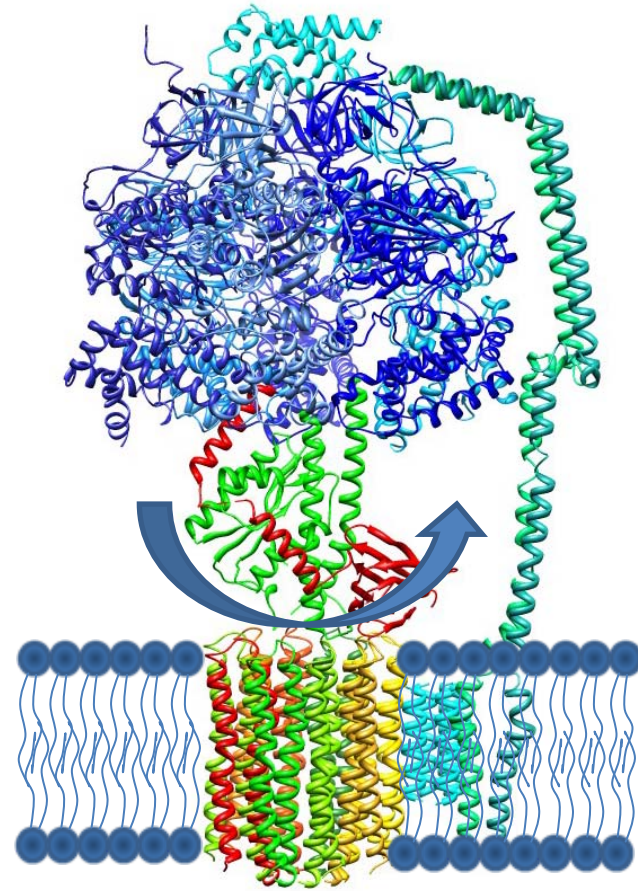
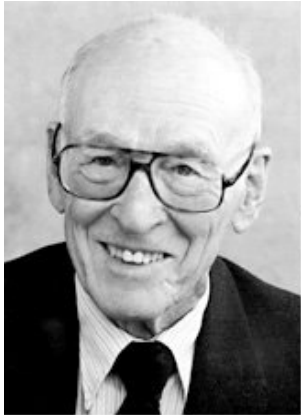
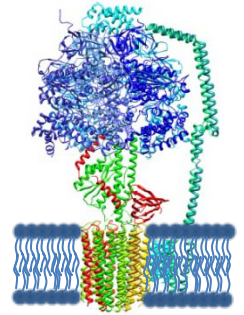


**Why does the  
H<sup>+</sup>-ATPase  
rotate?**



# Why does the H<sup>+</sup>-ATPase rotate?



Paul D. Boyer

## PAUL D. BOYER

Rotational catalysis is the only way that all three catalytic sites could proceed sequentially and identically with modulation by one single copy subunit.



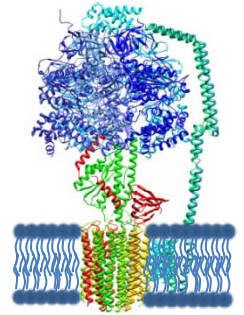
John E. Walker

## JOHN E. WALKER

A poem by Robert Frost gives a short and appropriate description:

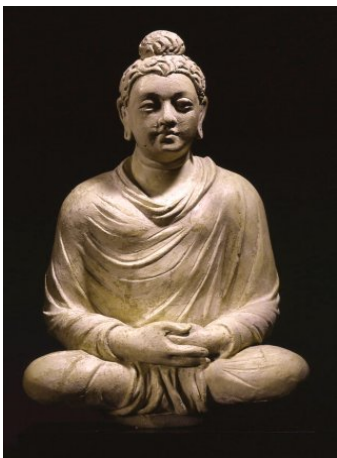
We dance round in a ring and suppose  
The secret sits in the middle and knows

# Why does the H<sup>+</sup>-ATPase rotate?



## MOSES

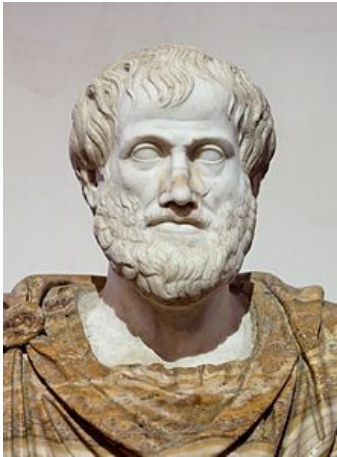
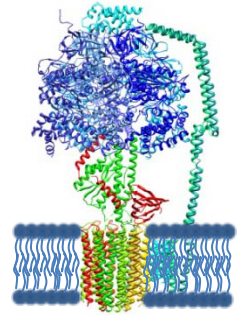
And the LORD came down from the Heaven and HE said to the H<sup>+</sup>-ATPase : "Thou shalt rotate". And the H<sup>+</sup>-ATPase started to rotate and there was much rejoicing.



## BUDDHA

Asking this question denies your own rotational nature.

# Why does the H<sup>+</sup>-ATPase rotate?



**ARISTOTELES**

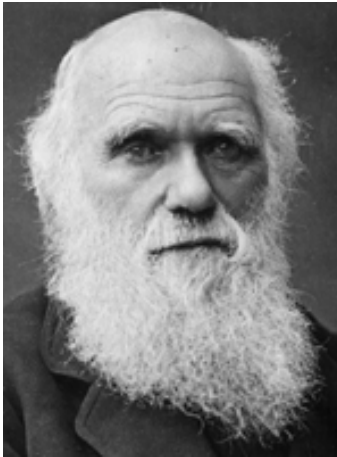
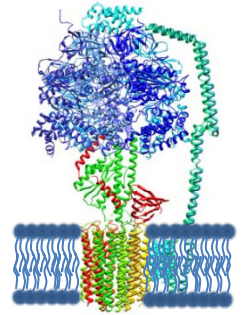
**It is the nature of H<sup>+</sup>-ATPases to rotate.**



**MACHIARELLI**

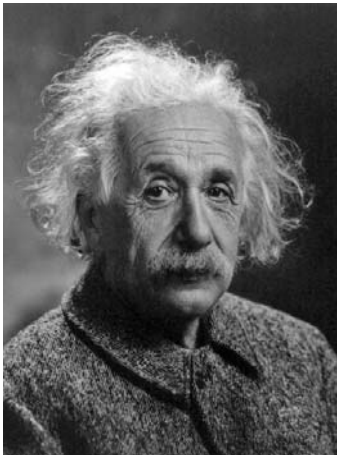
**The important thing is the rotation of the H<sup>+</sup>-ATPase. Who cares why? The fact of rotation justifies any motivation.**

# Why does the H<sup>+</sup>-ATPase rotate?



**CHARLES DARWIN**

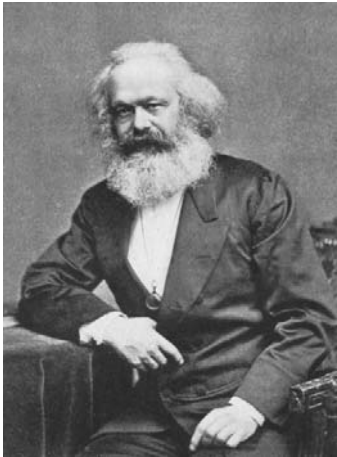
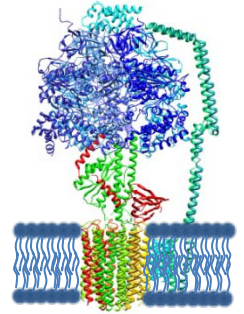
**H<sup>+</sup>-ATPases have been selected by nature over a long period of time so that they are now genetically prepared to rotate.**



**ALBERT EINSTEIN**

**The question whether the H<sup>+</sup>-ATPase rotates or whether the membrane rotates depends on your reference system.**

# Why does the H<sup>+</sup>-ATPase rotate?



**KARL MARX**

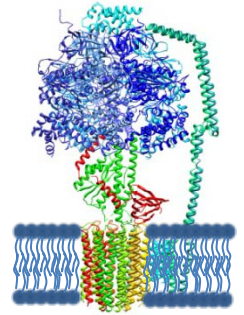
**Historically, this was inevitable.**



**MARTIN LUTHER KING, JR.**

**I have a dream: I see a world where all H<sup>+</sup>-ATPases are free to rotate and nobody will ask about their motivations.**

# Why does the H<sup>+</sup>-ATPase rotate?



**RICHARD M NIXON**

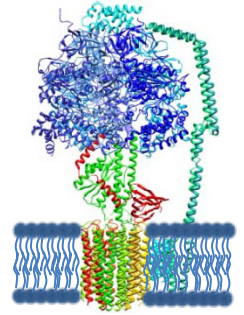
The H<sup>+</sup>-ATPase has not rotated. I repeat the H<sup>+</sup>-ATPase has NOT rotated.



**ANGELA MERKEL**

There is no alternative.

# Why does the H<sup>+</sup>-ATPase rotate?



**BILL CLINTON**

**I never rotated this enzyme.**

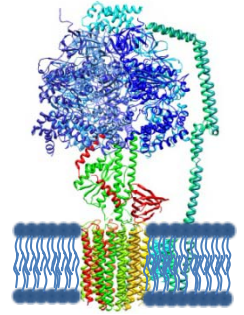


**JOSEPH STALIN**

**I don't care. Catch it. I need the ATP.**



# Why does the H<sup>+</sup>-ATPase rotate?



**RYUNOSUKE AKUTAGAWA**

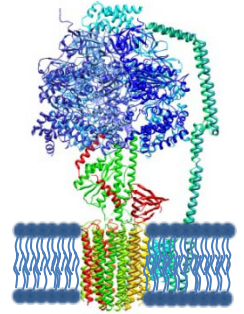
**This cannot be answered unequivocally.  
Ask any of the parts involved in rotation:  
Each one will give you a different  
answer.**



**ERNEST HEMINGWAY**

**To die. In the rain.**

# Why does the H<sup>+</sup>-ATPase rotate?



**BILL GATES**

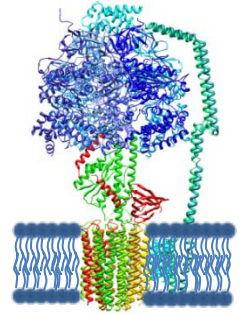
We just have released the new H<sup>+</sup>-ATPase Office 2012. This does not only rotate H<sup>+</sup>-ATPases but also all the programs and data in your computer.



**CAPTAIN JAMES T KIRK**

To boldly rotate where no H<sup>+</sup>-ATPase has rotated before.

# Why does the H<sup>+</sup>-ATPase rotate?



**STUDENT OF  
BIOCHEMISTRY**

# To make ATP