

# Enso and Monsoon Rainfall Variation over Bangladesh

In the present study an attempt has been made to examine the variations of rainfall over Bangladesh and to find possible correlation with El-Nino Southern Oscillation.

The oceanographic phenomenon of El-Nino which comprises mainly of a large catastrophic flux of warm water to most of tropical Pacific and South American coast, and the Southern Oscillation, an atmospheric event of a sea-saw of surface pressure between the south-east Pacific high pressure zone and the North Australian-Indonesian low pressure zone, have been known quite early in the century (Walker 1932). The inter-connection between the two was noted much later by Bjerknes (1966). These two interrelated events are now termed El-Nino/Southern Oscillation (ENSO) and a considerable amount of work has been done on their theories.

Gray (1984), working on hurricane activity in the North Atlantic and Atkinson (1977) and Chan (1985) studying the hurricanes of north-west Pacific found a significant reduction of hurricane activities during the year following El-Nino events in both areas. Their idea was modified by Dong (1988) who suggested that the typhoon activity is suppressed by the ENSO event. Similar results were found in the Australian region cyclones by Nichols (1979, 1984).

In the Indian Ocean region, Mandal (1989) found a somewhat weaker relationship with tropical cyclones over the Bay of Bengal and a correlation of the ENSO events with rainfall deficit over India and Bangladesh during 1951-1987. Gupta and Mathuchami (1991)

studied the tracks of Bay of Bengal cyclones during post-monsoon seasons during 1902-1987 and found a reduction of storm numbers and also a strong tendency of recurvature of the cyclone tracks South of 17° N during El-Nino years.

Choudhury, A. M. (1992) proposed that a study of the ENSO phenomenon might lead to a way of predicting the trend of weather and climate over Bangladesh. Chowdhury, Khan and Debsarma (1992) also indicated a relation of ENSO with deficit rain over Bangladesh.

In the present work a detailed study of rainfall for a period of forty-three years (1950-1992) over different climatological regions of Bangladesh have been made in order to find possible correlations with the occurrence of ENSO.

**SOURCE OF DATA**

The rainfall over different stations of Bangladesh from 1950-1992 were collected from the Bangladesh Meteorological Department, Dhaka. The years of occurrence of El-Nino upto 1987 have been taken from Mandal (1989) and indications of recent events were obtained from the Monthly Ocean Reports, El-Nino Monitoring centre, Japan Meteorological Agency.

**METHOD OF ANALYSIS**

The work has been done in two phases. Four stations have been selected from four climatic zones of Bangladesh, classified according to total annual rainfall. The stations are: Jessore (<1200 mm rainfall), Dhaka (1200-1500 mm rain-

fall) Barisal (1500-1800 mm) Srimangal (>1800 mm).

In the first phase the total yearly rainfall of all these stations have been studied in time-series plot. In the second phase, the rainfall of the stations have been studied season by season, e.g. Premonsoon (March-May), Monsoon (June-September), Postmonsoon (October-November), Winter (December-February) again in time-series plots.

The years where data for several months are missing has been omitted from the yearly graph.

**RESULTS AND DISCUSSION**

**Yearly Rainfall:** The time series graph of yearly rainfall of four stations of 43 years (1950-92) shows negative or decreasing tendency during ENSO events in seven out of 10 cases at Jessore and in 6 out of 9 cases at Dhaka, Barisal and Srimangal.

There is an increasing tendency in three cases out of 10 at Jessore and in two cases out of nine at Dhaka, Barisal and Srimangal.

The examination of the rainfall pattern studied season by season shows good negative correlation with the Occurrence of El-Nino years.

The Dhaka monsoon rainfall showed a smaller decrease than the others. This was studied carefully and compared to premonsoon and post-monsoon rainfall at the same station in order to account for the dissimilarity of trends as compared to other stations. It was found that in the other stations the pre-monsoon and post-monsoon rainfall were relatively lower than the monsoon

months, where as in Dhaka the mean rainfall in the pre-monsoon and post-monsoon were not all that much lower than that of monsoon season. The smaller decreasing tendency during the monsoon months at Dhaka is compensated by the higher decreasing tendencies during the pre and post monsoon seasons.

Test of significance have been performed for the variations and these showed that the overall negative or decreasing tendency of rainfall in El-Nino years through out the country is significant.

**CONCLUSION**

The examination of rainfall pattern over Bangladesh studied season by season as well as annual rainfall show good negative correlation with the occurrence of ENSO.

In the premonsoon season, all the four stations selected from four climatological zone, namely Jessore, Dhaka, Barisal and Srimangal show definite decreasing (negative) trend in the mean (43 years) rainfall with ENSO activity.

During the monsoon season the mean rainfall at Jessore, Barisal, Srimangal showed a negative (decreasing) tendency during the ENSO years. Rainfall of Dhaka showed a smaller decreasing tendency. This may be explained by our detailed examination of the data, which showed that unlike the other stations the mean rainfall at Dhaka is not much lower during the pre and post monsoon season than the monsoon season and the small decreasing tendency during the monsoon season is compensated by the higher de-

creasing tendencies during the pre and post monsoon season giving a good negative correlation in the total yearly rainfall with El-Nino.

In the post-monsoon season, all four stations show definite decreasing (negative) trend.

From the above discussions, it may be concluded that, rainfall is lower in El-Nino years. Since about 80 per cent of the total yearly rainfall in Bangladesh occurs during the monsoon period, this seems to indicate that the El-Nino/Southern Oscillation phenomena tend to decrease normal monsoon activity. This also agrees with results of previous workers on the studies on occurrence and severity of cyclones etc. during ENSO years. That is, meteorological disturbances seem to be suppressed during these years.

Further work is being done by us on this line and a considerable amount of observations of different parameters is necessary to correlate all the findings to any theory of the ENSO phenomena.

This paper has been prepared by ASM Sabir Ahmed, Dr A. Munim, Dr Q. N. Begum, Department of Physics University of Dhaka and Dr A. M. Choudhury Bangladesh Space Research & Remote Sensing Organisation (SPARRSO) Agartala, Sher-E-Bangla Nagar. It has been presented at the Seminar on "Monsoon Dynamics" organized by the Bangladesh Academy of Sciences (BAS) and Goethe Institute, (German Cultural Centre), Dhaka, on the 1st November, 1994.

# Single Cell Protein — A Magic Food!

MICROBES are dangerous. They cause diseases in humans and other animals, but these unfriendly microbes comprise a very small fraction, only 20-50% of the total microbial population.

Microbes can be used in biotechnological plants for the production of enzymes, various acids and medicines. Microbes can also be used in food industries, chemical and pharmaceutical industries as well. Some pathogenic microbes are used for the production of antibiotics.

Besides all these applications of micro-organisms scientists are trying to yield single cell protein (SCP) from micro-organisms. By definition, single cell proteins are micro-organisms cultivated on industrial wastes or by-products as nutrients to yield a large cell crop rich in protein.

Nutritive value varies in the case of SCP with the micro-organisms used. Protein digestibility values, expressed as a percentage, range from 65 to 96 for the various cultures tested.

Bacteria, yeasts and algae produced in massive quantities are attractive sources of food for animals as well as humans. The attractiveness of single cell protein as a food substitute or supplement is apparent from the following characters:

- 1) Micro-organisms grow very rapidly. It has been calculated that algae grown in ponds can produce 20 tons (dry weight) of protein per acre per year.
- 2) The protein content of microbial cells is very high.
- 3) Micro-organisms can utilize a large number of different carbon sources as substrates.

(Substrates are chemical nutrients which are utilized by micro-organisms for their growth).

4) Proteins are composed of amino acids, in other words amino acids are building blocks of proteins. There are 20 different types of amino acids, almost all amino acids are found in single cell protein (SCP).

5) Small space is needed for the production of SCP.

An algae *Spirulina* can be used for the production of SCP. This species, (in dried form) has been used for centuries from a lake in Chad. *Spirulina* was also eaten by ancient Aztecs in Mexico. Experiments on eating *Spirulina* have been conducted in USA, France and Mexico, and as a result USA and Mexico permit the sale of *Spirulina*.

Yeasts such as *Saccharomyces cerevisiae* or *Candida utilis* can be grown in large quantities but they lead to adverse gastrointestinal reactions in humans.

In English, the bacterium *Methylomonas methylotrophus* is being used to produce protein supplements for animal feed.

The most practical way to produce algal biomass for protein is in open ponds in sunlight. Experiments with the incorporation of *Chlorella* and *Scenedesmus* in human diets have shown serious problems, but *Spirulina* seems to be suitable for human consumption. The higher growth rate of bacteria as compared with other micro-organisms may often be of interest in SCP production but contamination with pathogenic bacteria is always a risk. Toxic compounds are produced by many fungi and yeasts; thus they are less attractive for SCP production.

A micro-organism that is to be grown as a source of protein must be non pathogenic, non toxic and they should have good nutritional value. They should be acceptable as food or feed. The production costs must be low.

Recovery of single-cell organisms are major tasks in the production of single cell protein. Yeasts and bacteria are normally recovered by centrifugation. Filamentous organisms may be recovered on rotary filters, which are cheaper. It is important to remove as much water as possible prior to final drying. As human populations expand and arable land does not, micro-organisms may become more important to the food requirements of the world in the future. Protein is in particularly short supply. Micro-organisms which can double their weight in a few hours, and often in less than an hour may help ease the problem. The question now is whether SCP can succeed economically. Several years after its auspicious beginning, the protein plant stopped production because protein could not compete in price with soyabean meal and fish meal. It remains to be seen whether other SCP products can compete in the market place. The price of SCP is affected by the cost of substrate and the cost of converting the substrate to usable protein. But the question remains can technological improvement and genetic engineering reduce the cost of SCP?

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## One tape—or 115 CDs?

### Prototype developed of Optical Tape Recorder

IMAGINE a conventionally-sized music cassette—but one that can store the music held on 115 Compact Discs, or eight hours of digital video, and which can be fully rewound in just 15 seconds. Imagine the player for such a tape, which has so few moving parts that the laser wears out first—after 50,000 hours, or five years of non-stop operation.

The prototype of such a player and tape exist today, thanks to the efforts of scientists at Philips Research Laboratories.

The driving force behind this breakthrough has been the accelerating demand for ever-smaller products, which has led to audio, video and data signals being compressed to their utmost.

Although special techniques can boost bit density on discs, the space that is available remains just a two-dimensional surface.

However, the project being explored at Philips Research Laboratories in Eindhoven involves using the third dimension: optically recording bits onto specially-treated conventional cassette tape, which is then rolled up into a cassette.

This technique combines the high-bit-density advantage of tape with the benefits on optical recording—a longer life time and greater reliability, as a result of the contactless read-out mechanism.

Combining the benefits of tape and optical recording has been far from easy. Among the problems that had to be solved was one that involved developing a read-and-write mechanism that was sufficiently fast to meet the high bit-rate requirement of digital video.

The difficulty, here, related to the laser that is used for writing and reading the bits onto the tape, which has to scan the surface at a high speed. This high speed is achieved in a CD player by rotating the disc containing the bits on a spiral track and moving the laser only in a radial direction. But if the bits on a tape were also to be lined up, the precisely positioned tracks would have to be parallel over enormous distances. In addition, the tape would have to be turned (automatically) 5,000 times to move on to the next track, which is obviously not practical.

So, what the Philips scientists did was to divide the signal into one-millimetre-long tracks, which only have to be exactly parallel over that distance. Eight stacks of tracks fit on a tape and, thus, the tape only has to be turned seven times. A buffer memory ensures that the signal is reproduced without interruption during turning.

**DCC is best**

A technological leap forward has made Digital Compact Cassette (DCC) sound better than any other consumer music system, including Compact Disc.

Two new DCC decks to be introduced this autumn will fully exploit 18-bit technology, it was announced at a Press conference at the Evoluon in Eindhoven on September 6.

Although it was previously known that the human ear could detect sound up to a level of 18 bits, it was thought that 16-bit sound quality was more than adequate. However, listeners to CD have still been able to hear unwanted noise.

This has been tackled by noise-shaping technologies, which have improved the sound of Compact Disc, originally acclaimed as being the ultimate in quality. The result is a quality that approaches the quality that is now possible with 18-bit DCC. This has been done by transferring unwanted noise to areas of the sound spectrum to which the ear is less sensitive, thereby cleaning up those parts that can be heard best.

In contrast with this, with 18-bit technology, the noise limits fall beneath any hearing level. Thus, the incorporation of this technology in DCC players and recordings results in a sound that is more natural and less metallic and harsh. This makes the DCC format, at a stroke, superior to all existing consumer formats.

This step forward is one that hardly any recording studio can match, now and for some time in the future.

Optical tape recording offers a most attractive way of storing and distributing vast amounts of information. A prototype player developed at the Eindhoven research laboratories has already been displayed at the recent Optical Data Storage conference in Dana Point, California, United States. However, much work remains to be done to further develop the system and tape. The results described here relate only to research: they do not imply the manufacture, or market introduction, of new products. Courtesy—Transcom Electronics Ltd.

But, how to move the laser beam over the tracks fast enough? To ensure a sufficiently high bit-rate the scan speed has to be 20 m/s, which is very demanding—it corresponds to the light beam of a flashlight, with a diameter of half a metre, covering a distance of 500 metres in five hundredths of a millisecond. Here, the solution to this problem was to reflect the laser beam by a polygon mirror with six sides that rotates 3,000 times per second around one of its axes, letting the beam sweep over a one millimetre track in an eight-thousandth of a second. In that time, the tape moves exactly the distance necessary for the next track to fall within the reach of the laser beam.

All the research and development work finally culminate in an optical tape recorder whose only mechanical parts are the motors moving the tape, the rotating mirror and the lens that focuses the laser spot. There is no need to wind the tape over pins and rollers before playing, recording, winding and re-winding, and the optical tape remains in its closed cassette and is scanned through a window, so it has a very short access time and it doesn't wear out.

# Scientists Flesh Out the Bare Bones of History

by Jason Lothian

HE was the original tough guy—pre-dating Sylvester Stallone, Arnold Schwarzenegger, even before Samson was running around smacking people with the jawbone of an ass.

The evidence is a piece of bone considerably smaller than an ass jaw: a 29 centimetre fragment of left leg tibia found in Boxgrove quarry in England.

From that 500,000-year-old bone, scientists deduce that Boxgrove man was the European champion, walking upright, making tools and probably beating the stuffing out of everything around him.

"He had arms like a Russian shotputter," says Dr Simon Parfitt of the Natural History Museum in London, part of the team working on the bone. "And he wouldn't be following any Marquis of Queensbury rules of gentlemanly combat."

That Boxgrove man was not a gentleman can be deduced from the available facts of prehistoric life. The muscles in his arms seem a less certain assumption.

But the knowledge gleaned from the find is not limited to the direct physical manifestations of a scrap of bone; it is also based on what can be read into the bone and surrounding objects.

Knowledge of his shotputters build comes from the work of experimental Archaeologists, who attempt to reproduce the tools found at archaeological digs. Boxgrove man's cutting and scraping tools were made by flaking chips from larger pieces of flint. The size of the chips suggests Boxgrove man was tremendously muscular.

In addition, the bone fragment has a series of muscle ridges, where muscle attaches to bone, which indicate an unusually high amount of musculature. If his leg was exceptionally muscular, it is likely his arms were too.

Detective work of this order is necessitated by the fragment's frustrating silence about all the other bones to which it was connected—and the world they collectively strolled around in.

His tools might tell something about his character. Parfitt is reluctant to say that humans 500,000 years ago were concerned with aesthetics but he notes that many of the tools found are strikingly attractive.

"They're beautiful objects, some perfectly symmetrical. It's almost as if they wanted beautiful tools. Mind you, some of them are quite ugly."

What he cut with his tools also reveals much about the man. In the last 10 years more than 10,000 large mammal fragments have been found at the site and hundreds of thousands of small mammal bones. Each has been laboriously catalogued, and examined by microscope.

"We know with certainty what Boxgrove man was eating from the cut marks on the bones from his flint tools," says Parfitt.

That his menu included bear and rhino as well as deer and horse only confirms the

likelihood of his machismo. No weapons have been found at Boxgrove but a nearby, slightly younger site has produced a wooden spear.

Whether Boxgrove was a hunter or a scavenger remains a mystery, however.

"I can't imagine standing with a wooden spear and having a rhino charge you," laughs Parfitt. But it may have happened. Alternatively, whole communities of Boxgrove men and women might have chased large predators away from recent kills. Or Boxgrove might have waited for the largest carnivores to slake their appetites and then snuck in before the small carnivores could strip the carcass.

Dr Mark Roberts, the anthropologist directing the dig at Boxgrove quarry, says scientists need to use anything and everything when trying to learn volumes from tibias: "We use life, the universe and everything. We use anything we can learn with."

Anything includes the teeth of voles.

Long ago voles had non-growing teeth with roots, ideal for chewing the berries and soft foods in the woodlands where they lived. Then, following a climate change which favoured grasslands, they evolved continuously growing teeth without roots. The new abrasive grasses wore teeth down quickly and without constantly growing teeth a vole's life would be short.

The date of this evolutionary change has been determined. So scientists can roughly estimate, from the teeth nearest the bone, the age of the Boxgrove bone.

Anything also includes Roberts' experience as a hunter. He has gutted, skinned and jointed deer with both a modern knife and with the flakes and edges found at sites like Boxgrove.

Whether a modern blade is used or the ancient tools, the process takes about 30 minutes.

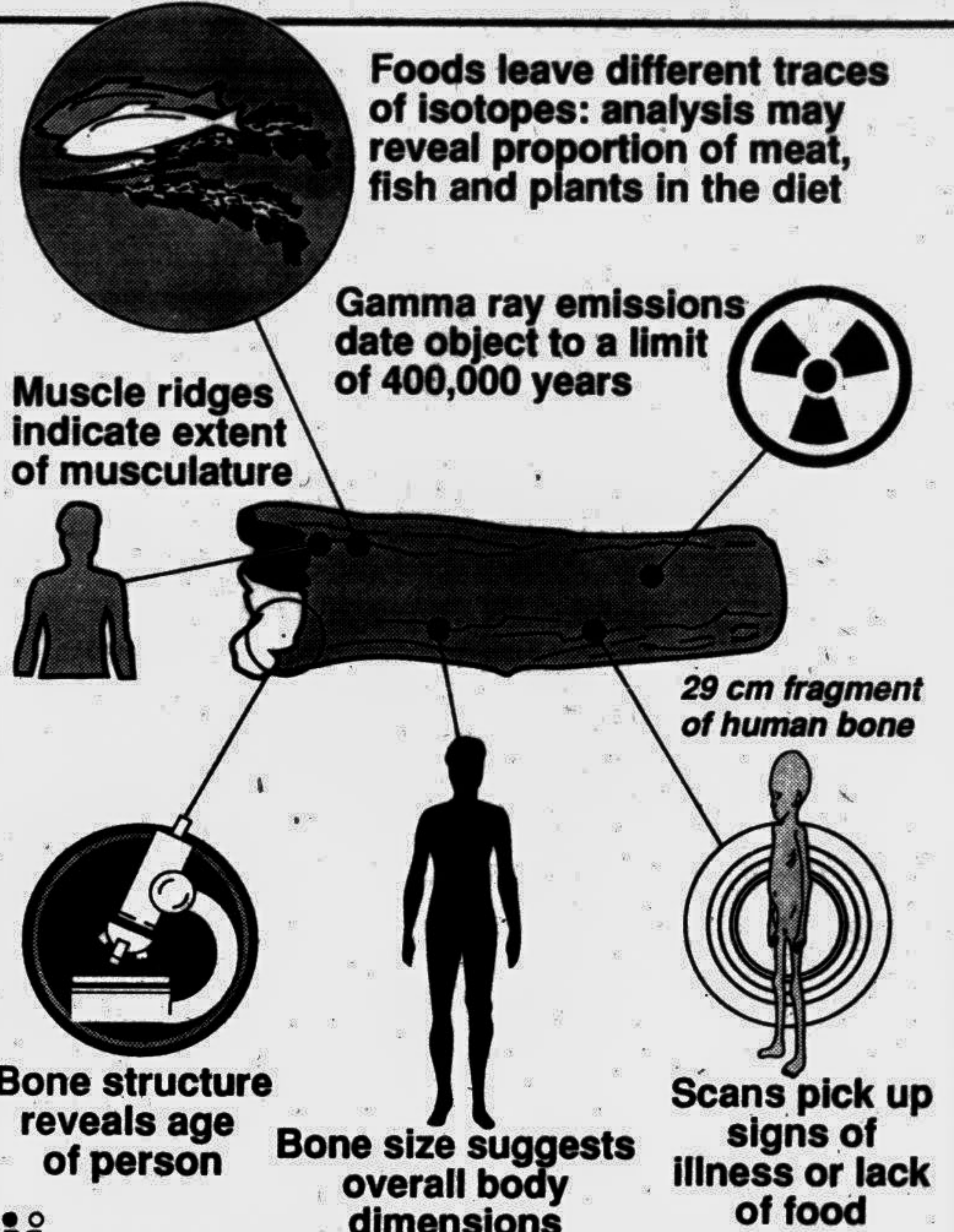
"I'd much rather use a modern knife but a flint would do the job very well," Roberts chuckles.

The effort has also demonstrated that Boxgrove man was careful with food preparation.

"When we look at the bones from the site there is no evidence of Boxgrove smashing down willy nilly with great choppers. Most of the marks are quite small, microscopic. He treated game carefully," says Roberts.

Indeed, Boxgrove man seems to have been quite in-

## Archaeological body-building



**Foods leave different traces of isotopes: analysis may reveal proportion of meat, fish and plants in the diet**

**Gamma ray emissions date object to a limit of 400,000 years**

**Muscle ridges indicate extent of musculature**

**29 cm fragment of human bone**

**Bone structure reveals age of person**

**Bone size suggests overall body dimensions**

**Scans pick up signs of illness or lack of food**

telligent about how he dressed his game. His meals were all cut up sensibly; jointed where a butcher would joint, sectioned and gutted in a most modern fashion.

The shinbone could provide years of study. There are animal teeth marks on the bone as well as what appear to be marks from flint tools. Aspects of Boxgrove's diet and medical history could be revealed by chemical analysis. In addition, his age at death might be ascertained.

Roberts and company plan to reinvestigate the Boxgrove site in an effort to learn more. Their dream—their pot of gold, according to Roberts—is to find a skull. From it could be learned what the fellow looked like, how much thinking he did and how healthy he was when he died.

The site is so rich in prehistoric relics, says Parfitt, each hole they dig is like a keyhole through which to peek into the past. — Gemini News

About the Author: Jason Lothian is a Canadian journalist working in London.

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## Discovered at Depths

HOBART, Australia, Nov 22: Four new species of deep-water fish have been discovered in southern Australian waters, and many more are likely to be found, an Australian fisheries scientist said Nov. 10.

The fish, two species of cod and two species of Ling, were discovered on little-explored underwater mountains of the Australian continental slope 50 kilometres (31 miles) south of the southern state of Tasmania, the scientist said.

"The four new species were found among only 12 specimens—this indicates that a fairly high number of new species are probably down there," Tony Koslow, a fisheries biologist with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) told AFP.

"We're looking forward to the opportunity of assessing these important environments," Koslow said, adding

the find highlighted the biological richness of Australian waters which are home to more than 4,000 known fish species.

He said the CSIRO was negotiating with the French government on the use of a small manned scientific submarine used to study sea mounts in the South Pacific.

The two new cod species belong to a rare group of fish known as paralaeomach, which had previously been found only in the Atlantic ocean, Koslow said.

The four new slender, dull-coloured species were discovered at depths up to 1,300 metres (4,290 feet) during a population survey of the popular export fish Orange Roughy, which can live longer than 100 years, he said.

The new fish were only 10- to 15 centimetres (six inches) long; but their age had not yet been determined.

