Nuclear explosions

Their detection and radioactive fallout

by H.S. Virk

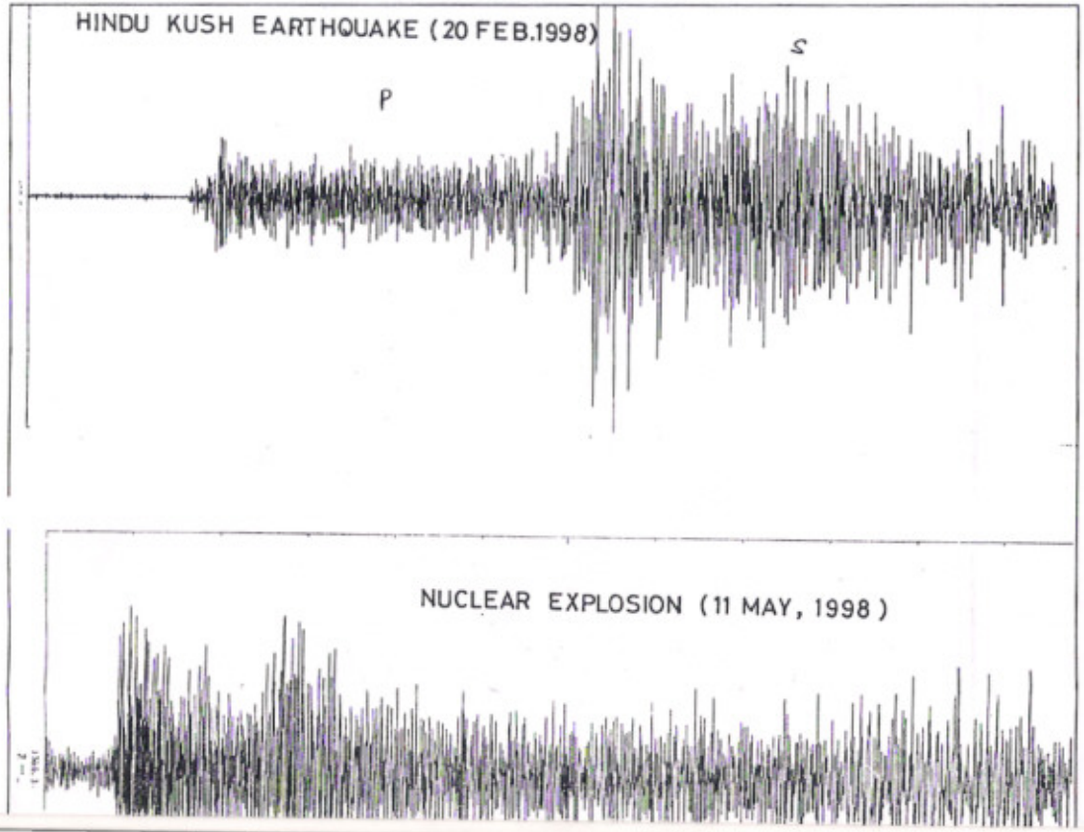
THE recent nuclear test explosions carried out by India has created a furore in the media, the world over. As the nuclear dust settles down at Pokhran, the Indian intelligentsia is still confused about the nature of the device exploded. It is called a thermo-nucler fission-fusion device because by fission reaction first an atom bomb is exploded to create temperatures in the range of 10 million degree centigrade when fusion of hydrogen isotopes (D-T_ becomes possible to explode what is called a hydrogen bomb. Indian scientists had perfected this technique during sixties and the first explosion took place in May, 1974. A series of tests are carried out cently. The fission device (5 kiloton of TNT) is based on plutonium fission using neutrons as ignition switch. In a tiny fraction of a second, the chain reaction sets in producing temperatures equivalent to those in the core of the sun.

The source of solar energy is also thermo-nuclear in nature where atomic hydrogen is being converted to helium by fusion reactions. Ultimately, the sun (a star) will consume all its reservoir of hydrogen and the contraction process will start leading to a white dwarf. Further, depending on its mass, it can end up as a neutron star or a black hole. So the evolution history of our sun and other stars in our galaxy is quite interesting and many riddle have been solved by

War II on Hiroshima and Nagasaki where a million Japanese were killed or maimed in a fraction of a second. The newspapers carried the following message of a scientist, the next morning.

The atom bomb is here to stay,
Most scientists agree,
Oh, yes the bomb is here to stay,
The question is, are we?

The nuclear test explosions carried out at Pokhran produced faulting and fracturing of the land mass in the surrounding area of "Ground Zero". The shock waves were strong enough to cause an earthquake of magnitude 4.7 on Richter scale. People were scared and ran out of houses and offices in Jodhpur at a distance of 250 km from the test site. The houses in nearby villages suffered heavy damage.

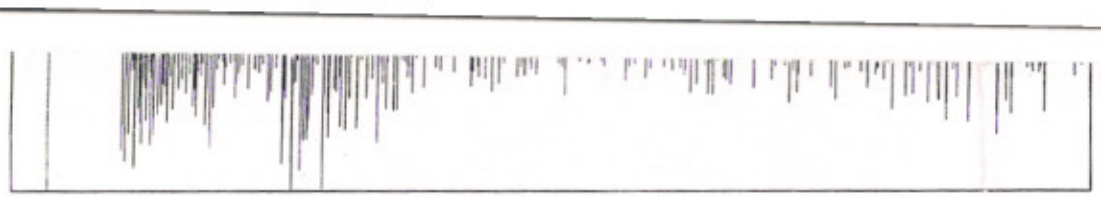


Underground nuclear explosions can be recorded successfully by seismographs. Rather this is the only technique to detect the high-intensity nuclear explosions. The earthquake station at Guru Nanak Dev University, Amritsar, is equipped with sophisticated digital seismographs (Reftek, USA). When the seismic data was analysed on May 12, the clear signatures of earthquake generated by nuclear test explosion at Pokhran appeared in the computer printout. The Pokhran event is distinguishable from a normal earthquake by the nature of signal recorded on the seismograph. In case of a nuclear explosion, there is a sudden and instantaneous release of energy at a point which travels in the form of compressional P waves from 'Ground Zero' (the epicentre). In case of an earthquake, the strain energy is released over a large volume of earth's lithosphere along a fault line, and the elastic waves have both compressional and sheer components known as P and S waves. The primary (P) waves are followed by secondary (S) waves of larger amplitude. The secondary waves are absent in case of nuclear explosions. Hence it is possible to make a clear distinction between the two as shown in the seismograms recorded in our laboratory.

It is interesting to remark that earthquake station set up by

many a riddle have been solved by astrophysicists.

Indian nuclear device is basically a prototype hydrogen bomb (45 kiloton TNT) which is far more powerful than the atomic bomb. After the first explosion of atom bomb in the desert of New Mexico the USA used it twice during World



Seismograms of Hindukush earthquake and underground nuclear explosion at Pokhran recorded at G.N.D. University, Amritsar Earthquake Station.

Punjab Government for seismotectonic survey and earthquake studies in Punjab for the safety of dams, birdges and high rise structures will play a vital role in detecting underground nuclear test explosions to be carried out by Pakistan and China in the near future.

Indian politicians and some of our scientists have claimed that there is no harmful radiation at Pokhran and surrounding areas after the nuclear test explosions on May 11 & 13. Looking at the visuals shown on the TV, it is obvious that a crater 300 metres in circumference and 15 metres deep is created at "Ground Zero" and fissures appeared in the surrounding area. It is true that in case of an underground explosion, most of the radioactive waste remains buried in the soil. However, the radioactive gases like Zenon, Radon, Krypton, etc can diffuse through the fissures and mix up with the atmospheric air. Even the particulate matter released after the explosion at the crater site is carried in the form of aerosols at greater distances depending upon the weather conditions. By a rough estimate, 10-15 percent of radioactivity is released in the air. The only safety factor is that the fission device used to start the thermo-nuclear fusion device was of 5 kton TNT capacity while the latter was much more powerful (45 kton TNT). Hydrogen bomb is basically a clean device compared with atom bomb which releases large amount of radioactivity and is known as dirty bomb.

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Plasma water gun: Welding the future

by Kalyan Ray

IT weighs a couple of kilograms and consumes only water. Yet it is set to change the welding technologies of the next century.

The tiny tool is a gun. But unlike the single purpose bullet spitters seen in Hollywood potboilers, cutting, welding, soldering, cleaning and fire extinguishing properties have been rolled into this particular gun.

The easy-to-use device, better known as plasma water gun, emits a jet of plasma (the same ion soup found in sun and other stars) made of water to cut, weld solder and clean various metals and non-metals, reports Russian News Agency Ria Navosti.

Plasma is ionised gas at a temperature of several thousand degrees celsius in which the concentration of positive and negatively charged particles is equal.

On the earth plasma can be produced by special plasma generators called plasmotrons by passing gas through a tiny hole where the gas puts pressure on an electric arc fitted inside the machine.

The energy generated due to the mounting pressure helps dislodge electrons from the gas molecules to make it a mixture of positive and negatively charged particles or plasma.

But the new device, made by Russian researchers from Moscow-based Alplaz Institute, exploits water or rather stream instead of gas molecules to produce the desired plasma.

Since the working medium in traditional plasmotrons is inert or air they must be outfitted either with liquified gas bottles or a powerful compressor for creating plasma. In addition, these machines require other auxiliary cooling equipments which increase the weight of the machines as well as the operational cost.

Another drawback associated with conventional gadgets is the emission of hazardous chemicals that have many harmful effects on the environment.

The new plasma gun is free from such shortcomings since it uses water as the working medium. Water serves both purposes of plasma source and coolant material with a fairly high success rate.

For running a plasma water gun, the machine has to be connected with an 220-volt and 50-hertz electric network after filling it with water.

The unit can be readjusted to perform other important tinsmith operations like welding of tin, copper and brass, as well as all sorts of soldering. Apart from that the tiny gun will be of help in rust removing and coating purposes.

A shift from water to water-acetone mixture working medium is also possible which guarantees a milder temperature regime in welding.

— PTI

Science Quiz

by J. P. Garg

1. Name the Indian metropolitan where a "Science City" was inaugurated by the then Prime Minister in August, 1997. Where in Punjab is another such "Science City" being set up and what is its proposed name?

2. After Tathagat Avtar Tulsi of Bihar, it is now the teenaged wizard from Andhra Pradesh who can solve complicated mathematical problems in a matter of moments. Name him.

3. DTH is a new name in communication technology. What does the abbreviation stand for and in which field of communication is it used?

4. Which instrument is used for measuring the total distance covered by a vehicle in certain time?

5. Which dreaded disease attacks human immune system? what is its full form?

6. A red-coloured flower that blooms in peak summer has the size and shape of a big ball. What is its common name?

7. Name the siter of "Columbia", "Endeavour" and "Atlantis" that perished in 1986.

8. Where are the Indian stations "Dakshin Gangotri" and "Maitri" located?

9. Forets are dwindling at a fast rate due to man's greed. But some communities grow trees on large scale to meet their needs. What is this collective course of action called?

10. A national institute has been in the news recently for its initial success in attempting to make a "carbon copy" of a buffalo. Which is this institute?

ANSWERS

1. Calcutta; near Jallandhar; Pushpa Gujral Science City 2. Vijaya Krishnan 3. Direct-to-home television 4. Odometer or hodometer 5. AIDS; Acquired Immuno Deficiency Syndrome 6. Football lily 7. Challenger 8. In Antarctica 9. Social forestry or energy plantation 10. National Dairy Research Institute, Karnal.