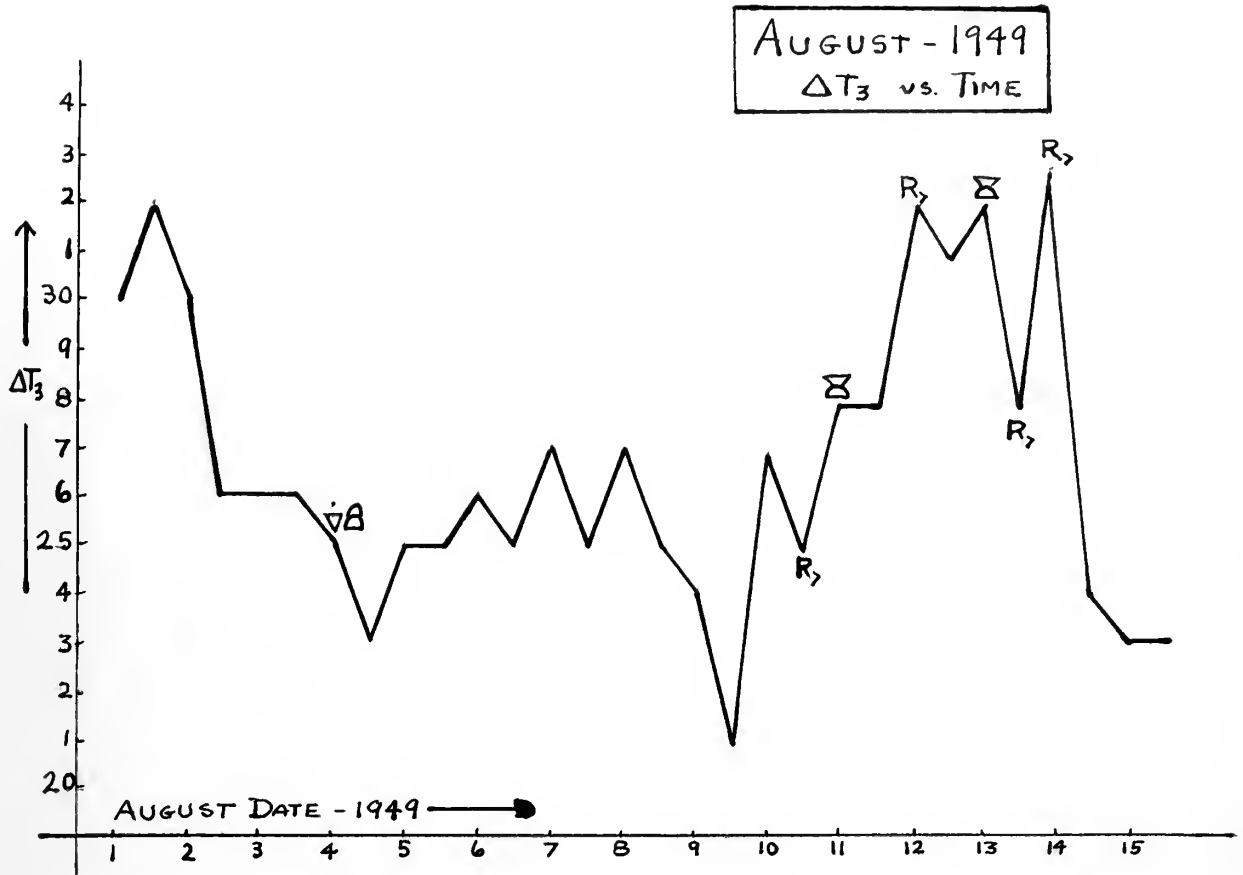
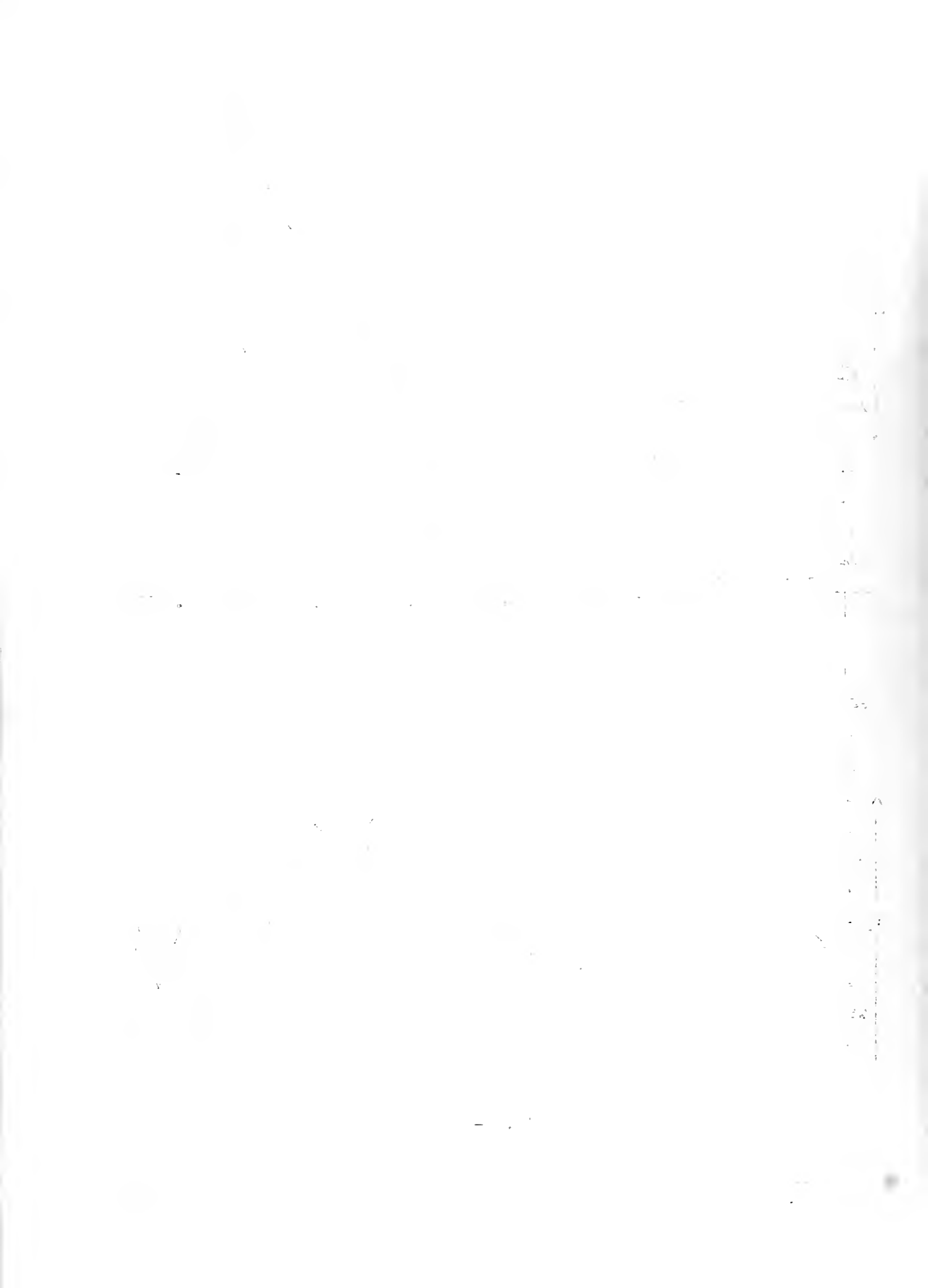


Fig. 4-a



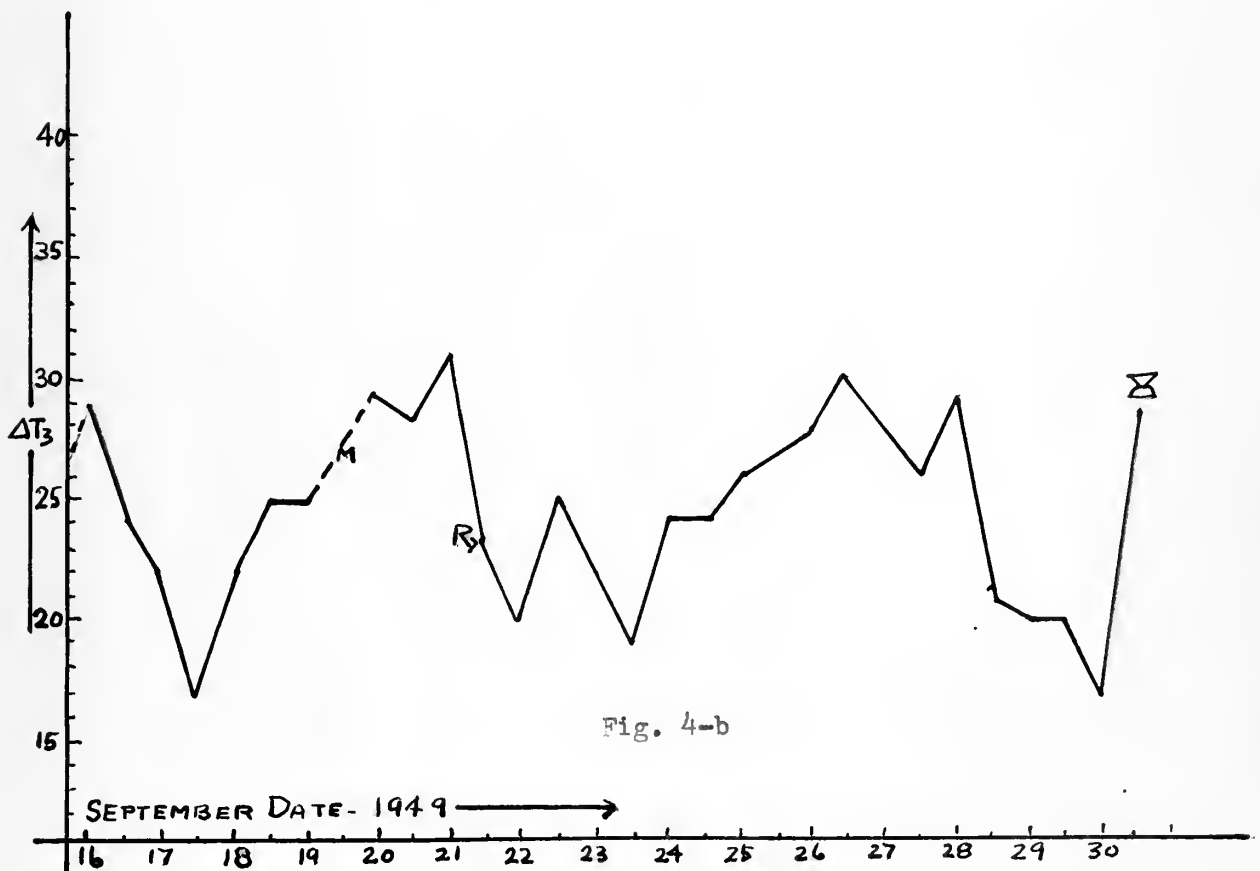
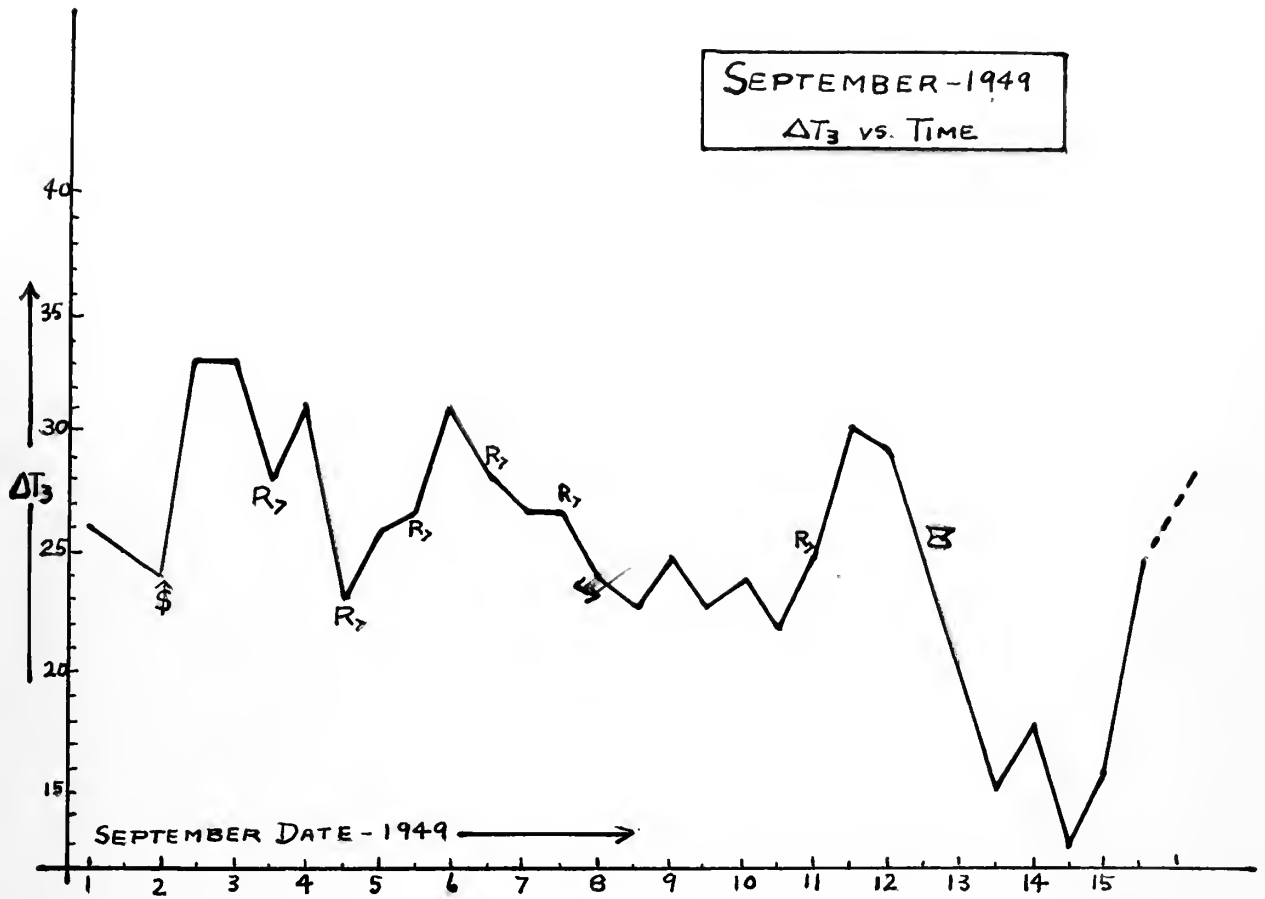
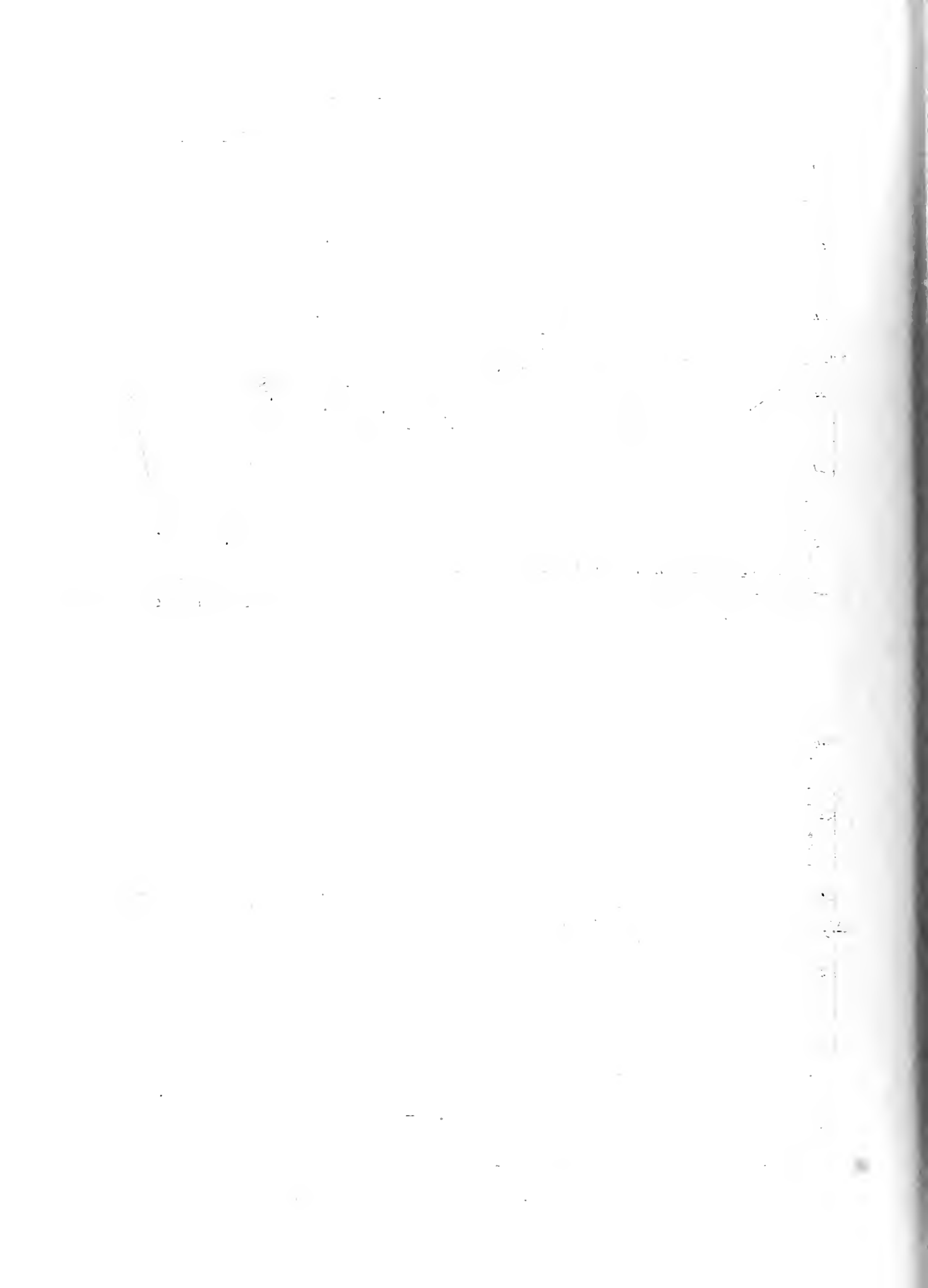


Fig. 4-b



AUGUST 1-16, 1949  
 MEAN R.H. 700-500 M.B. VS. TIME

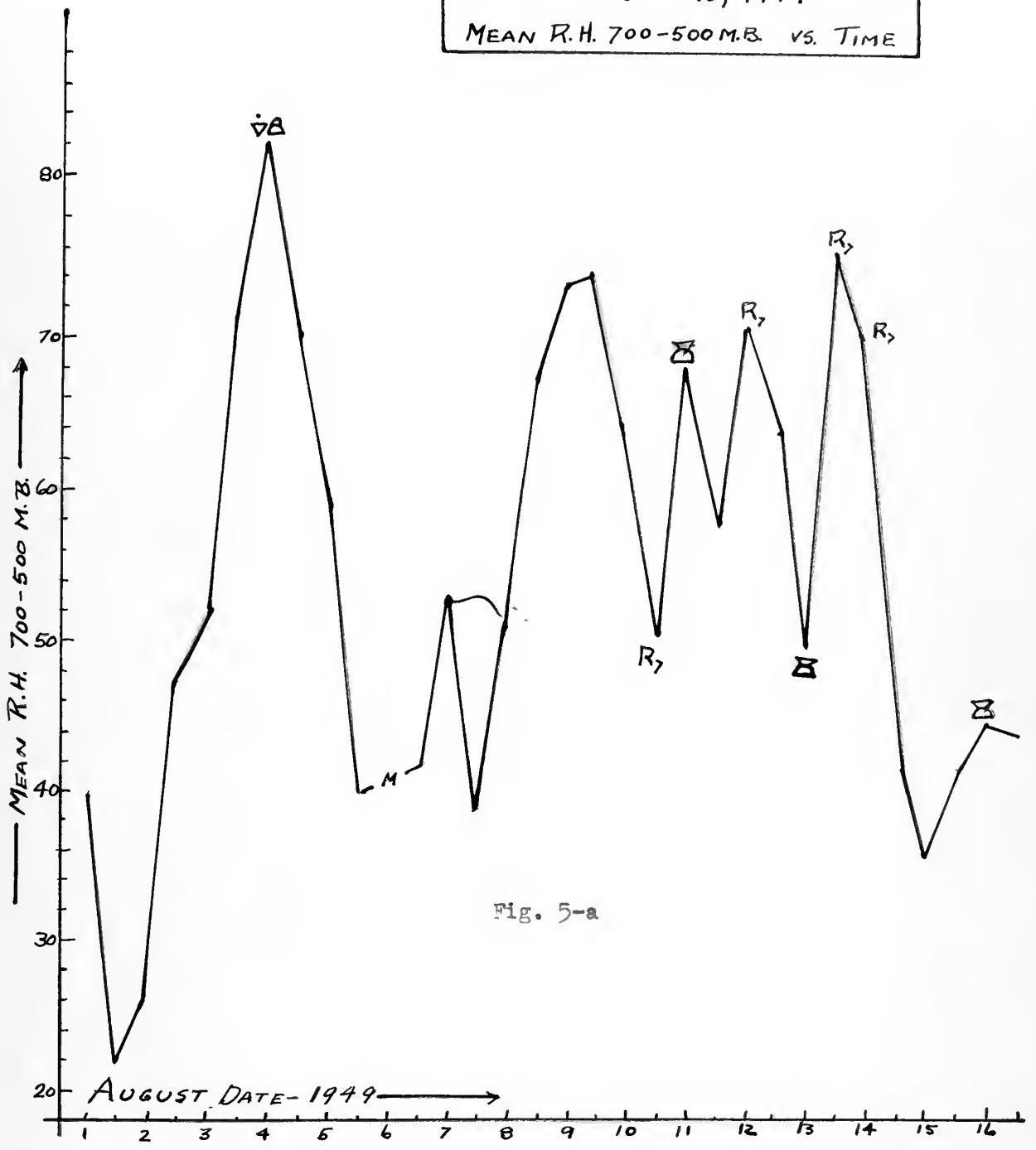


Fig. 5-a

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AUGUST 17-31, 1949  
MEAN R.H. 700-500M.B. VS. TIME

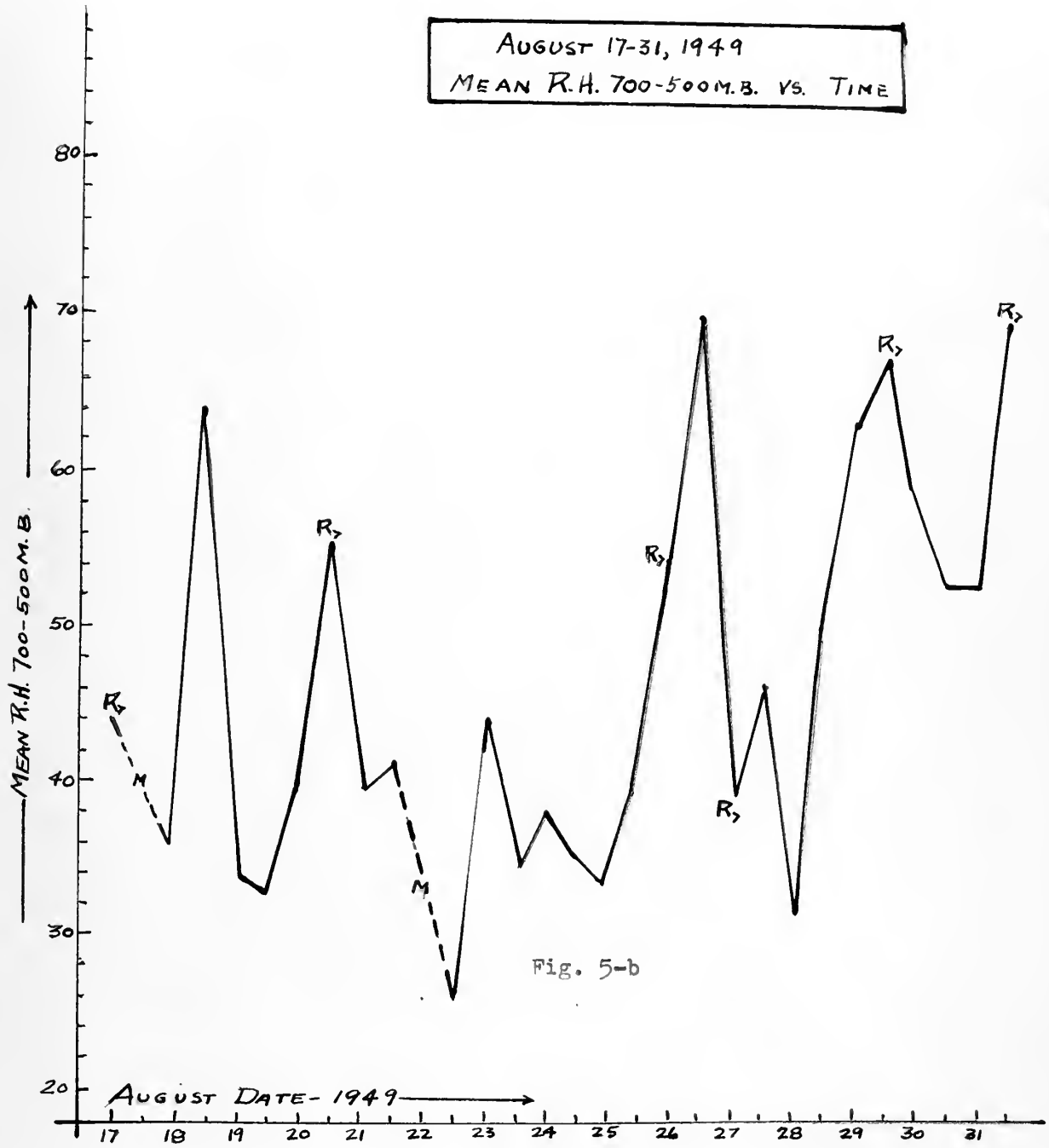


Fig. 5-b

1871

1871



## BIBLIOGRAPHY

1. Austin, James M. A note on cumulus growth in a nonsaturated environment. *Journal of Meteorology*, 5:103-107, June 1948.
2. Austin, James M. and Fleisher, Aaron. A thermodynamic analysis of cumulus convection. *Journal of Meteorology*, 5: 240-243, October, 1948.
3. Beers, Norman R. Atmospheric stability and instability. *Handbook of Meteorology*. Section V:402-409; section X: 693-725. McGraw Hill, New York, 1945.
4. Bjerknes, J. Saturated ascent of air through a dry-adiabatically descending environment. *Quarterly J. Roy. Meteorological Society*. Vol. 65, 1938.
5. Bjerknes, V., Bjerknes, J., Solberg, H., and Bergeron, T., *Physikalische hydrodynamik*, Paragraph 715. Springer, Berlin, 1933.
6. Byers, Horace R. and Braham, Roscoe R., Jr. Thunderstorm structure and circulation. *Journal of Meteorology*. 5:71-86, June 1948.
7. Byers, Horace R. Principal results of a comprehensive investigation of the structure and dynamics of the thunderstorm. *Tellus*. 1:6-17, November, 1949.
8. Cressman, George P. The influence of the field of horizontal divergence on convective cloudiness. *Journal of Meteorology*/ 3:85-88, September, 1946.
9. Jones, D. R. Stability analysis by objective techniques. MS thesis, U. S. Naval Postgraduate School, Annapolis, Md. 1948.
10. Petterssen, S. *Weather analysis and forecasting*. McGraw Hill, New York, 1940.
11. Stommel, Henry. Entrainment of air into a cumulus cloud. *Journal of Meteorology*. 4:91-94, June, 1947.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all receipts and invoices are properly filed and indexed for easy retrieval.

3. Regular audits should be conducted to verify the accuracy of the records and to identify any discrepancies.

4. The second part of the document outlines the procedures for handling customer complaints and inquiries.

5. All customer complaints should be addressed promptly and professionally to maintain a high level of customer satisfaction.

6. It is important to document all customer interactions and to provide a clear resolution to each issue.

7. The third part of the document describes the process for managing inventory and stock levels.

8. Inventory should be monitored regularly to ensure that stock levels are maintained and that there are no shortages.

9. The final part of the document provides a summary of the key points discussed and offers recommendations for future improvements.

10. It is hoped that these guidelines will help to streamline operations and improve the overall efficiency of the organization.

A PENDING

I

Introduction into the slice method equation of an expression for mass divergence:

The basic assumptions of the slice method are:

(a) Horizontal motion does not maintain any net inflow to or outflow from any stratum determined by the air between significant levels.

(b) Conditions are barotropic initially.

(c) All motions are adiabatic above the surface layers.

In this study, assumption (a), above, was replaced by the assumption that horizontal motion maintains a net inflow of air into the ascending column of air with a corresponding outflow of air from the descending column. Gressman [8] expresses this condition by

$$(1) Mv + M'v' = M'\Delta v'$$

where:  $M$  = mass of descending air in the unit slice.

$M'$  = mass of ascending air in the unit slice.

$v$  and  $v'$  are corresponding upward components of velocity.

$v'$  is the speed which, when multiplied by the mass of ascending air in the unit slice, gives the net rate of upward mass transport.

Beers [3] obtains as the fundamental result of the slice method

$$(2) \dot{c} = R \ln \frac{P_0}{P_1} \left( \frac{\partial T'}{\partial E} - \frac{\partial T}{\partial t} \right) \Delta t$$

Considering the case in which the ascending current is saturated, while the descending current is dry

$$\frac{\partial T'}{\partial t} = v' (\gamma - \gamma_m) \quad \text{in the ascending saturated air.}$$

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$$\frac{\partial I}{\partial t} = v (\gamma - \gamma_d) \quad \text{in the descending non-saturated air.}$$

Making these substitutions in (2)

$$(3) \quad \dot{c} = R \ln \frac{P_0}{P_1} [v'(\gamma - \gamma_m) - v(\gamma - \gamma_d)] \Delta t$$

but  $Mv + M'v' = M'\Delta v'$ , so that

$$(4) \quad \dot{c} = R \ln \frac{P_0}{P_1} \left[ (\gamma - \gamma_m) - \frac{M'}{M} \left(1 - \frac{\Delta v'}{v'}\right) (\gamma - \gamma_d) \right] \Delta t v'$$

letting  $K = R \ln \left(\frac{P_0}{P_1}\right) \gamma_d v' \Delta t$

$$(5) \quad \frac{\dot{c}}{K} = \frac{\gamma}{\gamma_d} \left[ 1 + \frac{M'}{M} \left(1 - \frac{\Delta v'}{v'}\right) \right] - \left[ \frac{\gamma_m}{\gamma_d} + \frac{M'}{M} \left(1 - \frac{\Delta v'}{v'}\right) \right]$$

which may be compared with Beers' equation III

$$\frac{C}{K} = \frac{\gamma}{\gamma_d} \left[ \left(1 + \frac{M'}{M}\right) - \left(\frac{\gamma_m}{\gamma_d} + \frac{M'}{M}\right) \right]$$

to indicate that the net effect of including in the slice method equations considerations of horizontal divergence is to multiply  $\frac{M'}{M}$  by the factor  $\left(1 - \frac{\Delta v'}{v'}\right)$ .

The entrainment rate of 100% per 500 mb. suggested by Ryers [6]

may be expressed as 
$$\frac{M'}{M} = \frac{M_0 (500 + dp)}{500 M_0 - M_0' dp}$$

where:  $M_1$  mass of ascending air at level  $p = p_0 - dp$   
 $M$  mass of descending air at level  $p = p_0 - dp$   
 $M_1'$  mass of ascending air at level  $p = p_0$   
 $M_0$  mass of descending air at level  $p = p_0$

so that with assumed values of  $\frac{M_0'}{M_0}$  a corresponding value of  $\frac{M'}{M}$  at any level may be obtained.

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$$\frac{1}{\sqrt{1-x^2}} = \sum_{n=0}^{\infty} \binom{2n}{n} \frac{x^{2n}}{4^n}$$

$$= \sum_{n=0}^{\infty} \frac{(2n)!}{(n!)^2} \frac{x^{2n}}{4^n}$$

$$= \sum_{n=0}^{\infty} \frac{(2n-1)!!}{(2n)!!} x^{2n}$$

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was made. This proved of little use because the area term  $A'$  does not lend itself to ready evaluation.

In summation, it is apparent that the entrainment process, which can be adequately described graphically, is not subject to a simple, continuous, non-graphical mathematical method capable of rapid evaluation.

The first part of the document  
describes the general situation  
and the objectives of the project.  
The second part contains the  
methodology used for the study.  
The third part presents the  
results of the study and the  
conclusions drawn from them.











Thesis  
W94

Wyatt

13131

An objective study  
of the influence of  
moisture distribution  
and lapse rate upon  
vertical stability.

Thesis  
W94

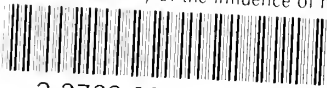
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An objective study  
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moisture distribution  
and lapse rate upon  
vertical stability.

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