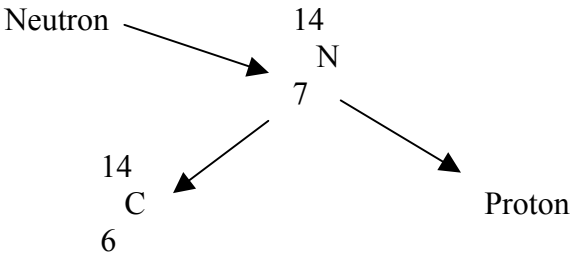
# The Dating with Radiocarbon

Before 1950 archaeologists could date the past only by using recorded histories. They used pottery and other materials in sites to date 'relatively'. They thought that sites which had the same kinds of pots and tools would be the same age. The relative dating method worked very well, but only in sites which had a connection to the relative scale. Most sites could not be dated. When radiocarbon dating was developed, it revolutionised archaeology, because it enabled them to more confidently date the past, and to build a more accurate picture of the human past.

## Transformation of part of nitrogen in the air into Carbon

Nitrogen in the air is bombarded by neutrons. The neutrons origin from cosmic radiation, but a few also from detonated atom bombs.




The nitrogen loses after the clash with the neutron a proton a transforms into a radioactive radiocarbon.

All plants and animals on Earth are made principally of carbon. During the period of a plant's life, the plant is taking in carbon dioxide through photosynthesis, which is how the plant makes energy and grows.

Animals eat plants, and some eat other animals in the food chain. Carbon follows this pathway through the food chain on Earth so that all living things are using carbon, building their bodies until they die. After death there is no more accumulation of radiocarbon.

## How does radiocarbon dating work?

In the 1940s, scientists succeeded in finding out how long it takes for radiocarbon to disappear, or decay, from a sample of carbon from a dead plant or animal. Willard Libby, the principal scientist, had worked in the team making the nuclear bomb during World War 2, so he was an expert in nuclear and atomic chemistry. After the war he became very interested in peaceful applications of atomic science. He and two students first measured the "half-life" of radiocarbon. The half-life refers to the amount of time it takes for half the radiocarbon in a sample of bone or shell or any carbon sample to disappear. Libby found that it took 5568 years for half the radiocarbon to decay. After 60 or 70 000 years it is no longer possible to date because of the too small amounts of radiocarbon.

The radiocarbon method was developed by a team of scientists led by the late Professor Willard F. Libby of the University of Chicago after the end of World War 2. Libby later received the Nobel Prize in Chemistry in 1960 for the radiocarbon discovery.

*How much Radiocarbon do we have after 5568, 11 136, 22 272, 33 408 years. Draw a graph.*

## What kind of things can you date using radiocarbon?

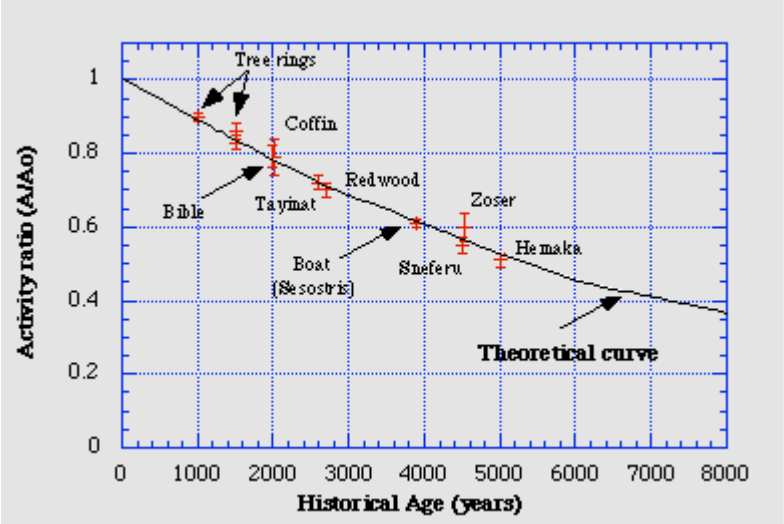
Because carbon is very common on Earth, there are alot of different types of material which can be dated by scientists. Below is a list of the different kinds of materials which can be dated:

- Charcoal, wood, twigs and seeds
- Bone, Leather
- Marine, estuarine and riverine shell
- Coprolites (samples of preserved faeces)
- Lake muds (gyttja) and sediments
- Soil
- Ice cores
- Pollen
- Hair
- Pottery
- Metal casting ores
- Wall paintings and rock art works
- Iron and meteorites
- Bird eggshell
- Corals and foraminifera
- Blood residues
- Textiles and fabrics
- Paper and parchment
- Water

*Is it possible to date gold, fossil fuels, granite, fossils? Which subjects benefit? Name objects which can not be dated.*

### How did Libby test his method and find out if it worked correctly?

Libby tested the new radiocarbon method on carbon samples from prehistoric Egypt whose age was known. A sample of acacia wood from the tomb of the pharaoh Zoser was dated for example. Zoser lived during the 3rd Dynasty in Egypt (4700-4600 BP). Libby figured that since the half-life of C14 was 5568 years, they should obtain a radiocarbon amount of about 50% of that which was found in living wood because Zoser's death was about 5000 years ago. *How old is a fossil tree of activity ratio of 0.4?*




### How much sample material do you need to date using radiocarbon?

You can date very small sizes carbon samples. Imagine a grain of rice, this can be dated now with radiocarbon. We can date pollen grains, seeds, tiny pieces of charcoal or a hair.

### What kinds of famous things have been radiocarbon dated?

The Dead Sea Scrolls are a very famous archaeological discovery. They date from the first century BC to the first century AD.

The Iceman is a very famous frozen body found in northern Italy in 1991. Samples of his bones, grass boot, leather and hair were dated, the results showed that he lived almost 5500 years ago, during the age when people first began using copper in Europe. *What is the Iceman's activity ratio of radiocarbon?*

## Are there different methods of dating?

We can date volcanic rocks using a method called argon-argon dating for instance. This method uses principles of isotopic decay like radiocarbon, but different isotopes (argon-39 and argon 40) which have a longer half-life (1250 million years). This means scientists can date rock which is many millions of years old.

Every year a tree leaves a ring, the rings increase in number over time until a pattern of rings is formed. Sometimes the tree has many hundreds of rings. Scientists can date the age of the tree by counting and measuring the rings. Radiocarbon daters can then date the tree rings and compare the dates with the real age of the tree.
We can also test radiocarbon by comparing the results with the dates produced by other dating methods, and there are many of those. These methods are completely different to radiocarbon dating and use different methods to provide dates. Some of the dating methods include Uranium/Thorium dating (dating coral etc), Thermoluminescence (pottery, sediments), Obsidian Hydration (obsidian), Electron Spin Resonance (teeth), Amino Acid Racemisation dating (eggshell, bones), and many others.

# Renewable and non-renewable resources

**Renewable resources in Tibet:**

- Water
- Fuel
- Food
- Medicine
- Clothing
- House construction
- Others

**Non-renewable resources in Tibet:**

- Minerals
- Fossil fuel
- Others

*Give examples in Tibet you know for each resource.*

# Oil exploitation until 2025

Saudi Arabia is the major oil supplier and has 25 % of the global oil. Only in the oilfield of Al-Abqaiq 8 % of the global demand are exploited. Saudi Arabia says it will be able to export for another 70 years. But how much are they able to export?

Between 2001 and 2025 the global demand will increase by 57 %. Which means from a today oil consumption of 77 million barrels per day (mbd) to 121 mbd in 2025.This is an additional oil consumption of 44 mbd.

How much will the oil exploitation increase?

| | |
|---|---|
| Saudi Arabia | +12.5 mbd |
| Caspian oil | + 8.8 mbd |
| Iran, Iraq and Kuwait | + 7.5 mbd |
| Nigeria | + 1.6 mbd |
| The other countries will have stagnating or declining oil exploitation | + 0 mbd (most probably much less) |
| This was and additional production of | +30.4 mbd |

*How many mbd are missing?*
*What happens it the supply can not meet the demand?*

But this scenario is not reliable. The Americans they forecast in 2004 they published there will be a rise of 12.5 mbd. In 2005 they published there will be a rise of 6.1 mbd. But it is not sure whether the Saudis can rise the production at all. So the gap is still increasing and further demand which can not be satisfied.

Problems for the Saudis**:**
1. Most oil is from 4 to 5 giant oil fields.
2. These fields are been exploited for about 40 to 50 years
3. With water injections they maintain the pressure but spoil much of the oil. Too much water makes it uninteresting.
4. The best is used the remaining has higher amount of sulphur which is a problem for the refineries.

$1m^3$ =6.2898 American Barrels
1 American Barrel = 159 liters of oil( to be precise 158.984 lts)
1 American Barrel =136 kg
*1. How heavy is one liter?*
*2. What is the annual oil production in Tons?*
*3. This is equivalent to how many* $m^{3?}$
*4. Is it a start for a new society/spirituality?*
*5. Focus on Samsara more and more difficult?*

# Fossil fuels in China

**ENERGY OVERVIEW**
**Proven Oil Reserves (2001):** 24 billion barrels
**Oil Production (2000):** 3.2 million barrels per day (mbd)
**Oil Consumption (2000):** 4.6 mbd
**Net Oil Imports (2000):** 1.4 mbd
**Crude Oil Refining Capacity (2001):** 4.3 mbd
**Natural Gas Reserves (2001)**: 1400 billion cubic metre
**Natural Gas Production (1999):** 24 billion cubic metre
**Natural Gas Consumption (1999):** 24 billion cubic metre
**Recoverable Coal Reserves (1996):** 114.49 billion tons
**Coal Production (1999):** 1.02 billion tons
**Coal Consumption (1999):** 0.98 billion tons
**Electric Generation Capacity (1999):** 277 GW (210 GW thermal; 65 GW hydro; 2 GW nuclear)
**Electricity Generation (1999):** 1,178 billion kilowatthours (936.5 conventional thermal; 222.8 hydro; 14.1 nuclear)

1. Does China import or export:
   a) Oil?
   b) Coal?
   c) Natural gas?

2. Explain the following ways to generate electricity:
   a) Thermal
   b) Hydro
   c) Nuclear

3. For how many years does China have:
   a) Oil?
   b) Coal?
   c) Natural gas?

# Problems of global warming in Tibet

***By Pushpa Adhikary***

The Tibetan plateau is the headwater of rivers that flow down to half of humanity. The Yellow River and the Yangtse start in northeastern Tibet and flow across China, the Mekong originates in eastern Tibet as do the Irrawady and Salween that traverse down to Myanmar (Burma). The Tsang Po starts near Lake Manasarovar and travels eastwards for nearly 2,000 km before cutting through the Himalaya to become the Brahmaputra and empty into the Bay of Bengal. Most of the major rivers in Nepal originate in the Tibetan

plateau and cut deep gorges to flow down to the Ganga. And there is the Indus and its tributaries which also start near Lake Manasarovar and flow westwards into Pakistan and empty in the Arabian Sea.

What happens to the water towers of the Tibetan plateau has a bearing on about three billion people in China, Southeast Asia, and South Asia. It is the snows melting on the Tibetan plateau in summer in the dry season that keeps these rivers flowing.

Alarming is the fact that glaciers across the Himalaya and Hindu Kush mountains as well as the Tibetan plateau are receding. Glacier snouts are higher up the mountains, and large lakes have formed from snowmelt dammed up by terminal moraines from the slopes of Kanchenjunga to K-2. What is unclear is what is causing this - is it global warming, or is it the cyclical warming up of the earth?

**Evidence**

- Before emptying into the Yellow Sea, the 5,464-km long Yellow River runs from northeastern Tibet through nine provinces and autonomous regions. Since the early seventies, the mighty river has failed to reach the sea for progressively longer periods. During 1997 it was dry for 226 days.

- Recent surveys show that the water level in Eling and Zhaling lakes, the main source of Yellow River in northern Tibet, was one meter below the 4,268 meter level in 1993. The flow rate has also fallen drastically from 7.8 cubic meters per second to 2.7 cubic meters per second.

- Madoi County in China which covers an area of 25,000 sq km, once had 4,077 lakes measuring more than one sq km each. Today, over 2,000 smaller lakes that used to dot the grasslands and river valleys no longer exist.

Northern Tibet boasts the largest animal husbandry area in China. But recently, natural calamities such as drought, snowstorms, high winds and low temperatures have kept its grass and livestock output unstable.

Professor Zhang Jiang Hua from the Chinese Academy of Social Sciences in Beijing believes that global buildups in the levels of carbon dioxide and other greenhouse gases are accelerating the current natural warming cycle in Tibet. "The global warming phenomenon is the main reason for receding snow in the mountains," says professor Zhang. "Tibetans alone cannot control it. For that there should be global initiatives." While a lot of what happens on the plateau is dependent on global atmospheric trends, Zhang believes China can do its share by protecting forests and controlling fossil fuel burning.

*Describe the importance of Tibet for the Asian water supply.*
*What are the presumed impacts of the global warming?*
*Why can the Tibetans not solve the problems by their own?*