Reading 18

Causes of Ice Ages

Geologists have shown that for about 80 percent of the past 2.5 million years, ice-age conditions have **prevailed** on the Earth's surface. During the past one million years, increased glacial conditions have run in cycles of approximately 100,000 years.

Many different factors may contribute to these increases in glaciation at regular intervals throughout Earth's more geologically recent history. A The three most prominent factors probably relate to the amount of sunlight that reaches the Earth. This varies over time for three main reasons. First, the planet wobbles* as it spins, due to the pull of the sun and moon. B Furthermore, the Earth tilts* on its axis and the degree of tilt changes over time. C Finally, the orbit of the Earth around the sun is elliptical and the length of the major axis of the ellipse changes over a period of about 100,000 years. D A mathematician named Milutin Milankovitch discovered in the 1930s that the pattern of insolation, or sunlight, predicted by **these eccentricities** in the Earth's movement matched the period of the last several eras of intense glaciation.

These Milankovitch insolation cycles were the dominant theory in ice-age research for much of the twentieth century despite the fact that the match between periods of peak insolation and most intense glaciation were not exact. For example, a cycle of 400,000 years predicted by the Milankovitch theory has never shown up in the climate records obtained through the study of microfossils deposited on the sea floor. Also, recent analysis has shown that the insolation theory predicts peaks of sunlight at intervals of 95,000 and 125,000 years. Climatological data does not support this predicted sunlight peaking. Other damaging evidence was the indication of a precisely measured sudden rise in temperature at a water-filled cave in Nevada, which preceded the increase in solar radiation that was supposed to cause it.

These and other problems with the Milankovitch cycles led some researchers to seek alternative explanations for the cyclic arrival of extended ice ages. In the 1990s, it was discovered that the orbital inclination of the Earth to the sun and planets could also be responsible for climate changes. If we imagine a flat plane with the sun in the center and the planets revolving around it, the Earth slowly moves in and out of the flat plane by a few degrees, repeating the cycle every 100,000 years. Two scientists, Muller and MacDonald,

have proposed that it is this orbital inclination which is ultimately responsible for the periods of glaciation and warming. They argue that because of the oscillation, the Earth periodically travels through clouds of debris, in the form of dust and meteoroids. Such debris could reduce the amount of solar energy reaching the surface of our planet, thus plunging **it** into regular cold periods.

The advantage of this theory is that it is not confronted with several of the problems associated with the Milankovitch theory. In particular, the new theory fits well with the analysis of ocean sediments taken from eight locations around the world. This analysis yielded data clearly showing the peak of the last several ice ages with a period of 100,000 years and corresponding to the periods when the Earth's oscillating inclination takes it through clouds of extraterrestrial debris.

However, many researchers in this field are not yet **persuaded** by the inclination hypothesis. The main problem is that the amount of dust that falls to the ground when the Earth travels through space debris is relatively small - not enough to produce radical climate changes. Volcanic eruptions, for example, release much greater amounts of ash and dust and have relatively little effect on climate. Supporters have countered that the by-products created by the dust as it vaporizes on entering the atmosphere cause subtle changes to the energy levels. Nevertheless, the necessary physical proof has yet to be found to convince the skeptics.

**wobble: to shake or move from side to side*
**tilt: to be in a sloping position*

1. The word "prevailed" in the passage is closest in meaning to
   A. ruled
   B. existed
   C. survived
   D. triumphed

2. What can be inferred from paragraph 2 about the factors that contribute to glaciation?
   A. They affect the Earth's spin.
   B. They are geologically recent.
   C. Only three factors relate to levels of sunlight.
   D. Other factors than those relating to the sunlight affect ice buildup.

3. The phrase "these eccentricities" in the passage refers to all of the following EXCEPT
   A. the various movements of the Earth as it spins
   B. the degree of change in the Earth's tilt over time
   C. the pattern of insolation matching the Earth's movement
   D. the changing distance to the sun during the Earth's elliptical orbit

4. Scientists accepted the Milankovitch theory even though
   A. the peaks of sunlight occurred at intervals of 95,000 and 125,000 years
   B. the peaks of insolation and intense glaciation did not match
   C. there were climate records of a 400,000-year cycle
   D. there were microfossil deposits on the sea floor

5. In paragraph 4, why does the author suggest the image of a flat plane?
   A. To help the reader visualize the positions and movements of the heavenly bodies
   B. To demonstrate to the reader how the Earth orbits the sun
   C. To support the argument that the orbital inclination increases tilting
   D. To show how the Milankovitch theory doesn't explain the cyclical changes in climate

6. The word "**it**" in the passage refers to
   A. such debris
   B. solar energy
   C. the surface
   D. our planet

7. In paragraph 4, the author explains that
   A. Milankovitch did not know about the orbital inclination of the Earth
   B. glaciation occurs when the orbital inclination has entered a new cycle
   C. the Earth always travels through clouds of debris after moving out of the plane by a few degrees
   D. the amount of solar energy reaching the Earth's surface causes the changes of temperature

8. What problem in the Milankovitch theory was mentioned as being explained by the Muller and MacDonald theory?
   A. The climate records obtained by studying microfossil deposits not matching his predicted cycle
   B. The irregularities of the Earth's movements through orbital inclinations not following any pattern
   C. The Earth's spin wobbling in relation to the Earth's oscillating inclination
   D. The peak in the ice ages occurring at intervals between 95,000 and 125,000 years instead of 400,000

9. The word "**persuaded**" in the passage is closest in meaning to

A. convinced
B. discouraged
C. affected
D. challenged

10. What problem is associated with the Muller and MacDonald theory?

A. The amount of debris that is released from volcanoes is proportional to the amount of interstellar dust.
B. The amount of ash from volcanoes and space dust that vaporizes in the atmosphere is too small.
C. The amount of dust entering the atmosphere is less than the amount of ash and dust released by volcanoes.
D. The by-products created by vaporized space dust cause relevant changes to the energy levels.

11. Look at the four squares that indicate where the following sentence could be added to the passage.

When the Earth is at its furthest from the sun, less sunlight reaches the surface.

Where would the sentence best fit?

Choose the letter of the square that shows where the sentence should be added.

12. Select the appropriate phrases from the answer choices and match them to the flaws in the ice-age theories to which they relate. TWO of the answer choices will NOT be used. Write the letters of the answer choices in the spaces where they belong. Refer to the full passage.

Answer Choices

A. Data of climate records not coinciding with predicted intervals of sunlight
B. Temperature rises occurring before the increase of sunlight
C. The irregularities of the Earth's movement during its orbit around the sun
D. The inconsistency between the periods of sunlight and glaciation
E. The relatively mild effect of volcanic eruptions on the climate

Flaws in the Milankovitch Cycles Theory

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F. The orbital inclination of Earth through clouds of debris

G. The relatively small amount of interstellar debris reaching Earth

H. The lack of clear support from ocean sediment data

I. The lack of physical evidence in support of the effects of the inclination hypothesis

Flaws in the Muller and MacDonald Theory

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Source of the task: Cambridge Preparation to the TOEFL IBT

Reading 18 — Keys

1 B

To "prevail" means "to exist" or "to occur more prominently or notably."

2 D

The phrase "the three most prominent factors" indicates there are other factors that may not be as prominent.

3 C

The phrase "these eccentricities" refers to the movements of the Earth. The pattern of insolation is not a movement of the Earth.

4 B

The phrase "the match between periods of peak insolation and most intense glaciation were not exact" means that the periods did not occur at the same time.

5 A

The author is using the flat plane image to show the reader how the Earth moves in and out of a plane.

6 D

The Earth, our planet, is plunged into cold periods periodically.

7 D

Space debris reduces the amount of solar energy reaching the Earth. This causes regular cold periods.

8 A

Muller and MacDonald’s theory is supported by the fossil record, whereas Milankovitch's theory is not.

9 A

When someone is "persuaded" or "convinced," they have been shown evidence that makes them believe something.

10 C

The problem with Muller and MacDonald's theory is that the amount of debris that reaches Earth in comparison to the debris from volcanoes appears too small to cool temperatures sufficiently.

11 D

The phrase "Earth is at its furthest from the sun" indicates that this is a detail related to the Earth's orbit around the sun. This would follow the sentence that discusses the elliptical nature of the Earth's orbit.

12 Flaws in the Milankovitch Cycles Theory

A

Milankovitch's predicted intervals of sunlight do not coincide with the climate records.

B

The Nevada lake temperature increased before Milankovitch's predicted peaks of sunlight.

D

Milankovitch's predicted cycles do not always match the periods of most glaciation.

H

The data from the ocean sediments docs not coincide with Milankovitch's predicted years of glaciation.

Flaws in the Muller and McDonald Theory

E

The mild effect of volcanic eruptions on the climate docs not support Muller and MacDonald's theory that interstellar debris affects the amount of sunlight that reaches the Earth.

G

There is not enough interstellar debris reaching Earth to support Muller and MacDonald's theory that this dust blocks sunlight.

I

Even though the glaciation corresponds to the periods of the Earth's moving through debris, Muller and MacDonald's theory is not supported by much physical evidence of changes in energy levels.