

# Rain, Chaos, and the Torah

Professor Nathan Aviezer  
Bar-Ilan University

# IMPORTANCE OF RAIN

Special holiday:

שמיני עצרת

Special prayers:

משיב הרוח ומוריד הגשם  
ותן טל ומטר לברכה

# Special passage in the Torah

"כי הארץ אשר אתה בא שמה לרשתה, לא כארץ מצרים היא אשר יצאתם משם, אשר תזרע את זרעך והשקית ברגלך כגן הירק. והארץ אשר אתם עוברים שמה לרשתה, ארץ הרים ובקעות, למטר השמים תשתה מים. ארץ אשר ה' א-להיך דורש אותה, תמיד עיני ה' א-להיך בה מראשית השנה ועד אחרית שנה"

“The land that you are going to inherit is not like the Land of Egypt from which you came, in which you can water your plants with your foot. In the land that you are going to inherit, you will drink water from the rain. It is a land about which G-d always cares. His eyes are on this land from the beginning of the year until the end of the year”

# Why can't we calculate when it will rain?

1. **Atmosphere** (known gases including water vapor).
2. **Data** (temperature, humidity, air pressure, wind speed, cloud cover).
3. **Energy input** (sun, surface of land, surface of sea).
4. **Equations** (gas laws, laws of motion, gravity, laws of thermodynamics).

**All this has been known for over 100 years.**

# **WEATHER IS NOT A LOCAL PHENOMENON**

**Require data from half the United States to calculate the future weather in any US city. Must insert tens of thousands of data points into thousands of equations. The further into the future that one wants to calculate the weather, the more equations one must solve and the more data points one must include. Requires billions of calculations!**

**QUITE IMPOSSIBLE !**

# PREDICTING FUTURE RAIN

That was the situation until the 1950s. Today, it is possible to predict the weather. Every TV news program concludes with a five-day weather prediction. The weather channel reports the weather for any city for ten days into the future.

**How is this possible ?**

# COMPUTERS

We now have electronic computers that can perform vast numbers of calculations per second.

First, thousands of calculations per second.

Next, millions per second, then billions per second.

Right now, engineers are designing computers that can carry out trillions of calculations per second.

Experience shows that about every five years, computer speed increases by a factor of about 10.

It requires billions of calculations for a five-day forecast, **but this is no problem for a supercomputer.**

# THE FUTURE

Today, using a supercomputer one can predict rain 10 days into the future. As computers become faster, 20 days, then 30 days, and then for an entire season.

The day will come when one can sit in shul on שמיני עצרת and look at a chart on the wall which will say for every day until פסח whether or not it will rain on that day!



# PRAYERS FOR RAIN

When that happens, prayers for rain will be unnecessary. We will already know when it will rain and when it will not rain. Not only will our prayers for rain be unnecessary, they will be **forbidden!**

One is not allowed to pray for something that one knows will not happen. That would require an overt miracle and one is not allowed to pray for an overt miracle (**תפילת שווא**).

# TORAH VERSES

However, this is not a problem. New situations call for new prayers.

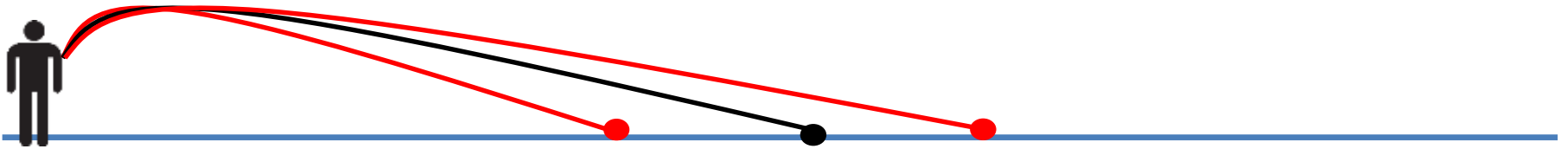
But there is a problem regarding Torah verses. The Torah states that we do not know when it will rain. **Israel is not like Egypt.** But in the future, when we can predict the rain, Israel will become just like Egypt.

**WILL THE TORAH THEN BECOME WRONG ??**

# CHAOS

Meaning of chaos: **extreme sensitivity to teeny, tiny changes in conditions.**

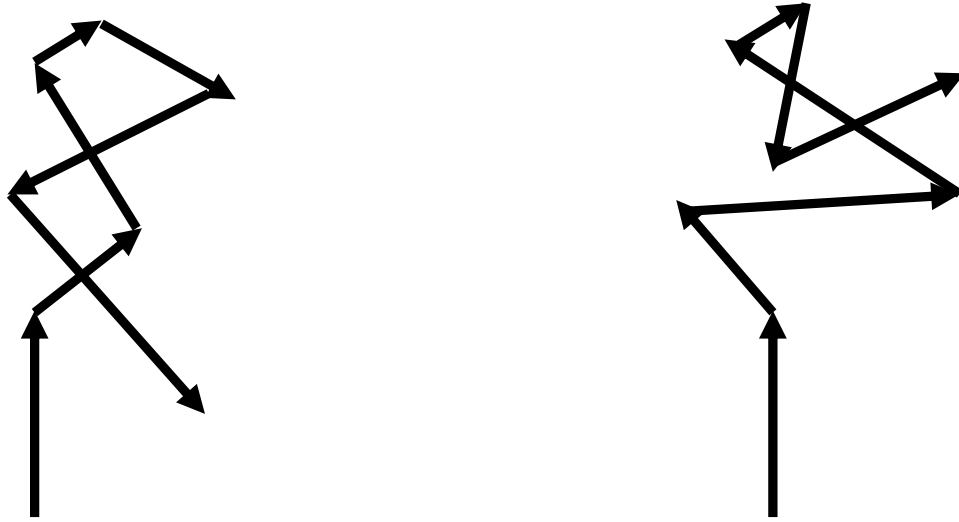
## Non~chaotic system



A small change in the initial condition leads to only a small change in the final result.

# CHAOTIC SYSTEM

Blow up balloon and release it vertically.



The zig-zag path of the balloon can never be repeated because the initial conditions of the balloon are never **exactly** the same.

Temperature, elasticity, initial direction, etc.

**These teeny, tiny changes are enough to completely change the zig-zag path of the balloon.**

# WEATHER IS A CHAOTIC SYSTEM

The smallest change in atmospheric conditions can lead to a complete change in the future weather.

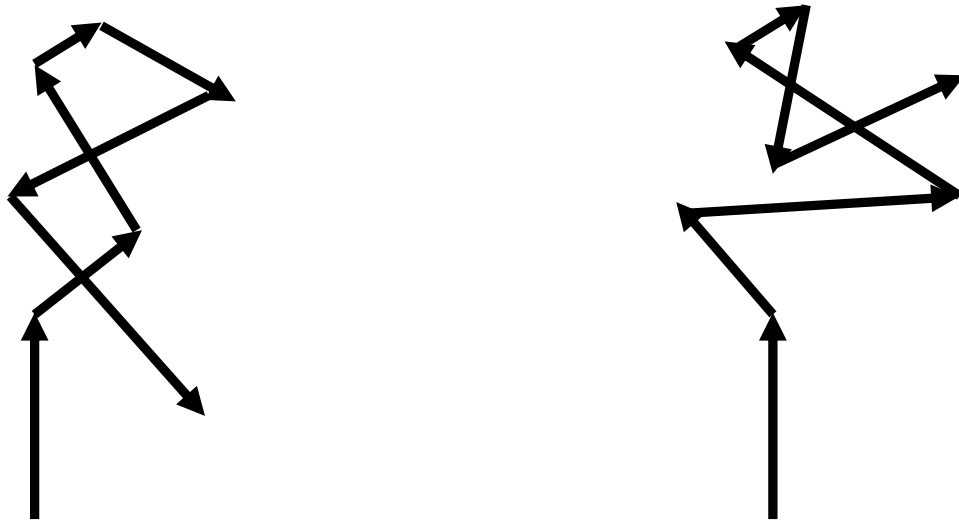
## BUTTERFLY EFFECT



**If a butterfly flaps its wings in Tokyo, within two weeks, it can change the weather in Jerusalem.**

Since one can never include in a calculation of the weather the motion of every butterfly in the world, and all other such teeny tiny changes, one will never be able to predict future weather, no matter how fast the computer is.

# CHARACTERISTIC TIME



For the first second or so, one can predict the vertical path of the balloon. This is called the characteristic time. Then, chaos sets in and no further prediction is possible. However, during the characteristic time, prediction is possible.

# WEATHER AND RAIN

The atmosphere = weather = rain is a chaotic system with characteristic time of 12~14 days. This means that it is possible to predict accurately the weather and chance of rain for 12~14 days in the future. **But after that, it is impossible to predict the rain and prediction will remain impossible** even if our computers can eventually carry out trillions of trillions of calculations per second.

# CONCLUSION

The Torah states that the occurrence of rain in Israel is uncertain and therefore we must pray for rain to G~d, Who is the ultimate source of rain and all our other blessings.

Recent scientific studies of the chaotic nature of the atmosphere have confirmed the above Torah statement. Thus, rain is another subject for which modern science yields confirmation and explanation of the verses of the Torah.