# MONTAGNA News

MONTAGNA.TV

SCIENTIFIC AND MOUNTAIN, CLIMATE AND ENVIRONMENTAL STUDIES JOURNAL

Special Edition Everest

Number 1
January, February, March 2012

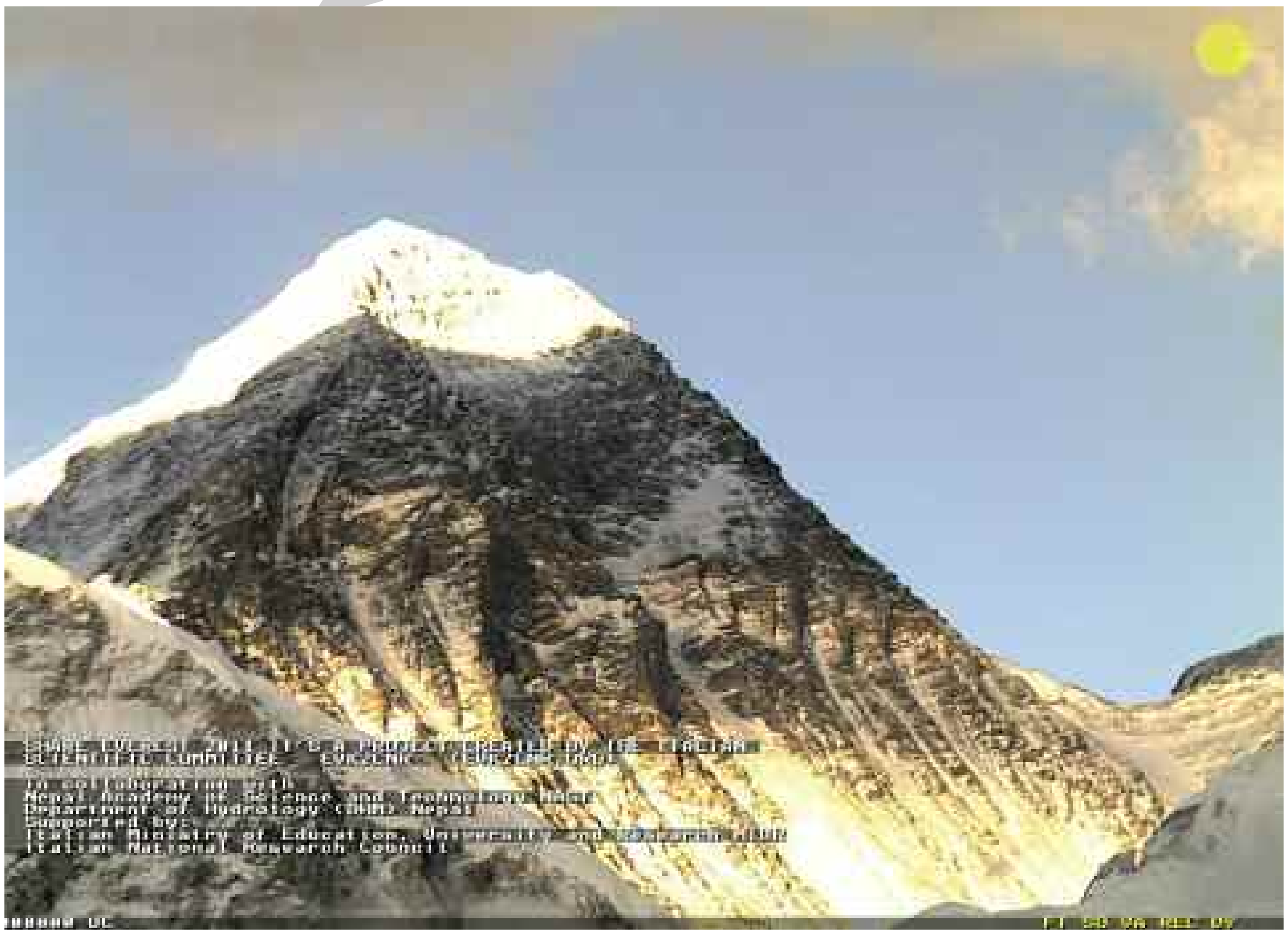
www.evk2cnr.org


# Everest, the mountain of science

By **AGOSTINO DA POLENZA** *Ev-K2-CNR Committee President*

*The history of the relationship between Nepal and Italy is strictly related to the world's highest mountain.*
*Mountaineering expeditions to Mount Everest and on other "8000" Nepali peaks have certainly given impulse to the first official contacts to obtain authorisation to explore and to climb the "earth's giants". However, these relationships soon evolved towards true international collaborations, first humanitarian and afterwards scientific cooperation.*
*In this area, the Ev-K2-CNR Committee boasts, being proud of it, an out-and-out record:* ***the realisation of the Pyramid International Laboratory Observatory****, in the Khumbu Valley, at the foot of Mount Everest at 5050 metres, realised with the fundamental collaboration of the Nepal Academy of Science and Technology (NAST) and of the National Research Council.*
*Everest, the mountain-myth of climbing for all high altitude supporters, has become in a few years, since 1990, "our home" shared with our Nepali friends. The Pyramid made by glass and steel, its facilities and its scientific instrumentation together with the network of sensors extending up to South Col at 8000 m asl is, in fact, recognized by the community as* ***"the international laboratory for scientific research at high altitude."*** *We are proud of.*
*In October 1990 the cooperation between Nepal and Italy has progressively increased: the ninety-three years old Ardito Desio together with the Italian Ambassador in Kathmandu and the Vice Chancellor of the Nepal Academy of Science and Technology inaugurated the Pyramid Laboratory. That was a very poignant and highly significant moment because of the presence, at that height, of an emblematic personality, for his age and scientific and exploratory career, such as Prof. Desio.*
*In those years a new approach of understanding mountains was born. And the Ev-K2-CNR Committee, knowing in detail mountains' reality and understanding their potential, immediately realised that it was no further possible to limit only to an exploratory and sporty relationship with the large and still unexplored high altitude ecosystems. It was necessary to go further: mountains are ancient witnesses of human development, a valuable reservoir from which obtaining information in the field of earth sciences, environment, medicine and physiology, anthropological science, eco-efficient technologies and environment management systems.*
*Therefore, Everest was not simply considered as a mountain to climb only, a record to be achieved, but as a valuable good, a privileged witness of climate change, the summit of a region that is a precious reserve of biodiversity, a treasure of traditions, cultures*

FOLLOW PAG. 7




*Mount Everest captured from the Ev-K2-CNR webcam installed at Kala Pattar*

# The fascinating history of the measurements of Mt. Everest

Mount Everest, situated along the border between Nepal and China, is regarded as the highest point on Earth. From a geological point of view Mt. Everest lies in the collision zone along the boundary between the Eurasian and Indian plates. Due to crustal movements and global warming the height of Mount Everest, and its variations, has been one of the main focuses of research in geoscience.

**1816** The Prussian geographer Alexander von Humboldt, in his article published in the "Annales de Chemie et de Physique" in 1816, reported the first tentative measurements of the Himalayan peaks when the elevation of the points in the plains were still measured with barometers.

**1820-1848** The Survey of India, under the direction of Col. George Everest...

FOLLOW PAG. 4

Twenty years with Ev-K2-CNR Committee

# Research and cooperation in Nepal

It all began when a 1986 American expedition declared K2 was taller than Everest. Agostino Da Polenza and Prof. Ardito Desio could not resist this challenge and, in 1987, they united their mountaineering and scientific strengths to launch the "Ev-K2-CNR Project" in collaboration with the Italian National Research Council.

They organized expeditions which put mountaineering at the service of science and re-measured both mountains using traditional survey techniques and innovative GPS (Global Positioning System) measurements. Not only did they confirm Everest's title but they also set the standard for altitude measurements to come. Two years later, they founded the Ev-K2-CNR Committee to continue promoting technological and scientific research at high altitude, particularly in the Hindu...

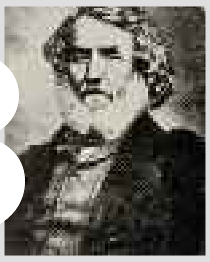
FOLLOW PAG. 16

***The Himalayas, also known as Roof of the World,*** *is an Asian mountain range, which divides India, Pakistan, Nepal Bhutan and China. It is about 2,400 km long and about 100 - 200 km wide; on the west it is connected with the afghan Hindu Kush range. It includes the highest world's peaks, such as Mount Everest (8848 m), K2 (8611 m) and Kanchenjunga (8589 m). According to the plate tectonics, the Himalayan range is the result of the collision between the Indo-Australian Plate and the Eurasian Plate.*

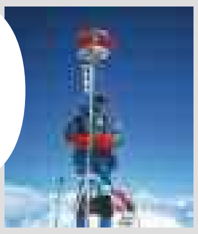
# OVERVIEW

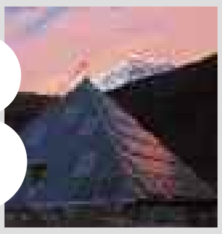










**The Journal is also available online in PDF format:**
**www.montagnanews.com**

MONTAGNANews
SCIENTIFIC AND MOUNTAIN, CLIMATE AND ENVIRONMENTAL STUDIES JOURNAL

Editor: Ev-K2-Cnr Committee, Via San Bernardino, 145 - 24126 Bergamo – Italy
tel: +39 035 3230511 fax: +39 035 3230551 E-mail: Web: www.evk2cnr.org
Program Director: Sara Sottocornola
Editorial Coordination: Francesca Steffanoni - Gabriele Previati
Graphic Project: ActiveMKT Production -. Milano
Printing: Grafistampa - Zanica (BG)


# MEASUREMENTS

## Mount Everest's Height

# 160 years of measurements

*Comparison of the values of the height of Mt. Everest with reference to the snow surface and to the geoid-ellipsoid separations.*


By **GIORGIO PORETTI** *Department of Mathematics & Geosciences – University of Trieste*
& **ROBERTO MANDLER** *SOGEST - Geofisica Trieste*


The height of a mountain is determined by three main factors. The first is the sea level that would be under the mountain if the water could flow freely under the continents. The second depends on the accuracy of the elevations of the points in the valley from which the measurements are performed, and on the mareograph taken as a reference (height datum). The third factor depends on the amount of snow on the summit. These changes from season to season and from year to year with a variation that exceeds a metre between spring and autumn. Measurements from a long distance are also influenced by the refraction of the atmosphere.

Geodetic studies have been performed since the beginning of the 19th century to determine the highest mountain of the Karakorum-Himalaya chain and its exact height.

Within the last 50 years new measurements attempted to provide the elevation of the mountains with reference to the earth's ellipsoid and the calculation of the ellipsoid-geoid separation that proved to be the main obstacle in obtaining the exact measurement of the elevation of the Karakorum-Himalayan mountains, together with that of the varying depth of the snow cap covering the summits.

The surveys of Mt. Everest in 1975 (NBSM - National Bureau of Surveying and Mapping of China) and 1992 (Italian EV-K2-CNR Committee) introduced an important concept, as the depth of the snow layer was measured with a graduated avalanche probe.

When the information came out in 1987 that K2 might have been higher than Everest, Prof. Ardito Desio, with Alessandro Caporali and Agostino da Polenza organised a quick check of the elevations of the two mountains using a new instrument, a Global Positioning System to measure the coordinates of the points at Base Camp from where the summit was aimed at with the theodolites. The geoidal elevations were than calculated according to the best geoid available at that time. This survey provided for Mount Everest an elevation of 8872 metres.

Very important changes in the measurement of the elevation of Mt. Everest were introduced by the 1992 Italian-Chinese measurement, when for the first time a GPS receiver was started on the summit by Benoit Chamoux linked to the Italian Ev-K2-CNR expedition.

The survey was rather complex. One GPS on the summit, three GPS' on the Nepali side, three on the Tibetan side operated by Chinese researchers. Contemporarily classical trigonometric measurements were performed from three points in Nepal and three in Tibet, while on the summit a tripod was installed with a red target and a system of reflecting prisms for the laser beams of the distance meters. This was the most complex (and reliable) survey ever made on Mt. Everest.

But two points still remained under discussion: the Geoid-Ellipsoid separation and the thickness of the snow layer. A new international geoidal value came out in 1996, another Chinese value in 1999.

Every time that a new global geoid calculation is performed the values change mainly in the areas with low density of gravity measurements.

In 1992, a Chinese determination gave -25.14 metres. Later on, in 1996, the new geoid EGM96 showed the value of -27.3 m while in 1999 a new calculation from the Chinese side rose to -26.2m.

Since 1991 Dr. Bradford Washburn, the founder of the Boston Museum of Science and one of the founders of the National Geographic Society, attempted a new measurement of Mt. Everest, providing some commercial expedition leaders with a GPS receiver to be operated on the summit. Also the National Geographic Society would have liked to have given its name to the elevation of the mountain and tried to ignore the Italian measurement.

After several attempts, Dr. Washburn succeeded in 1999 and the National Geographic measurement was announced taking into account the more recent value of -28.74 metres.

We can now compare the values of the height of Mt. Everest with reference to the snow surface and to the geoid-ellipsoid separations carried out in the last 160 years.

The variations of the height of Mt Everest are mainly due to different values of the geoidal undulation N and to the variation in the snow layer.

It is therefore necessary that eventual comparisons, between the elevations of the mountains, be carried out using a reference system internationally recognised such as the ITRF (International Terrestrial Reference System) with reference to the bedrock under the summit and not affected by an occasional snowfall.

To obtain a definitive measurement one should agree that the elevation must be taken with respect to the rock surface by performing a reliable determination of the depth of the snow layer.

If reference were made to the rock surface and to the ITRF datum using the GRS80 (Geodetic Reference System 1980) ellipsoid all

| Measurament taken by: | N | Geoid.El.Snow | Ellips.El.Snow | Geoid.El.Rock |
|---|---|---|---|---|
| Survey of India 1852 | | 8840 | | |
| Sidney Burrard 1904 | | 8882 | | |
| De Graaf Hunter 1930 | -30,18 | 8854 ±5 | 8823,82 | |
| B. L. Gulatee 1954 | -35,05 | 8848 | 8812,95 | |
| Desio e Caporali 1987 | -39,00 | 8872 | 8833 | |
| Ev-K2-CNR/NBSM 1992 | -25,14 | 8848,65±0,35 | 8823,51 | 8846,1 |
| J. Y. Chen 1999 | -26,20 | 8849,71 | 8823,51 | |
| EGM96 | -27,30 | 8849,82 | 8822,52 | |
| Washburn e Chen 1999 | -28,74 | 8850±2 | 8821,26 | |
| EV-K2-CNR 2004 | -28,74 | 8852,12±0,12 | 8823,38±0,12 | 8848,82±0,23 |
| EV-K2-CNR 2004 (N 1992) | -25,14 | 8848,52±0,12 | 8823,38±0,12 | 8845,22±0,23 |
| SBSM - China 2005 | -25,20 | 8847,93±0,14 | 8821,47±0,14 | 8844,43±0,21 |

1)**N**: is the **geoidal elevation** that is the difference between the Earth's Ellipsoid and Geoid (sea leve);
2)**Geoid. El. Snow**: geoidal elevation of the snow
3)**Ellips. El. Snow**: Ellipsoidal elevation of the snow surface
4)**Geoid. El. Rock**: geoidal elevation of the rock surface
**N** is the difference between 3) and 2).

| N= -25,14 | Latitude | Longitude | Height |
|---|---|---|---|
| Snow Summit | 27°59'16,963" | 85°55'31,736" | 8848,52 |
| Rock Summit | 27°59'16,998" | 85°55'31,723" | 8845,22 |

MEASUREMENTS

ambiguities would drop and one could carry out comparisons even up to an accuracy of a centimetre. In order to determine the depth of the snow on the summit of a mountain the researchers of the Department of Mathematics and Geosciences of the University of Trieste, and the geologist of SOGEST with IDS team(Ingegneria dei Sistemi – Pisa) joined together and a new instrument was designed using the most advanced technology. It was a portable GPR, coupled with a single frequency GPS donated by Leica. The GPR produces signals of a certain frequency and detects them when they are reflected by a hard layer. The deeper the layer, the lower the frequency of the signal and the higher the weight of the antenna.
Based on the experiences of the previous measurements, a 900 Mhz antenna was chosen that could reach a depth of 6 metres. The instrument including GPR, batteries and GPS, was housed in a fibreglass box of aeronautic type and resistant to heat, low temperatures, shocks and pressures of every kind. This was built by the company of Valentino Mueller in Aquileia (Gorizia). The total weight of the instrument was surprisingly low, only 4 kg, that could be easily carried to the summit by a Sherpa porter. The data recorded were processed at the University of Trieste and from the analysis of the surfaces resulting from the radar and GPS data it was easy to deduce that the two maxima did not coincide. One must therefore distinguish a maximum elevation "on the snow" and a maximum elevation "on the rock". The two summits are at a distance of about one metre in the direction of the prevalent wind.The coordinates of the snow summit were determined from the GPS recordings while those of the rock summit were estimated on the digitised interpolation surface. As a conclusion one can remark that Mount Everest was measured and its height calculated several times during the past two centuries. During this time the scientific knowledge and the instruments employed for the measurements have greatly improved, but the conditions of the measurements and the errors involved are so large that it is still impossible to determine how much (and even if) the height has changed. It can be asserted however that the summit has moved in a NNE direction for about 8 metres and is still moving at a rate of 4.2 cm/year. New measurements of the elevation of Mount Everest are reasonable if they give the opportunity for a more accurate measurement of the geoid-ellipsoid separation at the Pyramid permanent GPS station, which should be reached by the geometric leveling lines linked to the Indian leveling network. This opportune anyway in order to link the Pyramid GPS point with the leveling lines bench mark near Base Camp. Another improvement can derive from a new GPR survey for the calculation of the depth of the snow under the summit crossed by a larger number of profiles.

## Himalaya

# A moving mountain chain

*From Everest (1843) to present*

By **GABRIELE PREVITALI**

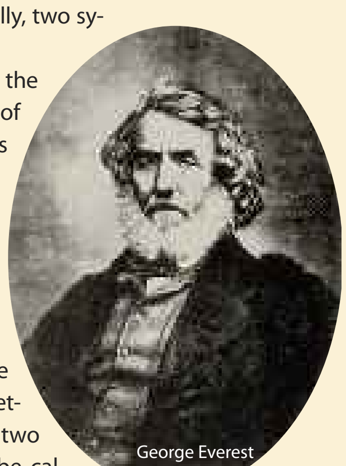
Everest felt truly satisfied when he arrived with his triangulations at Dehra Dun on the Himalaya slopes in 1843. His life's work was completed after 25 years. He had his observatory built in a nearby location, Kaliana, to obtain accurate astronomic observations to complete a project that would certainly go down in history.

Measuring mountains in 1625

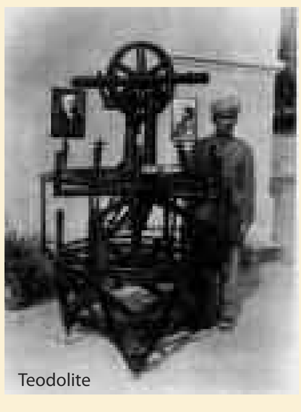
But it was exactly here that he faced difficulties that were unimaginable for him and which would disappoint him the most. In the tract between Kaliana and Kalianpur (another observatory 180 km southward), the triangulation and astronomic measurements did not coincide. In fact, there was a difference of 5".2 seconds of arc, equal to approximately 162 metres. He had the measurement and calculations repeated several times with more or less the same results. Unsure what to do, he reluctantly attributed the error to the measurements of distance that depended on the precision of the basic lines and, as is still normally done in topography today, distributed the error over the entire network.
But this fact disturbed him and he spoke with John Henry Pratt, Archdeacon of Calcutta, a good mathematician with a weakness for geophysics and geodesy. Pratt, in an article presented to the Royal Society of London on December 4, 1854, showed that the error could not be attributed to measurements of distance since the basic lines were checked with a precision of 10 cm.
The error could only be in the astronomic measurements and the cause was attributed to the vertical deflection which was discovered by Pierre Bouguer when he had influenced the calculation of the equatorial meridian arc in Peru.
However, Pratt did not stop with these considerations and went even further. Making a global hypothesis on the average height of the Himalayas and the extension of the Tibetan highlands, and giving the earth an average density of 2.7 gr/cm3, he calculated that the plumb line would have deviated by 27".85 at Kaliana and 11".9 at Kalianpur, with a difference of 15".885, almost triple the level observed by Everest.
In his article "On the Attraction of the Himalaya Mountains and of the elevated regions beyond them, upon the Plumb line in India", Pratt did not give a convincing explanation of this fact. However, Everest proposed the theory that the density of the lithosphere below the Himalayas was lower than what had been hypothesised (Walker, 1879).
Just days away from Pratt's presentation of the communication to the Royal Society, the Royal astronomer George B. Airy presented in turn an article entitled: on the Computation of the Effect of the Attraction of Mountain Masses, as disturbing the Apparent Astronomical Latitude of Stations in Geodetic Surveys.
In this article, he introduced the concept (but not the name) of Isostasy, affirming that the mountainous mass, composed of the Himalayas and Tibet, supposedly floated on a fluid and denser mantle similar to a wooden raft, so that the higher the emerging part, the deeper the submerged part.
Pratt's only reply in the following years was to embrace Everest's theory affirming in various writings that the lithosphere beneath the mountains had the same thickness as below the plains but formed by lighter material.
Only one hundred years later between 1970 and 1980, these theories were verified by means of deep seismic soundings that proved Airy right, showing how the earth's crust beneath the Himalayan chain is more than 75 km. thick (Finetti, Poretti & al. 1983).
It can be deduced that after the collision between India and Asia, the upper part of the continental crust thrust itself under the light crust of the Tibetan area, folding itself downward, whereas the upper parts folded like an accordion.
This way, the earth's crust doubled or tripled itself with a succession of dense layers alternating with ones less dense than those on top, contrary to what happened in the flatlands. This lighter mass of material on top of a denser and more elastic mantle tends to lift itself and for this reason, the Himalayan chain is being slowly uplifted.

## How to measure the mountains

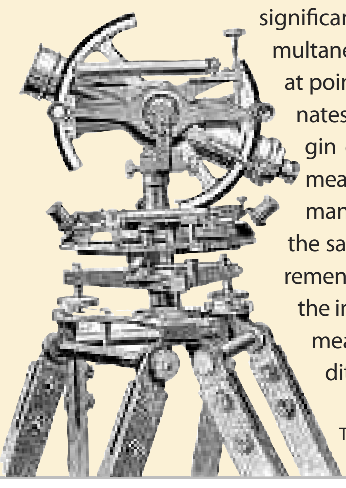
Establishing the height of a mountain means determining the height of its summit with regard to sea level. Basically, two systems are used for this purpose.
An optical system with laser sighting offers the greatest precision (with a margin of error of less than 1 mm per km). The system works using a laser distancing probe placed at the bottom of the mountain and aimed at a reflecting prism on the top. By measuring the time the laser beam takes to reach the prism and return to the distance meter allows the straight line distance between the two points to be calculated. Using electronic theodolites, the laser beam's inclination angle is determined with respect to the horizon and from this, one can calculate the difference in height between the bottom and the top. Precise as it is, this system is limited by visibility conditions. Despite its greater margin of error (up to 5 metres on the horizontal plane and seven vertically), the method using GPS (Global Positioning System) is not subject to the abovementioned difficulties. Furthermore, GPS precision can be significantly increased by measuring the peak simultaneously with other reference stations, placed at points of known geodesic heights and coordinates, in order to compare and correct the margin of error. The difficulty of using a GPS for measuring is due to the physical and logistic demands it makes on the person who must carry the satellite signal receiver to the top. A measurement campaign's total success is determined by the implementation and comparison of the two measuring systems, which guarantee the validity of the measurements.



George Everest



Teodolite



Teodolite

G.Poretti

## Who are the measurements of mountains important for?

*by **Prof. Giorgio Poretti***
*Department of Mathematics & Geosciences – University of Trieste*

After having examined the huge amount of data on the measurements made on the world's highest mountain, this question arises spontaneously. We asked one of the top world experts on the subject who has always collaborated with the "Ev-K2-CNR" commission exactly in this scientific field. Prof. Giorgio Poretti from the University of Trieste.
And the first reply to the question literally catches us on the wrong foot:
«There is no register that keeps track of the measurements made on the mountains.
Having established which mountain is the highest, ten centimetres more or less do not matter to anyone. Each country remembers the measurement that "its experts" made, and moreover, the technological developments this measurement lead to.
For example, GPS manufacturers (Leica and Trimble) have always been interested in the measurements (mine and Washburn's) for advertising purposes. Before we even reached the top, Trimble had called "Everest" a true GPS model.
As confirmation of the scarce at-

tention given to the subject, I must specify that only another researcher and I always mention other people's work!
In all truthfulness, I must also mention the German order of topographic engineers (Verband der Vermessungsingenieure) who gave me the "Das Goldenen Lot" award for measuring Everest.
For us, this was a consecration of our work, because when Germany and Switzerland approve our measurements…
To this date, we have never published our data in China because of language problems; I have no idea what they have written about it.
However, in Nepal, the measurement we made in 1992 was contested because we decreased the altitude by 5 metres (it is very probable that had we affirmed it was one metre higher, everyone would have been happy to mention our data).
Nor did we receive much acclaim in England: an article that was requested by an English publisher for the book "The seventy great mysteries of the Natural world" was so totally distorted that in the end I could not accept the version they proposed to me.

# MEASUREMENTS

Continued from front page

## The fascinating history of the measurements of mt. Everest

...carried out the measurement of the Great Trigonometrical Survey (GTS).

### 1852

One day in the spring of 1852. Dehra Dun, India, in the foot hills of the Himalayas. The door of the office of the Director General of the Survey of India opens and Radanath Sikdar enters. He was the chief of the team of human computers who were processing the data of the measurements of the Himalayan mountains taken during the winter. "Sir I have discovered the highest mountain of the world ..... it is Peak XV".

Radhanath Sikidar,
*an indian mathematician who first calculate the height of Peak XV*

*Publication of Sydney Burrard (1860-1943) and H. Hayden Geography and Geology of the Himalaya Mountains and Tibet (1907)*

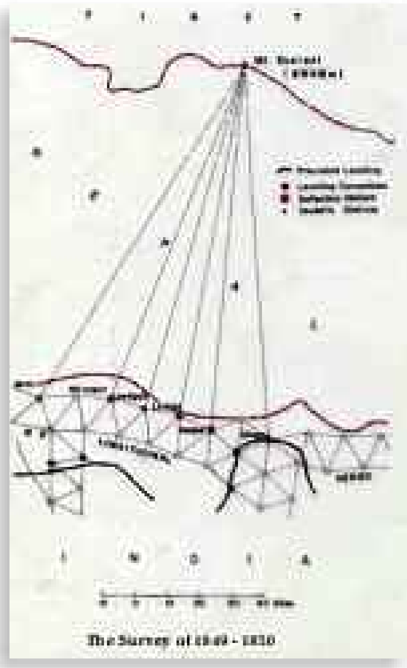

### 1856

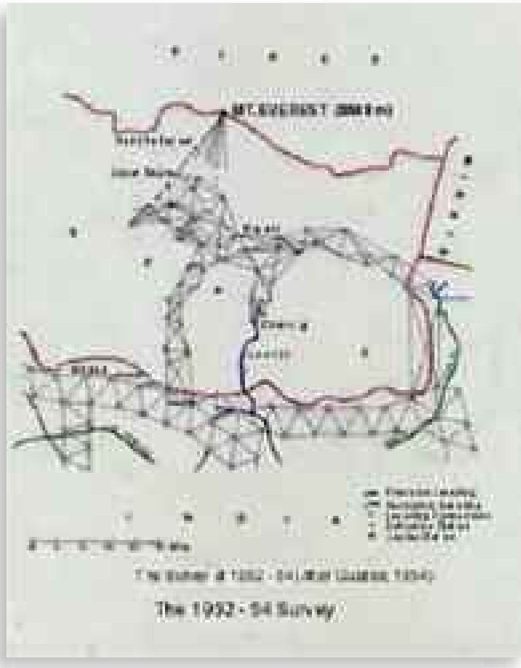
Confirmation of the measurement of the Survey of India.

### 1865

The name of Mt. Everest, in honour of Sir George Everest, Director General of the Great Trigonometric Survey from 1830 to 1843, is assigned to Peak XV.


A SKETCH
GEOGRAPHY AND GEOLOGY
HIMALAYA MOUNTAINS AND TIBET
PART II.
THE PRINCIPAL MOUNTAIN RANGES OF ASIA




### 1904

New measurements of Mount Everest were performed in 1902-4, from Darjeeling, under the direction of Sydney Burrard who brought the height up to 8882 metres a.s.l.

### 1930

The elevation was calculated with respect to the geoid (that is sea level) by Dr. De Graaf Hunter who also implemented the new knowledge of refractions and applied the correction for the deflection of the plumb line giving a value of 29050 ±15 feet.

### 1954

A more accurate measurement was performed by B. L. Gulatee who determined the height to be 8848 metres and pointed out the errors performed in the previous measurements. This time the measurements were carried out on Nepali soil, south of Lukla, from 9 points ranging between 80 and 110 km from the summit.

During the last 50 years new measurements have attempted to establish the elevation of the mountains with reference to the earth's ellipsoid and the calculation of the ellipsoid-geoid separation.This proved to be the main obstacle in obtaining the exact measurement of the elevation of the Karakorum-Himalayan mountains, together with that of the varying depth of the snow cap covering the summits.

### 1975

The surveys of the NBSM - National Bureau of Surveying and Mapping of China introduced an important new technique,by measuring the depth of the snow layer with a graduated avalanche probe. The survey confirmed 8848 m a.s.l. (29029±1 feet, 8848,13±0.35 m a.s.l.)

### 1987

News started to spread that K2 might have been higher than Everest. Prof. Ardito Desio, with Alessandro Caporali and Agostino da Polenza, organised a quick check of the elevations of the two mountains using a new instrument, a Global Positioning System, to measure the coordinates of the points at base camp, from where the summit was aimed at with the theodolites. The geoidal elevations were then calculated according to the best geoid available at that time. This survey resulted in a height for Mount Everest of 8872 metres.

### 1992

Very important changes in the measurement of the elevation of Mt. Everest were introduced by the Ev-K2-CNR/NBSM Italian-Chinese measurement when, for the first time, a GPS receiver was taken to the summit by Benoit Chamoux, a member of the Italian Ev-K2-CNR expedition. Using a value of geoid-ellipsoid separation N equal to -25.14 meters, the height of the snow top, calculated by Prof. Giorgio Poretti, turned out to be 8848,65 m (± 35 cm). The thickness of the snow was uncertain due to the possible presence of ice, but the probe reached a depth of at least 2 metres in the snow.

### 1999

In May a new GPS measurement was performed by a team of nine climbers of the American National Geographic Everest Expedition organized by Bradford Washburn, the famous explorer and cartographer, founder of the Boston Museum of Science. The calculations provide a value of 29035 feet (8850 m a.s.l.), while the 1998 and 1999 attempts failed to reach the summit with a new instrument, a ground penetrating radar that can locate the top of the rock buried under the snow.

### 2004

During the Italian scientific – mountaineering expeditions to Everest and K2 (expedition leader Agostino Da Polenza) to celebrate the fiftieth anniversary of the first ascent of K2, a complex re-measurement of the Everest summit altitude using a GPS was carried out. For the first time it was paired with a GPR testing that can detect both the proportion of snow cover and the presence of underlying rock.
The measurement lasted over 2 hours and included a second GPS "master" placed on the summit and a third located on the Chinese bench mark at the Tibetan base camp, with a link to the permanent GPS station at the"Ev-K2-CNR Pyramid" Laboratory on the Nepali side.
The subsequent processing, coordinated by Prof. G. Poretti, considering an N separation geoid-ellipsoid value updated to -28,74 meters, resulted in an altitude for the rock top of 8848,82 m (± 23 cm) and a snow thickness of 3.70 m , and a height of 8852,12 m (± 12 cm) for the snow ridge summit.

### 2005

Another measurement was performed in 2005 by the NBSM (National Bureau of Surveying and Mapping) on the 30th anniversary of the 1975 measurement. On this occasion they used the GPR, which was built in Italy by the University of Trieste and IDS, for the determination of the depth of the snow and they announced a slight change of N.

MEASUREMENTS

# Georadar & GPS

**The system used by the expedition "K2 2004 – fifty years later" to measure Everest is on the cutting edge of electronic technology, weighing less than 4 kilos compared to the 20 kilos of normal georadars.**

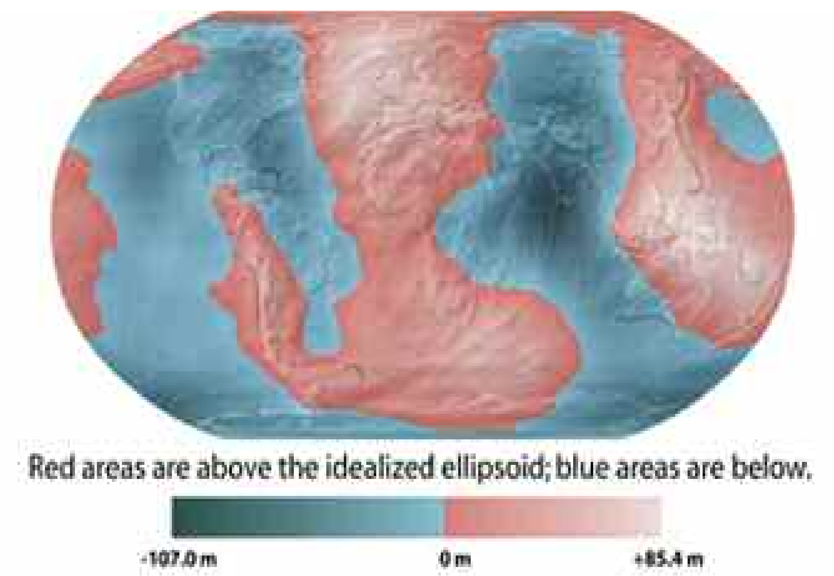
It resembles a catamaran model with a fiberglass hull and two small lateral runners to prevent it from turning over in the snow. Under the guidance of Giorgio Poretti and Roberto Mandler SOGEST, the researchers of the University of Trieste in collaboration with the expedition mountaineers tested various instruments and were able to furnish correct indications to the IDS (Ingegneria dei Sistemi) company in Pisa, which produced an innovative version of Ground Penetrating Radar (GPR) (*) paired with a GPS (weighing less than 4 kilos, compared to the 20 kilos for georadars on the market at that time) for reaching the world's highest summits. In fact, the mountaineers had requested maximum lightness and functionality in order to manoeuvre it in the prohibitive conditions of the 8000-metre altitudes. Thus, a tiny wonder of miniaturised electronic technology was created (named "Snow Radar by EV-K2-CNR") and in the future it may also be used to locate avalanche victims. Powered by special lithium batteries, this instrument has allowed Everest height to be measured with extreme precision, fathoming the layer of snow and ice that covers the peak to trace its hidden outline.
GPS technology is well known and uses signals sent by Navstar satellites for precise positioning of the instrument with 1-Hz sampling (one registration per second).

***(*) Technical notes***
*As per the GPR (georadar) component, together with the IDS company, which undertook the commitment to officially create the new instrument, it was decided that the 900 MHz radar antenna they produced would be used. An excellent compromise between easily penetrating signals in the snow and good resolution. A gpr card also produced by IDS, in anticipation of a slow "snail's pace" dragging and the availability of GPS positioning every 1 sec, is pre-programmed to memorize 10 signals per second with 2048 samples at 16 bits per signal, using industrial compact Flash Card-type memories of the industrial type (a reliable option available at the time). 10-signal-per-second sampling requires that a position string coming from the GPS component be inserted. For the latter, the final choice was a Leica MX421L GPS monofrequency antenna, exceptionally compact and light, furnished by partner Leica, which had already collaborated in the previous Ev-K2-CNR expeditions in the TOWER (Top Of the World Elevation Remeasurement) project.*
*To power the instrument, a special rechargeable lithium battery is used that is particularly resistant to low temperatures and may be used continuously for more than 7 hours.*


# The geoid

The measurements of elevation are referred to the "mean sea level" that under the mountains is approximated by another surface, the geoid, that represents an equipotential surface on which the oceans would lie if they were homogeneous, at constant temperature and not perturbed by atmospheric elements. This surface is determined from time to time by means of measurements of gravity and deflection of the vertical, by national (local geoid) or international institutions (global geoid). The geoid is very well defined on the oceans, or in areas where gravity measurements are very dense, while it presents several gaps in mountain or remote areas where gravity measurements are sparse.

**Deviation of Geoid from the idealized figure of the Earth**
(difference between the egm96 geoid and the WGS584 reference ellipsoid)




# Measuring Equipment

## From 1600 to present

*by* ***C. Calligaris** - Department of Mathematics & Geosciences – University of Trieste*

The best instruments available in every era have always been used for topographic measurements on the Himalaya mountains (and others). They were traditionally divided into two parts: measuring distances and measuring angles. It started with the vertical goniometer of the early 1600s to reach today's total stations with electronic memorization. In the Great Trigonometric Survey of India, William Lambton and George Everest took two English-built theodolites, one built by J. Cary and another by Throughton & Simms, which had to be carried on the shoulders of at least 16 men. They were used until 1873.
Metal chains or bars were used to measure distances and had to be protected from the sun to prevent thermal expansion. Measurements had to be as precise as possible because the measurement of the entire network depended on it. Barometers were used to measure the heights of the base stations.
In the 1992 surveying campaigns, Kern (Mekometer 5000 with visible laser beam) and Leica DI 3000 distance meters were used to measure distances. The angles to the summit were measured with Wild 2002K and Leica T3000 theodolites.
A tripod with two series of reflecting prisms (for laser beams from Nepal and Tibet) was carried to the peak, specifically created by Leica at Kern laboratories, the Leica 200 GPS, transported to the top by Benout Chamoux, recorded for 57 minutes. Two more Leica 200 GPSs operated on the Nepalese side and three Trimble 4000 GPSs were used on the Chinese side. During 2004 measurement a GPS Leica GRX 1200 was used at the summit, a GPS Leica 500 at the Pyramid benchmark and another GPS Leica at the Chinese branch mark at the Base Camp.

A third monofrequency Leica GPS was paired with Georadar to measure the depth of snow on the peak. Traditional technology was also used for this measurement with triple reflecting prisms on which laser beams coming from the Leica DI3000 distance meter were reflected and the angles were measured by a T200K theodolite located on the trigonometric point at the Tibetan base camp. **Sounding balloons** were launched to make corrections on the optical instruments (laser and theodolites) in 1992.
**Vertical deviation measurements** were made with an original programme, ASTRA, and an ACER Travelmate computer was used to link the Leica T200K theodolite with a monofrequency GPS (but with phase measurements) to define the position and the passage time for the stars chosen for the measurement.

# MEASUREMENTS

The importance of geodetic research

## Why are mountains measured?

by **GIORGIO PORETTI** Department of Mathematics & Geosciences – University of Trieste

If we look northward during the winter months from the shore of the Adriatic Sea, we can see an expanse of snow-covered peaks. It is only natural to wonder why they are white when the surroundings are not. The obvious answer is that they are higher and the next question, equally obvious, is: "how high are they?"
Two hundred years ago Prussian geographer Alexander von Humboldt attempted to establish a connection between the height of a mountain and the level of snow as it appears on the horizon, never taking into consideration the mountain's latitude.
The mountainous masses have a huge influence on many geophysical and topographical aspects and subsequently knowing their height is of fundamental importance not only for understanding the "shape of the Earth" but also for determining anomalies in gravity and deviation of the vertical which influence the direction of the plumb line and therefore every object in the world's topography. Forming imposing barriers against air currents, mountains significantly influence the local and regional climate of the neighbouring flatlands. It is therefore important to also know their positions, masses and heights.
We must bear in mind that as height varies, so does the air density and pressure, the quantity of oxygen and likewise the lift of an aircraft also varies. Therefore, passing over a mountain chain becomes an undertaking that must take into consideration the peaks it wants to fly over.
Before GPS was introduced, mountains were, from a topographical point of view, always the landmark par excellence for the triangulation of the geographic network of every country. The refraction coefficients for observations made with theodolites had to take into account the temperature and density of the air according to height.
If mountain tops have known coordinates and heights, the positions of bridges, roads, dams, etc., can be calculated according to them. If there are no mountains, one must use church bell towers or other monuments that can be seen from great distances.
Knowing the height of mountains over the entire planet has allowed the terrestrial ellipsoids to be defined as reference surfaces for flat coordinates.
The height of mountains is a factor in determining the terrestrial geoid and subsequently the surface of the oceans or that which the sea would have if it were free to move under the continents.
The geoid is determined according to anomalies in gravity which in turn depend on the density and extension of the mountain masses surrounding them.
Finally one must keep in mind the challenging effect that mountains have on those who look at them from a distance as well up close. It is a real challenge to climb and measure them with maximum precision, trying to do something optimally which would be easy at sea level. In the mountains, it becomes an arduous task that requires physical, organisational and mental capabilities for both the logistic situations as well as environmental conditions.

## Prof. Desio's tools

*One more "lesson"*

By GABRIELE PREVITALI

In tracing the surveying history of the world's tallest mountain – EVEREST – we came upon various tools adopted by the "distinguished" scientists who undertook this "arduous" and as of today, not totally complete endeavour.
Even if our "player" never dealt directly with ChomoLungMa (the mother of the earth), we must honour the person who was the mastermind behind the EV-K2-CNR Laboratory-Pyramid, which was always a fundamental landmark for our surveys and observations during our expeditions: Prof. Ardito Desio.
In this remembrance of him, we will reproduce several images of the instruments that Prof. Desio used since the very beginning of his extensive career as a scientist (and even back to the times of the K2 expedition of 1954) and which, compared with the new technologies available today, resemble "museum pieces".
However, they are proof of the high level of professional training and skills (not to mention doggedness) of those who knew how to use these analogue instruments (and not digital ones that "do everything by themselves"), after years of training and experience in the field.
The following reproductions are courtesy of "eco stampa.it"

a) Lens, thermometer, goniometer, rock pick, compasses and altimeters
b) The priceless Monticolo surveying device (with personalised case and the professor's name) (*) Concentrated in a single unit with compact size and therefore easily transported, these instruments allowed surveying to be done on terrain then reproduced graphically. The survey devices allowed distances, direction and slopes to be measured, whereas those with graphic applications reproduced directions, and finally, those with calculation applications assessed horizontal distances and altitude differences.

***(*) Technical notes :***
*It consisted of a small portable table (13x18x1 cm) suitable for expedition work. Devices for surveying, graphic and calculation applications were found in this space. The surveying devices allowed distances, direction and slopes to be measured. The graphic application devices allowed directions to be reproduced and strokes to be registered. The calculation devices allowed horizontal distances and altitude differences to be calculated.*
*Often used in the past and sometimes used today, the Monticolo surveying device measured the terrain for walkways and irradiation. In the event of highly extended terrain, it is better to do a standing survey (traverse survey) and then, after having checked the closing, a detailed survey for irradiation making stations on the vertexes of the standing survey.*
*It was invented at the end of the 1800s, carefully studied and tested in many years of practice by Engineer A. Monticolo and was manufactured by the Officine Galileo in Florence.*

## How to measure Mount Everest

by **C. Calligaris**
Department of Mathematics & Geosciences – University of Trieste

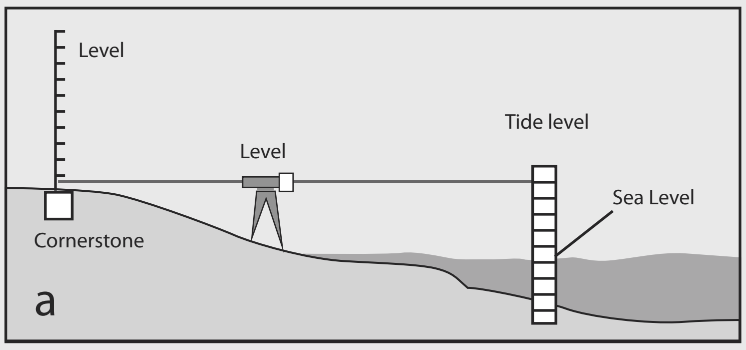
Measuring the height of a mountain peak with respect to the average sea level can be done by two methods: the classical method and the satellite method (GPS). Geometric leveling (the most precise) is used for the classical method and can eventually be supplemented with stretches of trigonometric leveling, which is quicker yet less precise. GPS measuring gives the height with respect to the earth's ellipsoid and requires that an N correction (geoid-ellipsoid) be made, known as the "height of the geoid".
Nonetheless, in both cases the height must be taken from the sea to the foot of the mountain using geometric leveling. With Mount Everest, if the measurement is made from the Nepalese side, the closest sea is the Indian Ocean and the reference is given by the Calcutta mareograph. Measuring from the Tibetan side refers to the Chinese leveling network as it has a fundamental reference point that is valid for all of China in a flat area that is tectonically very stable close to Xian, linked with the Qingdao mareograph on the Yellow Sea.
Geometric leveling has already been done from Calcutta to Birganj on the border between India and Nepal, then from Birganj to the Kathmandu airport. From this point onward, leveling has yet to be done, with eventual stretches of trigonometric leveling for the steepest areas. Geometric leveling probably exists along the main roads for the Kathmandu-Lamosangu-Jiristretch. The Jiri-Lukla and Lukla-Pyramid-Kala Pattar stretch has yet to be done.
Trigonometric leveling has been carried out for this stretch but the Lukla-Jiri link is missing.

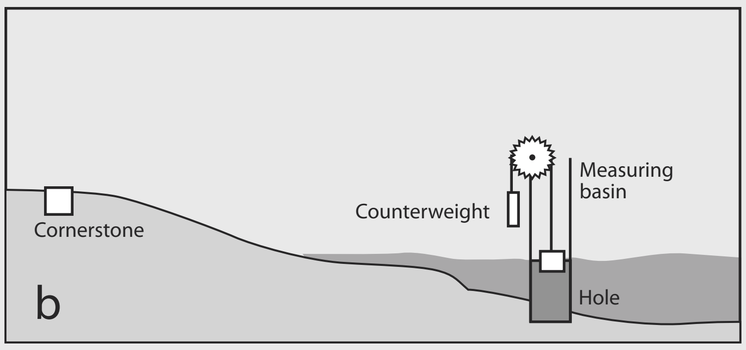
**Classical measuring**

When the value of the elevation is determined by leveling at a benchmark near the Pyramid Laboratory, some points in view of the summit must be pointed out, from which the distances and the zenith angles to the summit can be measured, using a laser distance meter and a theodolite or a very accurate total station.
The instruments are positioned on the final leveling benchmark, while on the summit a sight target and a set of reflecting prisms must be erected to be visible from the valley. The same procedure must be performed from the different points linked by leveling and in view of the summit. Measurements must be made several times in both positions of the theodolite telescope, if possible at different times of the day as the measured angles and distances must be corrected with temperature and pressure values in the valley and at the top. While processing data for determining the orthometric height, the deviation of the vertical and subsequently the angle created by the local vertical with the earth's ellipsoid normal must also be considered.

**GPS measuring**

One or more GPSs are positioned in the valley on the leveling benchmarks for satellite measuring. A GPS is then placed on the top and made to record simultaneously with those in the valley. The registration time must be as long as possible (at least one hour). The GPSs in the valley can eventually be replaced by the Pyramid's permanent GPS. If the points in the valley are geometric leveling benchmarks, the difference between this and the level of the satellite height will give the N values which can then be extrapolated on the vertical of the peak.



# MEASUREMENTS

## Everest, the mountain of science

*and people to discover. This intuition was strongly supported by Nepali partners, starting from NAST, but also WWF Nepal, DHM (Department of Hydrology and Meteorology), local universities such as Kathmandu and Tribhuvan Universities, Nepalese NGO, the Government of Nepal's institutions dealing with tourism, parks, forests and environment, leading to a constant development of the many activities that, for over twenty years, take place not only in the Sagarmatha National Park, but across all the country.*
*Thanks to these synergies the first agreement of cultural and scientific cooperation at government level between Italy and Nepal was developed, and a central point of this agreement was the Pyramid International Laboratory Observatory and the research carried out, and that was renewed over the years with mutual satisfaction.*
*Great is the debt of gratitude from us all from Ev-K2-CNR towards this mountain and the institutions and population of Nepal and of the Nepali Himalayan valleys. We may summarize the result in some unique evidences at the international level:*
** **550 research team missions,** involving over **220 researchers**, some of whom carried out missions over several years, working in **143 different institutions and scientific units**, coming from all over the world;*
** **More than 1200 publications, dozens of book chapters and several scientific volumes. Thousand of dissemination articles, hundreds of television programs and a few movies** about researchers' activity during missions at the laboratory, around and on Everest.*
** **Exceptional scientific expeditions to Everest in 1992 and 2004**, during which the peak measurements was performed using, for the first time, laser technology, GPS and Georadar. A record that was never equalled again.*
****Tests and results of great scientific significance in the framework of the SHARE project** (Stations at High Altitude for Research on the Environment), obtained through the implementation of the Pyramid International Laboratory Observatory (5079 m asl) (the station and the world's highest environmental monitoring network which provides information on the pollutants' movement, and the composition, characteristics and concentration of atmospheric aerosols - both anthropogenic and natural - of ozone and of other compounds, responsible of the greenhouse effect).*
** **Installation of the world's highest weather station** (South Col, 8000 m asl), which transmits real-time data on temperature, humidity, pressure, wind speed and direction, UV radiation.*
** **Important research in physiology and medicine**, from the indoor pollution impacts on local communities, to the effects of pulmonary hypertension on aerobic capacity at high altitude.*

*Records are many, strictly scientific but also regarding advanced technology, like the experience that, last May, allowed to **install the webcam that from Kala Patthar,** at an altitude of 5600 m asl and at just 11 km from the mountain, **which provides high resolution real-time images of the Everest summit.***

*It's complex to summarise, in these few lines, the efforts and results obtained in more than 20 years of work. What it is worth mentioning in this occasion is that Italy and Nepal have in common a great mountain tradition. Both promote knowledge, exchange of experiences and give great value to the environment as something inalienable and to be transmitted to future generations. Both know that Mount Everest for over 25 years and recently the Dolomites are mountains and mountain ranges recognized by UNESCO as World Heritage. Both know that there are values of solidarity and respect to which refer in mutual relationships. The values and attitudes that Prof. Desio transmitted us, which in these years have inspired the collaboration with this wonderful country of mountains and people with great cultural traditions.*
*This collaboration continues growing. Everest is a unique symbol of this collaboration, but also a concrete and strong reality that is constantly evolving.*

## Everest facts and figures

**Name**
**Sagarmatha, Chomolungma, Qomolungma.**
The name "Everest" was introduced in 1865 by Andrew Waugh the successor of George Everest as Surveyor General of the Survey of India.

**Countries**
Nepal, China

**Valley**
Khumbu Himal

**Height**
Snow: 8848.52 m; rock: 8845.22 m

**First completed ascent southern side**
Summit May 29, 1953 11:30 a.m.

**Mountaineers on the summit**:
- Sir Edmund Hillary (New Zealand) and Tenzing Norgay (Nepal)
- via South Col - Southeast Ridge
- The English expedition reached the base camp on April 12, 1953 and departed again on June 3 after 52 days
- 9 mountaineers
- 20 porters
- Expedition leader Henry Cecil John Hunt
- 0 deaths
- Oxygen used
- 9 upper camps

**First attempt (failed)**
- 1921 – English expedition
- Expedition leader C-K. Howard-Bury
- Northern, eastern, western sides
- Height reached: 7000 metres, North Col

**First ascent northern side**
May 25, 1960 – Chinese expedition – North Col Northeast Ridge

**Attempts prior to 1953**
15

**First italian expedition**
1973 - expedition led by Guido Monzino

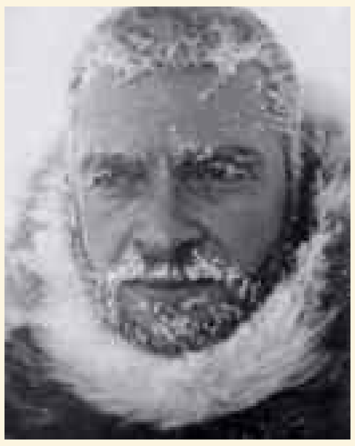
**First verified victim**
1921 expedition: 2 victims


Sir Edmund Hillary e Tenzing Norgay


Via Colle Sud


Apa Sherpa


Jordan Romero


Guido Monzino

**Second completed ascent**
- Spring 1956 – Swiss expedition headed to Everest Lhotse – via South Col, Southeast Ridge

**First ascent without oxygen**
May 3, 1978 - Reinhold Messner (Italy) – Peter Habeler (Austria) – Via South Col, Southeast Ridge

**First winter ascent**
February 17, 1980 - Krzysztof Wielicki (Poland) and Leszek Cichy (Poland) – Via South Col, Southeast Ridge

**First solo ascent**
August 20, 1980 - Reinhold Messner (Italy) first solo ascent without oxygen – Via North Col, Northeast Ridge

**First complete descent with skis**
July 10, 2000 - Davo Karnikar (Slovenia)

**First woman to reach the summit of Everest from south**
May 16, 1975 - Junko Tabei (Japan)

**First woman to reach the summit of Everest from north**
May 27, 1975 - Phantog (Tibet)

**Person that has ascended Everest the most times**
Apa Sherpa (Nepal) – 21 times to the Everest peak

**Youngest to ascend Mount Everest**
May 13, 2010 – Jordan Romero (USA) reached the peak at 13 years of age with his father and three sherpas

**Oldest to ascend Mount Everest**
May 25, 2008 - Min Bahadur Sherchan (Nepal) reached the peak at 76 years of age

**Ascent routes**
18

**Most common route**
South Col - Southeast Ridge: the traditional route of the first climbers

## Mysteries

During the British expedition to Mount Everest in 1924, George Mallory and Andrew Irvine disappeared while climbing to the summit from the Northern side. It has not been established whether the two men fell after having reached the summit, or more likely, after having abandoned the attempt.

Mallory's body was found in March 1999, whereas historian Tom Holzel announced in 2010 that he had possibly found the remains of Irvine's body. Nonetheless, the camera, which could offer more information on this legendary ascent, has never been found.

*George Mallory and Andrew Irvine*

TRADITION

# Everest - Peak XV

*history & legends (and a few tall stories)*

By **GABRIELE PREVITALI**

R First "report" of an ascent to the top of Mount Everest dates back to the 9th century! Padma Sambhava (Guru Rinpoche) diffused Buddhism in Tibet and legend has it that he «ascended to CHOMOLUNGMA (Jo-mo-glan-ma, originally) on a beam of light».
Little or virtually nothing was known about this mountain (the highest in the world) in Western countries until 1847. Only the first surveys made in that year allowed the English geographers, who ascended from India, to "approach" the Himalayan spurs and take some measurements from a great distance, given that it was impossible to enter Tibetan as well as Nepalese territories.
In 1852, the previously uncertain and implausible data finally became precise and reliable (the succession of measurements and relative heights are illustrated in a dedicated chapter in this special): Peak XV is the highest mountain in the world!
This imposing mountain was not given an official name for 13 more years. In reality, the Tibetans had always had a name for it:

**CHOMOLUNGMA**
(**Jo-mo-glan-ma**, originally meant "**Mother Goddess of the Earth / or the World**").
Even if, in addition to the mountain itself, the people who gave it this name also extended it to the entire massif that included the world's highest peak.
They also have a name for it in Nepal:
"DEVADHUNGA" ("the abode of the deities"), according to the English explorers of that period, or "**GAURI SANKAR**" (Sanskrit for "the goddess and her consort") according to the German explorers, who also discovered the Tibetan term:
"CHINGOPAMARI".
A topographical map of Tibet published in Paris in 1733 bears the name "TSCHOUMOU—LANCMA", this is the demonstration that it was a well known name.
But the English, against to the tradition of always respecting local terminologies, in 1865 decided to honour the Past General Surveyor of India, for all he had done for Asian geography as head of the Great Trigonometric Survey, Sir George EVEREST, and proposed to give his name to Peak XV.
Then a long dispute began that awarded a certain success to the name Gauri Sankar which, between the 1800s and 1900s, became the official name of Peak XV for many cartographers.
In 1903, however, it was established that the mountain defined by the population as **Gauri Sankar (7134 mt) was another**, a good 59 km. from Everest.
Even during the first official expedition to attempt an ascent in 1921, the documents and permits issued by the Tibetan authorities clearly indicated the name "CHHA-MO-LUNG-MA".
For the entire Western world, **EVEREST** was soon to be established and identified as the **WORLD'S HIGHEST MOUNTAIN** (nowadays even the Chinese call the mountain Everest and the massif Chomolungma).

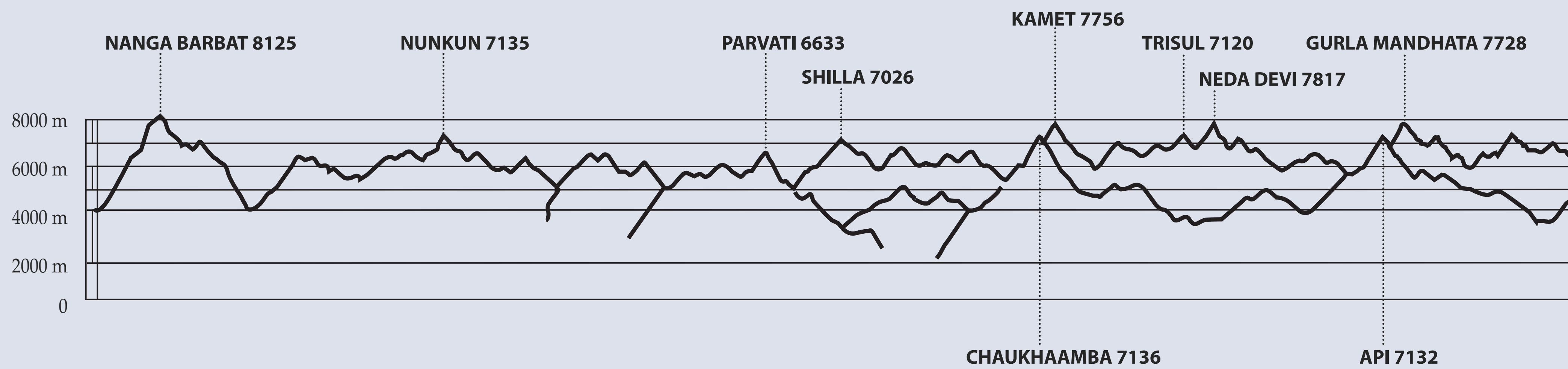
*Monastero di Khumjung Gompa 3795 m. valle del Khmbu, Nepal*

# Chomu Lungma: *the Goddess*

By **LHAKPA TSHERING** Sherpa Ev-K2-CNR Pyramid staff

Chomu Lungma is known as God of Sherpa people. The name of the god is Khang Doma.
Khang Doma is a Lady god. Chomu lungma has four sides. Each side of Chomu lungma is known by one Khang Doma's name.
People when they start their expedition on Everest they makes puja (pray) for safe and success.
We have always to think that Mt. Everest is our god and never do single mistake.
But the problem is that in mountain some time we lost our memo power or by mistake some time we do mistake our self. Then god will angry with us and can be happen anything in any time. That's the reason why we do puja before to starting with our activity.
We make "puja" not only at base camp but even in our home place or at Gomba before we leave for Everest Expedition.
For "puja" we need one monk from Gomba or from village to pray in (Sherpa) Tibetan language. However people who can read or who have an idea about puja then they can do "puja".
I mean we need an idea, experience about the puja. (God is great, they understand.)
And if possible always we have to put a hat on our head when we do a "puja".
Never do a "puja" with a bear head, this means we need some discipline too. But no black hat, because black hat is a bat sing so we always have to use white or other colour hat, like cow boy hat or similar hat. That's way in a Sherpa tradition (culture) we always use cow boy hat with Sherpa dress.
In this regards every year we are celebrating a Manirundu festival in Tengbuche monastery (In December). In this festival the monk prays and dances with story of Chomu lungma to make Chomu lungma HAPPY.

# Himalaya's mountains




*8 of the world's 14 "8000-metre" mountains are found in this mountain range extending for over 2500 KM (the distance separating London and Moscow, for clarity's sake) with an average depth of 200 km*

TRADITION

# Our tradition

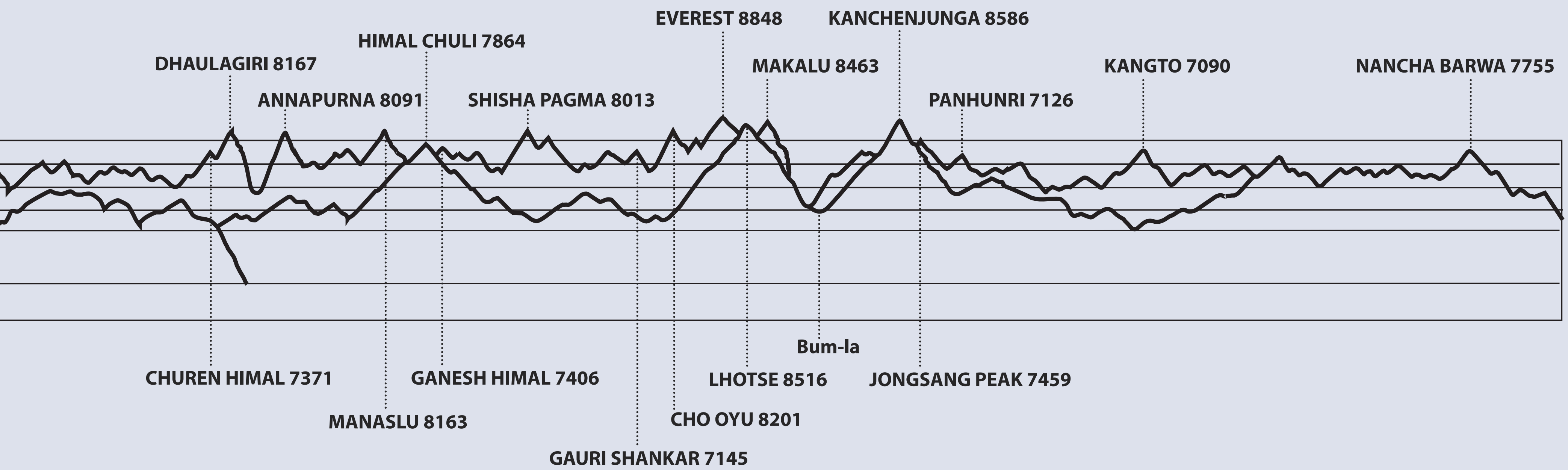
**LAXMAN ADHIKARI** Sherpa Ev-K2-CNR Pyramid staff

The mount Sagaramatha or Chomulongma is known as the world highest mountain in these days but history with introduction of Buddhism and people of Himalaya reason.
In Himalaya region of Nepal there are many monasteries and temples in different district but their behaviours, culture activities and religious are nearly similar.
Mostly Himalayan ethnic people consider mountain to be like God. Almost all the mountain has a god name and is connected with goddess or deity. Himalayan region people arm or close with Tibetans border so we can see direct reflect with Tibetan religious and Tibetans Buddhism.
Among many historical and religious place, Khumbu is also one of the most important place from a religious point of view. In These days Khumbu is directly connected with westerns so they are not deadly religious but they believe on mountain god and pray everyday fore a very auspicious day.
World height summit is called Sagaramatha by the official authorities of Nepal and Chomolungma by the Tibetain and Everest by Westerners, Local people also call Everest because of daily use with westerns and pray, religious people pray mountain because Mountain is the palace of goddess
I don't know exactly if it's written some where in Buddhist text or not but local old people and monks says that "there are five sister of lady goddess".
The oldest one is: Tashi Sheriring ma ( Mt.Gauri Shankar) we can see this during the flight to Lukla from Kathmandu. Near Jiri (this goddess is also known as Dharma protector).
The 2nd sister , Miyolangsama (Mt. Sagaramatha) world heightest peak. This goddess is very pretty and very beautiful. She is orange and bright looking.
The 3rd sister, Ting gyi shal Zangma , meaning ( fair blue-faced ,I don't know which mountain is this).
The 4th sister Chopen Drinzangma Mt Makalu.
The 5th sister Takar Drozangma (this mountain is in Kham Tibet)
After collapse Tibet country to the China, Himalayan border are closer for travel and trading. The small trade of salt, meat , leather and woods are fully stopped. Many Tibetan escape form Rumbuk monastery and mindroling monastery to Nepal and India. Not only that, then the train to go Rumbok for Buddhism study is fully blocked. Many ritual books are stocked in Rumbuk Monastery (north side of Mt Everest). Inhabitants of Himalayan is migrated from Tibet as caravan so originally they are Tibetans so even very high passes they go to Tibet for study and trade rather than trade with Terai region. To trade and deal with lower level people they have one major problem is Language and hot climate.
In Khumbu my grand mother's (just passed this year ago of 99) is Last people who escape from Rongbuk monastery of Tibet, she studied in Rongbuk monastery for 18 years. After fully stocked and permanently settled in front of high Himalaya region they have lot of free time so in only winter they go down to exchange Himalayan herbals with rice and salt and clothes. But all other season they crave the stone with ritual and enlighten words. Like Don't Kill animal (Ahha sha saa ma haa), Om ahh hum (keep clean ) and many long history on the stone , until these days you can see old stone carve up to Namxce and every small villages or big, not only that they start to build small monastery and start Buddhism train. The building monastery is started after the permission and blessing of Saul rimpoche (the abort of Zaa Rumbok monastery).
There are mainly two types of praying and worship style. One is community based and one is individual. Community also can be divide two parts, one by the groups of villagers and One is done by Monastery. Dumjee, Manirimdu, Chokjen , Bumjo, Nugne ,Yarchang, Kengur Tenguyar rhouee, are example of annual ritual programme performed by villager. Lha chhetuk , Kurim , Kengur Shhalak, Yum rorhouee, Serkim bulu , Younjap bulu, are example done at home. These are done at home on daily monthly or 3 monthly or biannual basis. Tibetan based Buddhism believes on reincarnations, Sherpa community is flower of Tibetan custom and culture so they deadly believes on previous and next life. Ritual performance (community) or worship style is different on each monastery so below I submitted information is based on Khumjung Gompa.
Dumjee : There are several saying about this festival some people says this is total offer to Guru Padmasambawa but some people says its festival to drive away evil spirits and pray for long live and without trouble in mountain journey and to protect and to make easy life.The dumjee festival is celebrate very year on summer (between June & July) at Khumjung Namche Pangboche, Thame & Rimijung at same date. Forche and Lukla on same date (between May –June) The Dumjee festival is same but offering book is different

*The only stories that have reached Western ears have always been gathered by Westerners and from the viewpoint of the Western world.*

*EV-K2-CNR's more than decade-long stay (due mainly to the Pyramid and completed expeditions) has given us the opportunity to let our two local collaborators speak for themselves and give their experience.*

*It is our specific wish not to change anything in the original text in English as well as the Italian translation in order not to undermine the true "native sentiment".*



# The 1992 and 2004 expeditions

*Measuring for "science and mountaineering"*

By **GABRIELE PREVITALI**

It all goes back to an announcement of the American Prof. George Wallerstein who, in May 1987, declared that <<he had done some geodetic surveying in the region north of the Karahorum near K2, and had discovered vast discrepancies with the altitudes on the official cartography. Unless one discovers that the scientist had carelessly reported some figures from the surveying done with his GPS, but which he himself declared they were few and approximative due to the lack of electric power and environmental interferences……>> (from: EVEREST – K2 , montagne di sogno di Agostino da Polenza, 1994 Ferrari Editrice).

The potential doubt that the world's highest mountain might not be Everest persuaded Prof. Desio to involve the CNR in a "re-survey" of the world's highest peaks (Everest and K2). Thus is began the still existent EV-K2-CNR experience (already with the idea of a pyramid high altitude scientific laboratory in mind, which was materialised in 1988 as a design and it was physically realised in 1989). The first surveying expedition left, in 1987 and due to new GPS instruments available combined with traditional geodetic systems allowed a new leg to be drawn (only for Everest because of the adverse atmospheric conditions).

**Ev-K2-Cnr 1992**

In 1990, the construction of the pyramid began, and it soon became inhabitable and in 1991 began to function completely and autonomously. Indeed the idea of preparing the first real mountaineering-scientific expedition to Everest with the most advanced technology available (laser distance meters, the most advanced type of GPS receiver, etc.) began in the winter of 1991. After a long preparatory process, it became reality on September 28, 1992 when Giuseppe Petigax, Lorenzo Mazzoleni, Pierre Royer and Lapka Nuru Sherpa reached the summit carrying the GPS receiver. But the Sherpas in charge of carrying the special tripod with sight target and refleting prisms could not make it to the top and left their load at 8750 metres in the snow. Benoit Chamoux who was with them came downn to South Col where he learned that the GPS had not been turned on and was left in its case on the summit.

The next day Benoit and Oswald Santin left to the summit (this time with oxigen), they took the instrument abandoned the day before on the way, reached the summit, installed the tripod, the target and the prisms and started the GPS. When on the walky-talky he read loud the words of the viewer ".... please wait....MEASURING......check your input...." we understood that we had performed the first measurement of Mt. Everest with a GPS on the summit. It recorded for 57 minutes then the climbers had to climb down and it was the time for the distance meters. The classical measurement was also rich of suspence until the red beam of the Mekometer could be seen shining on the summit. The next day (30 september) the newly arrived G. Pietro Verza and Abele Blanc probed the thickness of the snow cap on the summit of Mount Everest to complete the expeditions tasks. During the next decade other surveys followed with results that did not deviate much from the 1992 surveys. But as the 50th anniversary of the K2 conquest by the Italians led by Prof. Desio approached, a new initiative arises for absolute surveying that will unite science and mountaineering once again. And what would that link be if not the Ev-K2-CNR Committee.

After long preparatory works started in 2003.

**"K2 2004 – fifty years later"**

The new project was presented, which involved two distinct successive expeditions to Everest and K2 with the precise objective of reaching the summits and measuring their heights with the technologies available (the "official" height was set then at 8850 m. based on the surveys done in 1999 by explorer and cartographer Bradford Washburn on behalf of the National Geographic Society with GPS receivers at South Col and on the summit).

This time, the entire expedition was followed "live" thanks to new satellite technologies and was covered in great details.

We need only to extrapolate a few of the most significant excerpts coming from base camp on May 24, 2004, when the expedition leader communicated that:

«The four mountaineers who reached the summit, Claudio Bastrentaz, Alex Busca, Karl Unterkircher and Mario Merelli in turn with 2 Sherpas, have brought about an amazing technical achievement in absolute safety. Not only did they reach the peak without the aid of oxygen and therefore with their own forces as proof of their fantastic personal preparation levels, but they also continued to work at the summit with great lucidity while positioning the instruments and carrying out programmed scientific surveying, performing the demanding operations in full compliance with a precise scientific protocol that had been previously decided.

Prof. Giorgio Poretti, head of "Ev-K2-CNR" geodetic and geophysical research adds: «These mountaineers were fantastic, with special mention going to Alex Busca and Karl Unterkircher who performed to perfection every operation requested by the researchers at Base Camp and, on Roberto Mandler's orders, positioned the equipment for the survey. For more than three hours, they moved along the mountainside to trace the perfect points for georadar surveying, to let it fall along a line of maximum slope, allowing us to implement a surveying grid that now we will study and analyse slowly and carefully. All the instruments perfectly worked and we are almost certain that we have finally taken a remarkable step forward. We believe we can determine the exact depth of the snow on the summit, then calculate the exact measurement of the peak» and compute a realistic mathematical model of the rocky and of the snow summits of the mountain.

**«This perfect assonance between mountain climbers and scientists demonstrates the absolute scientific skills and preparation deployed by the "Ev-K2-CNR team" for the 50th anniversary of the Italian expedition to K2 with the "K2 2004 – fifty years later" team».**

Thanks to this very important teamwork, Prof. Giorgio Poretti, and Dr. Marco Lipizer University of Trieste, were able collect a large amount of data (gathered with innovative instruments) through which the new measurements were processed and then made official in the report which we will present of in another page of this special.

## "Log my Book"

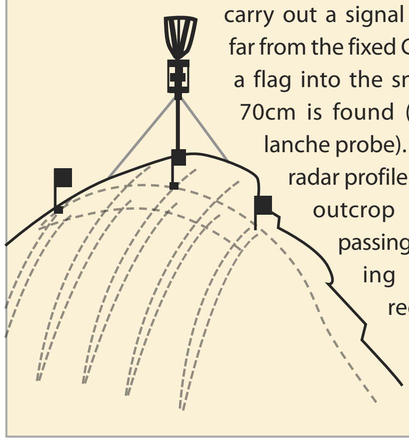
*From the memory of my part in the national scientific-climbing expedition for "K2 - 50 years later " in May 2004 to Mt. Everest*

by ROBERTO MANDLER

..."On the summit, a short time to recover from the exhaustion and to savour this important moment, then it is time to turn our attention to the scientific program, that provides for the positioning and the starting of the small GPS "master" Leica 1200 at the edge of the snow, where bedrock appears on the surface, 20 metres near to the summit.

The georadar/gps unit is then activated, starts correctly, also with its pre-heating system, while a good gps signal is received. As the instrument is operating correctly, our climbers start with the first GPR profile in the direction of the summit, but suddenly they communicate that the GPR led is blinking. Giorgio and I, for a moment, felt real panic, but there was no time to verify if the instrument was recording correctly or not!! In an agitated state, not wanting to waste more precious time, and completely forgetting the possibility of shutting down and re-starting the instrument, I gave instructions to continue the job on profile to the summit, hoping for the best. We waited anxiously, until from the summit they advised us that the led had stopped blinking, thus resolving the fault on its own!

**The surveying program** initially foresees a measurement of snow depth near the beginning of the first profile, on which to carry out a signal speed calibration. Not far from the fixed GPS "master", they insert a flag into the snow, where a depth of 70cm is found (measured by an avalanche probe). Following this an initial radar profile is made, from the rocky outcrop towards the summit, passing near the flag and marking this passage on the recording. The next profiles interest the whole summit area, with parallel lines, longitudinal to the crest, and crossed lines, transversal to the crest, with profiles on both slopes, in order to cross the rock crest covered by the snow. Our climbers work laboriously for almost two hours to make the georadar profiles, which is a very long time to operate without oxygen at 8850m, keeping us up to date through radio on their operations, while at base camp we try to imagine the surface morphology and the layout of the profiles.



When they complete the profiles, it is time to mount with some difficulty the sight target, and help was given to them through radio instructions from base camp. The sight target, which is easily visible by the powerful theodolite telescope operated by Marco Lipizer at the track intersection point for the advanced base camp, is the target to aim at for the traditional optic measurement.

It is necessary to speed up operations as much as possible in order to reduce the time of extreme stress our climbers are now under. Ok, finished! You may now go down, no, on the contrary you can't... an unexpected request has come from Patrizia, sent by satellite directly from Italy, and I have to pass it to our heroes on the summit: a special message of thanks for President Ciampi, to be recorded by radio. They have to repeat it several times for it to be sufficiently clear.

Finally, our climbers can face the long-awaited and endless descent to Camp3. At this point, our program for the measurement included a personal request of mine to bring a rock sample of the summit of Everest, but I don't have courage to ask them... While our boys begin the descent, the target is left on the summit, fixed by four wires, and is immediately measured by Marco Lipizer at base camp.

Everything seems to have gone as planned and in the messy tent we all complement each other, with much backslapping and handshaking"!

EVEREST 2004

# Summit and Measurements

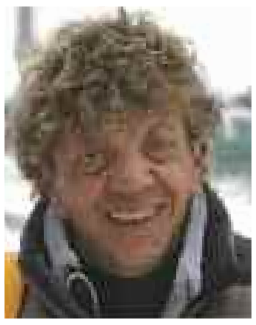
*As seen by the mountaineers and researchers of the K2 2004 expedition 50 years later*

By **GABRIELE PREVITALI**

*Seven years have passed by (May 24, 2004) but the memory is still vivid in the minds and hearts of the protagonists of that "survey" which, in 2004, marked a breakthrough in surveying history .*
*Listening to mountaineers Alex Busca, Claudio Bastentaz, Mario Merelli and technician Roberto Mandler at Base Camp is like being there at that moment in time: «The peak, finally! A moment to catch your breath and look around almost with exhilaration and maybe a lump in your throat for the fatigue but most of all for the indescribable thrill».*
*Let's let them speak for themselves:*

**Alessandro Alex BUSCA**
(coordinator of the mountaineers at the peak for surveying): nothing compares with the fatigue of being up there. Everest, the peak and the surveys were an unforgettable experience, but teamwork was the force that united us and characterises us still today. Without it, we could not have accomplished all that we did that day: assemble the GPS, the pole for the Prism, take the measurements, and many other operations that would be complex even at lower altitudes. To say the least, it was a fantastic day for me: I felt great, had come all the way to the top without oxygen, wonderfully, and it was a pleasurable experience. For this reason, it was almost "normal" having to stay there to do all the work we had set our minds on. Due to the fact that there was little wind and magnificent weather, we were able to work safely, and in addition to successfully summiting, which is always a mountaineer's top objective, it was enormously satisfying to have contributed to such an important scientific achievement: surveying with a new and innovative system designed by Italian scientists: one small regret: not having the time to sit down, look around and enjoy the beauty of this incomparable wonder (only those who have made it to the world's rooftop can understand)! I especially appreciated the great work done by our Serap Jangbu sherpa (expedition sirdar) and Lhapka Tshering sherpa, who carried the equipment up and lent a helping hand in positioning it. A final thought goes to dear Karl (Unterkircher) who is no longer with us and who, in addition to sharing all the hard work and success, immortalized us in his marvellous videos.

**Claudio BASTRENTAZ**
the fatigue is perhaps the most excruciating memory. But then the huge thrill I felt when we reached the top immediately comes to mind! Reliving the videos and hearing the comments on the spot again, I realized the enormous achievement we had made, which exhaustion had somewhat diminished for me. That's why today I remember that fantastic experience - also thanks to the beautiful images Karl left us with his videos and "breathless" comments – with overwhelming emotion. After so much effort, it was only the teamwork and sense of duty that "convinced" us to stay up there and do another big job (this time mountaineering/scientific). Positioning the materials, taking all the measurements, following – as much as possible – the indications coming from base camp, going up and down those "twenty metres" that seemed like a joke but turned out to be enormous up there, all these factors turned it into an endeavour in an endeavour. After more than two hours of hard work, we hardly even realized that the time had passed at that altitude. The call from base camp was providential: it's time to come down; you've been up there too long! Who can ever forget an experience like this with companions of that calibre? Special thanks go to the sherpas. Without them, we would never have achieved that scientific goal, with the instruments that they carried up there for us.



**Mario MERELLI**
seven years have gone by and it still feels like yesterday: one of the most wonderful expeditions of my career, it was the result of the work of a true group and a touch of good fortune that is always essential in those moments. If only I think of what happened the day before with our friends having just returned from those horrible conditions, I can hardly believe we had such a gorgeous sunny day to accompany us on our way to the summit. We were not even thinking of leaving immediately and attempting the summit; instead that favourable weather convinced us to get ready (eat early enough, rest as much as possible) and then go up, up until we reached the summit. After so much hard work, here we were ready again for a new undertaking: we hadn't finished yet because we still had the "fateful" surveying to do. We had run lots of tests even at medium altitude, but up there, it's a totally different story. Personally, I don't remember literally anything else about what we had tried to do: fortunately, base camp kept sending us helpful suggestions and lots of indications. In the end, the second priceless result of that wonderful day: helping reach - as mountaineers - an important scientific breakthrough. Not just as mountain climbers but exceptional collaborators of men of science. I will always be proud of this enormous accomplishment. The teamwork was terrific and fundamental with each person doing his part (a kind thought for our friend Karl who is no longer with us). We also saw people summit with business expeditions, just to take a photograph, while we stayed there to carry out our missions. And what a thrill when we read the message from President Ciampi. And finally, we received the order: come down, come down now, everything is ok. Finally we could descend to the base camp. We could not take it any more! And everything went well, perfectly in fact!

**Roberto MANDLER**
(geologist, coordinator of the setting up of the prototype georadar/GPS and responsible of the climbers' work at the Base Camp): I'll never forget the enormous stress all Prof. Poretti's collaborators felt when the new instruments (GPS) were turned on. This instruments had stayed at camp III for an entire day waiting (after the first attempt to summit) to be carried to the summit. That little light would not come on: what do we do now? Then Alex (Busca) yelled out: the steady led is back on! Now everything can continue safely with almost absolute certainty that the data will be effectively registered (even if we were sure of this only after returning to base camp). The second and more demanding job was getting along with the mountaineers on the summit. The work to be done - which wouldn't be simple even here on our European mountains - was significant and at that altitude…but all the members at the summit knuckled down to some hard work, accompanied by a gorgeous day, and after having positioned the instruments as requested in the best way possible, they took all the measurements that we expected them to do (staying over 2 1/2 hours at the summit). Our sirdar Serap Jangbu sherpa's contribution was fundamental, as he carried the instruments up as well as personally saw to it that an essential part of the instruments was situated to launch the initial set up for the surveys. A couple of anecdotes:.
* when Claudio (Bastrentaz) summited, he found a photograph of the Dalai Lama, the traditional Tibetan shawl and flags tied to a stake: they had been Benoit's during the EV-K2Cnr expedition of 1992; * for mere physical reasons, it was decided that the optical sight would be left at the summit (with the mirrors that served as finish line); our pole at the summit or part of it is still visible in many of the successive expedition images from 2005, 2006 and 2007;
* stones: for the first time, thanks to the initiative of our Sidar Sherpa, and the good fortune of being able to easily reach the rocky face at the summit, stones from the Everest peak were brought (as Nones would also do that year from K2) to us so they can be given to specialists for analyses that had never been done before.
* Summit and summit overflying: on that occasion, Angelo D'Arrigo (the great competitive aviator) flew over with his "Ala special Stratos" and succeeds in the historic undertaking of crossing Everest, reaching the top at 8900 metres of altitude.
* bare-handed at 8848 metres: the gorgeous day and a light breeze that accompanied the work of the mountaineers, allowed them to work at that height barehanded for a few minutes; in some of the videos we can see the ties on the trekking poles fluttering in this light wind. In conclusion, from a scientific viewpoint, it was a meaningful experience that was rich with professional and personal satisfactions. Contact with persons from different backgrounds whether for profession or personal interest, reality as seen from base camp (and the less pleasurable reality of failures and misfortunes); having achieved a scientific milestone which had been studied for so long, but which was linked to a series of unpredictable and unmanageable events (weather, men, luck, human choices, etc.) I have made this experience of mine available to anyone who is interested in a blog (still incomplete).
*http://www.sogestgeo.it/Ev-diario/Ev-diario.htm*

**Karl UNTERKIRCHER**
*great alpinist / scientific expedition.*
*He is a friend and excellent alpinist who also took the most impressive photographs and video on May,24 along with a "live" comment which remained incomparable.*
*As incomparable was his contribution to ensure success to this scientific experiment. And because he is no longer with us, but between "his eternal snow", we should not forget that, for Karl, 2004 was the year of a supreme record:in just three months, both Everest and K2.*
*He is still in the indelible memory of his fellows, in the memory of those friends who, step by step, followed him in his wonderful missions and have tried to describe them at best.*

*1992 The Italians and the Chinese*

# High altitude memories
## New measurements on Everest

By **GAIN PIETRO VERZA,** technical Manager of Ev-K2-CNR Committee

Autumn 1992, the Ev-K2-CNR Pyramid is now two years old and the various research projects are moving forward, including many in physiology under the guidance of Prof. Cerretelli. Thanks to the tireless efforts of Italian Prof. Poretti, the agreements with the Chinese have progressed and the joint measurement of Mount Everest becomes a reality.
Italian geodesists establish 3 measurement points in Nepalese territory and the Chinese 3 others in Tibetan territory; each of these points is connected geodetically with the others and also with the Nepalese and Chinese networks.
Simultaneously a determined mountaineering expedition is climbing the mountain, carrying an optic sight, laser reflectors and a dual frequency GPS receiver.
The measurements will be taken contemporaneously from the 6 points using the most advanced technologies:
* the optics of the theodolites and laser distance meters that guarantee 0.1 mm per kilometre precision and also require the use of weather balloon probes to assess the temperature, humidity and pressure profiles amongst the average 5000 metre height of the 6 points and the summit at almost 9000 metres.
* GPS radio signals received on the double frequencies of the precision geodetic receivers.
The toughest part of the operation? Not just climbing to the top of Mount Everest, but assembling the equipment and starting up the measurements, and as if that were not enough, weather must be good for clear visibility to the summit. In order for measurements to be precise, they must be taken in that very same instant simultaneously. Today, an operation of this nature would only require that we make a conference call chat with internet and coordination would be perfect. In 1992, we had a satellite terminal composed of two large 70 kg trunks that consumed half a kilowatt of energy and made an audio connection that cost 13 dollars a minute: the data connections were possible but very costly.
To coordinate activities with the Chinese, I set up short wave radio channels with 100 watt radios and in VHF with walkie-talkies; for that occasion, we installed a radio link over the Pyramid with the ambition of crossing the Himalayan chain with the force of a simple walkie-talkie.
The primary channels were the short wave channels and while we were waiting for the Chinese station to be activated, I ran back and forth between the Pyramid and base camp.
Finally the first signals arrived, but they were scarcely intelligible: the interference that is typical of short waves and the Chinese operator's English competed to keep us from understanding.
All we can do is change channels until we find one that is acceptable. But I am at the Base Camp and the radio is in the Pyramid. All we can do is operate the radio but the transmitter has around twenty controls and no one feels up to it. The only person able to follow my instructions exactly and give me correct feedback is Dr. Lenotti, the expedition's physician. And it works! The connection is made and I inaugurate a career of remote controlled operations.
The mountaineering expedition advances rigorously and my mountaineer colleagues and guides constantly improve their performances on the way to the Everest summit. I am recovering from a fracture at the end of June and after two months, I am only able to climb 300 metres; then my ankle gives way and my spirit with it. I try to concentrate on the technical aspects: a GPS on the summit of Everest must be made to work and everything must be perfect.
But I make an agreement with Everest: I will give my best to the highest point possible. Every morning I run up to 5300 and learn to breathe. If my legs are weak, at least my breathing will be strong.
We install the radio link. It is not one of those microscopic, computerised and coded objects that you use today. It is a simple, sturdy and resistant radio system made by an Italian company. The company no longer exists but the repeater still works!
The antenna is installed at 5600 metres, right above the Pyramid. The signal is perfect in all of upper Khumbu. One day, a raspy unrecognisable voice announces the attempt by the Chinese. We guide them with the powerful short wave radio and little by little we define the positions from which the connection is finally clear. We won't depend on the short wave radio any more and the researchers can speak directly with the mountaineers.

Days become increasingly intense and I have earned a place on the third team, the last in chronological order.
Agostino unleashes all of his experience and jointly with Poretti, comes up with an efficient strategy:
1) a team for transporting equipment to the summit
2) a team for measurement start up
3) a team for removing and returning everything.
Benoit Chamoux, the Frenchman who climbed K2 in 19 hours, is with us. He is a puny man who, when walking on the glacier, looks like he is gliding over the snow in incredible harmony with these mountains but unfortunately will be stopped on Kachenjonga, his 14th peak over 8000 metres. We honour him with a "chorten" above the Pyramid.
September 28, 1992, Benoit is on the first team and ascends with the materials up to the southern peak without oxygen. It becomes late and is dangerous to continue. The terrain between the southern peak (8750 m) and the peak is difficult and very exposed, with the wind dominating the ridge.
On September 29, Benoit ascends with oxygen and takes the materials to the Everest summit; he is accompanied by the second team composed of "fresh" mountaineers. The work of the first two teams, including the powerful Ragno di Lecco Lorenzo Mazzoleni who will stay on K2, makes it possible to start measuring.
On the peak, a tripod is mounted which will remain visible for many years and where the sherpas will fasten the prayer flags and a photograph of the Dalai Lama. Visibility is good and the six lasers of the measurement points reach Mount Everest.
Poretti is immortalized in an image in which he is gazing at the peak from the theodolite; Agostino is photographed in a joyous leap at the Base Camp.
I am laboriously climbing to South Col; after having given up the continuous ascent from camp 2, I stopped at Camp 3 with Marco Marmasse. The others were descending; those who had reached the summit were enthusiastic, the ones who had given up a little sad. Neither of us felt we would continue so we slipped into two tents at Camp 3 at 7400 m.
I met with Abele Blanc on South Col on the measuring day. Abele tried but was turned back; I suggested he try it with oxygen. Somebody has to go up and disassemble the installations since we are alone on South Col.
The next day, we start out at three o'clock from South Col. We summit at 9 and stay there for a half hour, then Abele suggests we descend. We load ourselves with the material but I stay another half hour on the summit alone, amazed by the mountain's height, the vastness of the Tibetan panorama and the closeness of the Nepalese villages. I imagined that 4 kilometres below at Pangboche, it was a day like any other and that they had continued to plant potatoes there.
Measuring Everest was a scientific event of worldwide prestige. It still remained undiscovered under the thickness of the snow cap. Where was the highest rock? And how much ice and snow covered it?
Only in 2004 did our expedition bring a georadar able to take this measurement, ascending this time from Tibet.
But down at the Pyramid, the Doris antenna remained active, the georeferencing system of the satellite system, that has been registering the movements of the earth's crust since then. The Doris antenna was linked to the geodetic measuring points on Mount Everest.
Now when I look at it, I think of its 40 cm movement NE and the 3 centimetres it has moved upward and once more I feel the force and energy of these mountains that rise up in a few dozen kilometres from the forest to reach the earth's apex.

# Ardito Desio and Mount Everest

By **CLAUDIO SMIRAGLIA**, University of Milan, Ev-K2-CNR Committee, italian glaciology commissioin

Comparing Ardito Desio and Mount Everest may seem somewhat strange. Desio never carried out specific studies in the region where the world's tallest mountain is located. His reputation, not only as a scientific researcher but moreover as explorer, is also linked by an "amateur" audience, to the victorious expedition to K2", the highest peak in the Karakorum range and second highest on our planet, which he organised and lead in 1954.
Desio was clearly not immune to Everest's attraction; we need only recall his words in 1953 when he spotted it together with Kanchenjunga, even if from a distance: *"What immense joy I feel! It was the same joy I felt when I conquered the first summits of my youth. They were the peaks of my youthful and adult dreams, peaks where my imagination and reading had taken me so many times before. I simply could not get my fill of those two sublime mountains".*
However, destiny did not take him in the years to come into direct contact with the world's rooftop, despite the fact that his travels and explorations ranged from Hindu Kush, Burma, Ethiopia, and the Philippines, to the central Himalayas, Tibet, South America and Antarctica. An unexpected event occurred in 1987 which connected a ninety-year old Desio and Chomolungma, the Tibetan name for Everest. In early March of that year, the New York Times reported that K2 was the world's tallest mountain, topping Everest by 11 metres, news that was immediately picked up by newspapers and Italian television. The new surveys had been conducted by Prof. George Wallerstein, professor of astronomy at the University of Washington, using the new Global Positioning System (GPS) topographical instruments that were starting to be diffused then. The news aroused immediate interest, yet not without some doubts on the part of those who had guided the Italians to the first successful ascent on what had always been considered the second highest mountain on earth. His experience and rationality as scientist and explorer made him believe that before revolutionising the hierarchy of the planet's two highest mountains, a consolidated fact for almost a century and a half, it was necessary to measure both mountains with the same instruments. Desio had already reached an age where normal people avoid jumping into new and exhausting initiatives. But Desio was not a normal person, and once more he reconfirmed those qualities that had distinguished him most: creativity, decisiveness, and the ability to find the right person for every undertaking. What he was able to accomplish in so little time was miraculous, as those who organise mountaineering or scientific missions in those distant regions know perfectly well. The expedition destined to re-survey Everest and K2 was organised in a month, with financial backing from the National Research Council, then chaired by Prof. Luigi Rossi Bernardi, with logistical assistance from mountaineer Agostino Da Polenza, who only a few years before had made a second Italian ascent on K2, and with the collaboration of Prof. Alessandro Caporali from the University of Padua for the scientific-operational sector. Battling the various forms of bureaucracy, a raging monsoon, and physical problems due to high altitudes, in a week's time Everest was re-measured with GPS and theodolites. The mission continued uninterrupted to K2, where logistic-political problems were intensifying. Only the security of Desio's presence in Islamabad liberated the situation, allowing researchers to continue toward the Concordia Cirque. Once more, all the required surveying was completed after an intense week of work. The gathered data was processed and proved, beyond a shadow of a doubt, that Everest is the world's tallest mountain and K2 is "only" second. But this was only the beginning of Ardito Desio's scientific and organisational "second childhood". The foundations had already been laid for the Ev-K2-CNR Scientific Research Programme during the rousing events of the 1987 expedition. The missions come one after the other, always coordinated on scientific levels by a rejuvenated Prof. Desio. They reached their apex with the realisation of the Pyramid-Laboratory which would become the base for a complex multidisciplinary scientific programme.
But this enterprise also was not free from difficulties and set-backs. The initial project for locating it on Everest's Chinese side was stalled by unforeseen political problems. With his usual promptness in decision making, Desio transferred all the activities to the Nepalese side. Despite environmental difficulties, the world's highest scientific laboratory became reality in 1990 and began to receive the first researchers, physiologists in particular. The official inauguration took place in October of the same year. Ardito Desio simply could not miss it. Neither his 93 years of age, or a 90-minute helicopter trip from 1300 to 5000 metres could diminish his enthusiasm, which would continue until his death at the age of 104 exactly ten years ago. The Pyramid at the feet of Mount Everest dedicated to him, physically sealed this union between the world's tallest mountain and the "K2 scientist", while his message continues to live on in the new scientific missions which see the Himalayan and Karakorum highlands as a privileged place of enthralling research.

## Ev-K2-CNR

# Everest “live”

*An eye on the Roof of The Word*

By **FRANCESCA STEFFANONI**

Since the last month of May, everybody can watch Mount Everest “live” on the web, with high resolution images.

This is possible thanks to the new webcam installed by Ev-K2-CNR on the top of Kala Patthar, which offers the best panoramic view on the summit of the highest mountain in the world.

This is the nearest webcam to Everest: it’s installed only 11 km far from the mountain.

The installation was performed within the 2011 Share Everest expedition promoted by Ev-K2-CNR and falls within the collaboration between EvK2CNR, the Nepal Academy of Science and Technology (NAST) and Department of Hydrology and Meteorology (Dhm), approved during the Bilateral technical committee of March, 24 2011.

The webcam is active only with daylight, almost between 6 am and 18 pm, Nepali time zone.

The installation of the webcam was performed by the Ev-K2-CNR Italian and Nepalese technicians, coordinated by Giampietro Verza : "We have been working for months on tests and preparation, and finally we completed the last step.

Installing the Mobotix webcam is a great result that has led us to a new record: the highest webcam in the world.
Some years ago there was a webcam showing Everest at the Syangboche Everest View Hotel, but it was more than 30 km far from the mountain. Ours is only 11 km far from Everest".

"The greatest difficulties were those related to connectivity and WiFi – Verza explains -. We had to set up radio links and repeaters to ensure the connection from Kala Patthar to the Pyramid Laboratory.

At 5000 m sockets are not easy to find! It was a good teamwork with our Nepali staff.

As soon as they understood the goal of this operation, they got enthusiastic.

When the link was activated, and we saw on our screens show the grandeur of Everest, there was a wave of emotion!"

The Everest webcam was installed within the 2011 Share Everest expedition, sponsored by Ev-K2-CNR and aimed to restore the world's highest weather station, the Share Everest South Col (8000 m).

The webcam is located on the summit of Kala Patthar, on the same ridge of a weather station that will receive data directly from the Share Aws South Col.

Data and images collected in Kala Patthar are suddenly transmitted to the Pyramid Laboratory, which stands at 5050 meters in the Khumbu valley, and is managed by Ev-K2-CNR in collaboration with NAST.

# “Inside the Research”

***Discovering the hearth of the Pyramid International Laboratory/Observatory***

*The Pyramid is divided into three levels, which are used for the following purposes.*
*On the first level there are services for common use, laboratories, warehouses and swithchboards, divided as follows:*

- *Two large laboratories, equipped with: decomposable and dismantled sectors, provided with canalizations for power supply, panels for the tools connection and lighting, custom-made metal dismountable containers, pliable metal chairs;*
- *Section dedicated to chemical analysis with: deionizer, high purity production system, samples manipulation device in controlled atmosphere as well as the normal equipment of a chemical laboratory;*
- *Bathroom premises complete with WC, sink, shower;*
- *Common use/meetings premises equipped with: metal structure tables made of dismountable and the second level is composed of three medium sized laboratories completely separated among them, a first aid room against mountain sickness and toilets*

*It is furnished with laboratory tables, chairs, lockers, containers of various material, hyperbaric chamber, oxygen concentrator and complete transportable set of oxygen bottle, regulator and mask.*
*The third one is dedicated to data processing, telecommunications, and to the management, it is however furnished with a tool supporting table, metal support containers, chairs.*

*Inside the Pyramid you have at your disposal several instruments and services:*

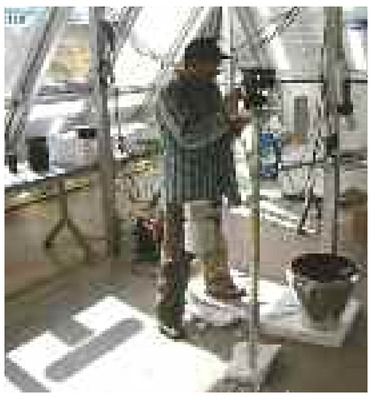
***ELECTRICITY***
*Main photovoltaic system*
- *Pyramid section*
- *Lodge section*
- *Auxiliary services section*

***COMMUNICATIONS***
**HF Radio** *(for communications on national level, including the aircraft ones)*
*- VHF Radio*
- *Walkie talkies*
- *Radio link (covering up to Namche Bazar)*
- *Fixed bases (one in the Pyramid, the others, in the countryside, for the operations)*

*- Telephone/ satellite modem*
- *IP telephone (internal switchboard ME)*
- *satellite mobile phones*
- *telephones/portable satellite modem*

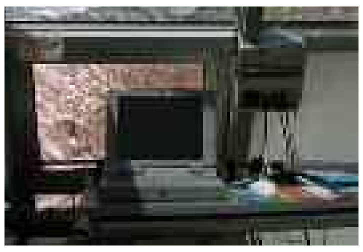
*- Satellite Terminal VSAT*
- *Internet connection*
- *Data connection*
- *Videoconference*

***SECURITY***
*- First aid*
*- Pharmacy*
*- Oxygen concentrator, hyperbaric chamber, portable oxygen set with mask*
*- Dismantled stretcher for transport on difficult ground*
*- Injured immobilization set*
*- Alpine material aid set*



***TECHNICAL SERVICES***
*- Electric laboratory*
*- Electronic laboratory*
*- Photovoltaic alimentation set for countryside works (Photovoltaic with AC erogation)*
*- Field broadband internet connectivity set*
*- “Virtual presence set”: rucksack which allows to make an AV connection via satellite with a local fiel operator*
*- Broadcast live set: rucksack which allows to broadcast live via field satellite*
*- Transportable set for long distance VHF / HF communications*

***LOGISTIC SERVICES***
*Base camp and research fields set*
- *Tents*
- *Mattresses*
- *Rucksacks*
- *Alpine material*
- *High altitude clothing*



***IT SERVICES***
*-Networks*
- *Internal laboratory LAN*
- *Public IP network*

*- Computer*
- *desktop*
- *notebook*
- *server*

*- Printers*
*- Wireless access*
*- Internet access and variable band*

***RESEARCH SERVICES***
*- Local weather stations*
*- ABC station web cam*
*- GPS Master station (not working at the moment)*
*- Doris station for ground movement measurements*
*- Seismic station (to be shortly re-installed)*
*- Chemical analysis laboratory*
- *Very pure water*
- *High cleaning room (samples manufacturing)*
- *Chemical laboratory equipment*

***HOTEL SERVICES***
*- High level service lodge*
- *Kitchen with Italian food*
- *Dining room with satellite TV*
- *2-3-4 places rooms*
- *sanitary services - showers*
- *Hot water +solar energy heating*

GLACIERS&CLIMAT

# Everest: glaciers, water, climate

## *The challenge of the future*

By **CLAUDIO SMIRAGLIA**, University of Milano, Ev-K2-CNR Commitee, Italian Glaciology Commission

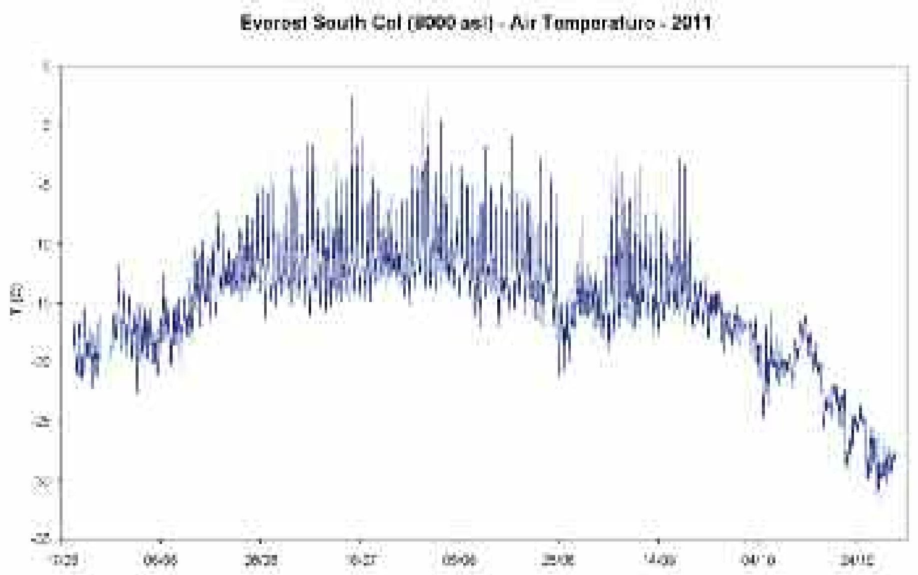
Mount Everest is not only the world's tallest mountain but is an important glacier junction.
Its slopes are indeed covered with imposing icefalls, of which the most interesting from a scientific, landscape and tourism standpoint are the glaciers Khumbu (12 km long, 45 km2of surface area) on the Nepalese side and Rongbuk (20 km long, 85 km2 of surface area) on the Tibetan side. Both are well-known and often visited as they host the base camps of numerous expeditions heading toward the "world's rooftop".
In reality, from the adjoining ridge that runs from Chumbu (west of Pumori) to Shartse (east of Lhotse), many series of less known and less visited glacier structures descend, and in some cases even larger ones, such as Barun or Khangshung.
Everest's glaciers have the typological and classical morphological features of Himalayan glaciers: long sublevel tongues that often connect to upper feed basins with imposing seracs such as the renowned Khumbu icefall; collecting basins with relatively small surfaces compared to the overall size of the structures, beneath high and extensive rock and ice faces; they are mainly fed by monsoon precipitation, but derive at least two-thirds from avalanches, and especially a detrital cover that covers the surface of the tongues with thicknesses in the lower part that can reach several metres and where lakes and ice cliffs are found.
Perhaps this last landscape feature is the most obvious and important regarding the ongoing evolution of these glaciers in relation to climatic dynamics. When the detrital cover exceeds the threshold level of a few centimetres, it modifies the energy exchanges between ice and the atmosphere, practically reducing melting.
The evolution of some of these glaciers has long been studied with terrain surveying and remote sensing techniques (including the initial works by the Swiss, the Japanese who have a long tradition of research on Khumbu, followed by the Germans, French and Italians, the latter in the framework of the PAPRIKA project coordinated by the Ev-K2-CNR commission).
The aims of these research projects are numerous and reflect the climatic complexity of this region and its difficult accessibility.
In particular, the greatest challenges yet to be faced are those of exactly determining the evolutionary state of these glaciers in relation to other Himalayan regions, identifying the connection with the climatic dynamics in progress, quantitatively establishing the magnitude of the water resources they possess, verifying the effective influence of new ablation agents that were recently discovered have on them such as black carbon, underscoring the risk factors they represent (in particular, the overflow of supra-glacial lakes), and engineering response and survival times.
As per their evolution in progress, it has been established that the variations in length and surface are relatively reduced compared to what is happening in the Alps (in the last fifty years, the overall area of Everest's glaciers has decreased by 5%, whereas the surface that is free of detritus has dropped by 10%); the reduction in thickness has intensified at rates of over 1.5 metres yearly in the transition strip between the sector covered by detritus and

that which is not, that is to say, between the glacier's inactive (stagnant) and active sectors.
This increase in thickness reduction has been accompanied and caused by the expansion of the supra-glacial lakes which have in some instances, such as with Imja lake at the feet of Lhotse mountain which from the middle of the last century to the present has grown to gigantic and disturbing proportions (its depth exceeds 100 m.).
Taking into account these high rates of thickness reduction, patterns indicate the possibility that within a century, the majority of the tongues of Everest's glacier could disappear; this phenomenon will be preceded by the formation of large lacustrian basins and fragmentation of the tongues into two distinctly separate sections: one with stagnant ice covered by detritus and one with active ice.
There are many unsolved problems in particular on planning and application levels. In order to face them (and begin solving them), researchers from the various countries must be coordinated, as Prime Minister of India Manmohan Singh suggested in 1999: "We have to recognise the need for much greater engagement and coordination with all our neighbours which share the Himalayas

# Everest: the environmental climate monitoring roof

By **PAOLO BOANSONI**, SHARE Project, Isac-CNR scientific director

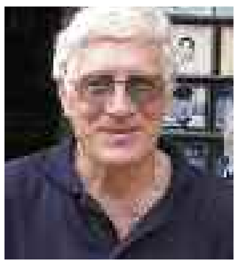
Life in the most populated regions on the Earth, like India and China, in addition to be influenced by dizzying industrial growth and energy demands that exponentially increase with the growing needs for mobility and intensification of transport, cannot help but being affected by the climatic influence that the Himalayan mountain chain and nearby Tibetan Plateau are able to exert. The large mountain chain dominated by the highest peak on the planet, Everest, thermally and dynamically affects atmospheric circulation and, consequently, the Asian continent's monsoon cycle.
This monsoon cycle promotes the intensification of the winds that Arabian navigators exploited to ease navigation to India and the Asian continent in the summer, and to the East African coasts in the winter.
Thus the Arabic word "mausim", "season", was used to indicate these winds that were associated with heavy rains in the summer. The monsoon rains combined with the Himalayan glaciers feed the large Asian rivers including, to the South, the Brahmaputra and the Ganges providing the precious resource of water.
Lately the monsoon cycle and Himalayan glaciers have been negatively influenced by increasing pollutant and greenhouse gas emissions that thus contribute in heightening worries over the already precarious climatic and environmental safety conditions.
To better understand and study the phenomena tied to atmospheric pollution and climate changes, at the beginning of 2006, operating within SHARE (Stations at High Altitude for Research on the Environment) for EvK2-CNR and ABC (Atmospheric Brown Clouds) for UNEP (United Nations Environmental Program), near the Pyramid at 5,079 metres above sea level, the Nepal Climate Observatory at Pyramid began to take the first readings on the composition of the atmosphere in the spring of the same year. Since then, this laboratory, which has become the Global Atmospheric Watch program Global Station for the World Meteorology Organization (WMO), is an irreplaceable "sentry" able to assess the health conditions of the atmosphere in the Himalayans. Studies conducted in these years by researchers from the Institute of Science of the Atmosphere and Climate of the CNR, CNRS, University of Urbino and Ev-K2-CNR Commitee at the foot of Everest have proven that pollutants reach Everest and the Himalayan glaciers via the Khumbu valley in the period that precedes monsoons.
The valley acts as a "fast track" to transport high concentrations of pollutants from a gigantic cloud that covers Southern Asia called the Atmospheric Brown Cloud. The Khumbu valley winds from the foothills south of Everest, in the eastern Himalayans, and from the Ice Fall into Nepal for about 50 kilometres to the village of Lukla, 2,800 metres above sea level which, with its airport "wedged" in the mountain, is the gates to Everest climbing expeditions.
This long valley, running South to North, is one of the main routes that alpine expeditions cross to reach the Everest Base Camp and, from here, to climb the highest peak on the planet called Chomolangma (Mother of the universe) by the Tibetans, Qomolangma by the Chinese and Sagaramāthā (God of the Sky) by the Nepalese. However, this same route is one of the many that the monsoon air masses follow during the summer and pollutants follow during the pre-monsoon period to then rise up the Himalayan chain.
To better understand the atmospheric circulation in the Khumbu valley, meteorological measures were recently taken at 8,000 m altitude, at Everest's South Col under the SHARE project.




These are the only continuous observations currently conducted by a ground station at this height and, for example, the temperature variations read at altitude 8,000 m (see illustration) and the thermal response to the monsoon cycle always rouse particular interest.
This privileged observation point near the peak of Everest is only the latest and highest of those found in the SHARE network in the Khumbu valley: Changri Nup (5,700 m), Kala Patthar (5,600 m), NCO-P (5,079 m), Pyramid (5,050 m), Pheriche (4,700 m), Namche (3,500 m) and Lukla (2.660 ml) contribute to furthering studies on atmospheric circulation and the application of appropriate simulation models.
Research and observations in these areas thus essentially aim to better understand the climate and atmospheric circulation and fine-tune new simulation models that can provide precious information and forecasts on the climate and more.
In fact, in commemoration of the dramatic climb of May 10, 1996, when a violent and freezing snow storm with winds over 100 kilometres per hour enveloped Mount Everest, surprising four expeditions and killing nine climbers, these studies are and will also be focused on providing climbers with better forecasts on "what the weather's like" at the Top of the world.

# MEASUREMENTS

## Our conclusion



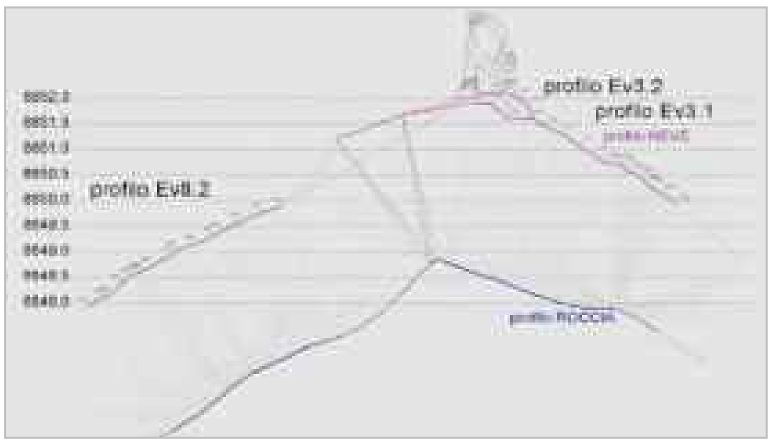
*In order to achieve a milestone on the long history of Everest measurement it's essential to refer to specific scientific and historic elements. The Ev-K2-CNR Committee may only substantially draw on an important relationship that, on this topic, has represented a virtuous approach to our goal: setting, from a scientific point of view, the height of the Earth's highest mountain, both covered by a layer of snow, and, above all, the rock forming the actual mountain.*
*The article by Professor. Giorgio Poretti, Roberto Mandler and other* ***"The height of mountains. May 24 2004: a new measure of the height of Mount Everest "*** *(published in the Proceedings of the CNR conference "K2 fifty years after scientific research in extreme environments"-*
*December 2004 - ed. Il Veltro no.1- 3 - 2005, and in some important international journals over the years 2005 and 2006) gathers the experience of the team involved in the measurement, which also included the topographer Gino De Min, Andrea Zille and Marco Manzoni. In the following summary, other elements of assessment will be provided in favour of those who wish to update themselves on this topic through this "special edition".*

*May 24, 2004:*
***A new measure of the height of Mount Everest***
*In recent years it was frequent to hear about the re-measurement of some of the most famous mountains of Alps and Himalayas, with values that, despite the millimetre accuracy of the instruments employed, showed sometimes differences of a couple of meters. Therefore which are the variables playing such an important role in these measurements and how should they be evaluated in the calculation of the mountain height? The height of a mountain is determined by three main factors. The first factor is related to the presence of snow on the summit. This varies from season to season and from year to year with a variation that exceeds a metre between spring and autumn. The second factor depends on the accuracy of the elevation of the points in the valley from which the measurements are performed.*
*The third factor is given by the sea level that would be considered under the summit if the water could move freely under continents, and therefore from the tide gauge taken as a reference.*
*If the Italian and the Swiss measurement shave a constant difference of about 20 centimetres, it is straightforward to imagine how greater may be the difference between the Chinese and the Nepalese side of Mount Everest which refer respectively to the mareograph of Quingtao on the Yellow Sea and of Karachi on the Indian Ocean, that are located at a distance of more than 6000 km. However, this difference was reduced over the years by means of more precise and dense leveling networks and it is shown by the leveling differences of the border points.*

***New determinations of the geoid under the Everest summit***
*Satellite measurements obtained by GPS receivers or DORIS stations provide the coordinates of the Earth point with reference to its geometric surface, an ellipsoid defined by internationally recognised parameters.*
*On the other hand, the measurements of height are referred to the "mean sea level" that is approximated by another surface, the geoid, that represents an equipotential surface on which seas and oceans would lie down if they were homogeneous, at a constant temperature and not disturbed by atmospheric factors. In 1992, when researchers from the EV-K2-CNR Committee, in collaboration with the National Bureau of Surveying and Mapping, Beijing, carried out the measurement of Mount Everest height, the difference between ellipsoid and geoid was calculated, from the Chinese side, as -25.14 meters. Later on, in 1996 the new geoid EGM96 showed the value of -27.3 metres while in 1999 a new calculation, from the Chinese side, rose to - -26.2 metres. The 1999 measure was referring to the new value of -28.74 metres. Adding this value to that of 8821,09 metres of the ellipsoidal height, the value of 8849,82 metres is obtained that is then rounded to 8,850 meters.*
*The value that would have been obtained from the Italian-Chinese measurement of 1992 would have been 8852.25 m and therefore significantly larger. This difference was explained by the fact that the snow covering on the summit had been eroded by the strong winter winds. The values of the Everest height may then be compared with reference to the snow surface and as a function of the N separation between geoid and ellipsoid.* ***It is thus evident that the changes in the Mount Everest height, in the last decades, are mainly due to the variation in the snow cover and to different separation values between geoid and ellipsoid.***
*It is therefore necessary that any comparisons between mountains elevations would have to be carried out using an internationally recognised reference system such as the ITRS (International Terrestrial Reference System).*
*To achieve a definitive measure* ***it must also be agreed that the height has to be measured with respect to the rock surface*** *making an indisputable measure of the snow cover depth.*
*For the determination of the snow depth on the mountains summit a new technologically advanced instrument was designed. It is a portable georadar (GPR - Ground Penetrating Radar) coupled with a GPS. This instrument was used for the first time in the framework of "K2 2004 - 50 Years Later " expeditions both on Everest in May 2004 and on K2 in July 2004. In the hours immediately before the measurements on the Mount Everest summit, some points of observation and measurement in the area of Base Camp, were arranged.*
*One point, for the classical measurement with theodolite and distance meter, was located at the confluence between the two glaciers that descend from the north face of Mount Everest (Rongbuk and East Rongbuk). Nearby a Leica GPS SR530 was installed with data recording every second. Another Leica GPS 300 double frequency receiver was placed on the trigonometric and leveling benchmark of the Chinese GPS network present in the Base Camp area.*
*A further reference point was the permanent GPS station at the Ev-K2-CNR Committee Pyramid Laboratory located in Nepal in the Khumbu Valley.*
*These points are taken into account in the global processing with the aim of geographically framing those points found on the summit by providing a benchmark of known coordinates.*
*The elaborations related to heights have taken into account the data collected along the profiles, those from the fixed station at the rock outcropping and those recorded at some measuring stations present in the surrounding area, including also the permanent GPS station at the Ev-K2-CNR Committee Pyramid Laboratory in Nepal. The IGS (International GPS System) located in Lhasa allowed, other than providing data, to appropriately frame the coordinates of the mountain summit in the ITRS system. From the analysis of the snow and the rock surfaces obtained from the processing of the radar profiles, a general thickening of the snow layer on the summit crest is observed, with maximum snow thicknesses between 285-370 cm, in particular along the profiles 1, 2, 3 that involve most directly the snow top of the summit. Therefore, to model the rock surface, one should consider a pencil of spheres, whose centres are located on the snow surface and whose radius change with the depth of the snow measured every tenth of a second.*
*The envelope surface fitting this pencil of spheres represents the rock profile for the points of which the coordinates are consequently recalculated.*
*Summarising, this data and the previous considerations in Table 4,* ***it may be concluded that the elevation of the snow was calculated at 8852.12 meters while the elevation with respect to the rock turns out to be 8848.82 meters.***
*The comparison with data gathered in 1992, when the snow depth measured with an avalanche probe on the highest point, turned out to be 2.55 meters (Beinat et al., 1993), is interesting. As an average of the classical and satellite measurements a value for the ellipsoid height, very close to the actual one, was obtained (with a difference of 13 cm) despite differences in the season.*
*Therefore the largest divergence was in the value geoidal undulation, which differed by 2.60 meters from the current one. The coordinates of the snow summit were determined from the GPS recordings. The coordinates of the rock summit were estimated estimated digitising the interpolation surface digitising of the interpolation surface.*

***Specific and global error in the measurement***
*A very important component in the estimation of the Mountain's height is the assessment of a probable error in the coordinates and elevation calculation. Errors in the GPS measurements on the base triangle, between Base Camp and the permanent station, from the permanent station to the georadar and in the georadar measurement must be taken into account. Moreover, the error of interpolation with polynomial best-fit must be considered too. The total error can be estimated at 0.23 m neglecting the intrinsic error of the IGS station in Lhasa and of the EGM96 Geoid.* ***The elevation of the snow summit of Mount Everest may be defined as 8852.12 ±0.12 m a.s.l. while that of the rock summit as 8848.82 ±0,23 m a.s.l.***
***For the Chinese Geoid the values are 3.6 metres lower. Snow: 8848.52 m; rock: 8845.22±0.23m a.s.l...***

***Conclusions***
***Classical and satellite instruments used in the measurement of the mountain height have become ever more sophisticated and accurate****, allowing to measure the snow depth in correspondence of the snow summit and in the surrounding areas. The instrument employed, a georadar coupled with a GPS provided the coordinates and the snow depth along 8 profiles on the Mount Everest summit.* ***This allowed to reconstruct the snow summit and the rock summit and to differentiate between the height of a mountain "on the snow" or "on the rock".***




Continued from front page Research and cooperation in Nepal

...Kush-Karakorum-Himalaya (HKKH) region.
The next year, in 1990, by Desio himself (at the age of 93), inaugurated Ev-K2-CNR's innovative Pyramid International Laboratory/Observatory at 5,050 m a.s.l. in Nepal, built with approval of the Government of Nepal and with the collaboration of the Nepal Academy of Science and Technology at that time RONAST.

Since 1990 over 520 scientific missions went to the Pyramid Laboratory/Observatory.

**1987**: - The Project Ev-K2-CNR was born.
- Makalu Expedition, environmental and toxicological research in remote areas.

**1989**: - The "Committee Ev-K2-CNR" founded.
- Observation of the Himalayan Thar and others ungulate of the Sagarmatha National Park.

**1990**: - Installation of the Pyramid Laboratory - Observatory.
- Human Factor Project - investigations on the modifications of psychological variables condition of hypoxia.
- Activities geographical and ethnological in the southern Tibet.
- 1991: Installation of the seismic station at the Laboratory Pyramid.
- Human Geography and ethnographic.
- The material and spiritual culture of the people of Kangchenjunga.
- Evaluations of the changes of respiratory function and bronchial Hyperactivity aspecific.
- Geodynamic evolution of the highest peaks of the Himalayan chain: Everest and K2.

**1992**: - Scientific expedition "Everest 92" - remeasurement of the summit with GPS and laser technologies.
- Qualitative study of water resources of the upper valley of Khumbu.
- High altitude cognitive disorders.
- Influence of human activities on biogeochemical cycles in remote areas.

**1993**: - Environmental investigation on the pollution in remote areas and high altitudes.
- Fractional limitation of maximal aerobic power in normoxia and hypoxia.
- Identification of useful variations and of the study of the glaciers of the region of the Everest (Nepal and China).

**1994**: - Territorial informative system of the Khumbu Valley.
- Scientific expedition "Extreme Altitude Survival Test (EAST) '94" – physiological investigations up to 6,500 m on Everest.

**1995**: - Construction of loft housing in the Pyramid.
- Physiopathology at high altitude: telemedicine from remote regions.
- Study of the evolutive and environmental phenomena, and of quality water resources.
- Atmospheric physics and chemistry.
- Geology, geophysics.
- Wildlife and Flora of the Himalayan region - Plant genetic resources.
- 1996: Test of telemedicine Cardiological on nine participants at a trekking.
- Study of the glaciers of the Everest as contribution to the knowledge of the climatic and environmental evolution.

**1997**: - Project E.A.S.T. Lhotse (Extreme Altitude Survival Test), physiological investigations up to 7600 m.
- Physics and chemistry of the atmosphere.
- The first remeasurement of the geodetic network established by GPS measures between India, Nepal and Tibet.

**1998**: - Effect of the different respiratory patterns on the function autonomy, cardio respiratory and mental during the exposure to high altitude.
- Recent variations of Himalayan glaciers and relationship with the climate.

**1999**: - Project AER with the harvest of lichens in the National Park of Sagarmatha.
- Survey for the monitoring of glacier Changri Nup.
- Cultural and environmental changes in the park of Sagarmatha.

**2000**: - Studies on stress and the immune system as the effects of prolonged hyperbaricat hypoxia
- Myth, ritual and habitat in oriental Nepal.
- Protection of the environment and preservation of mountain cultures in the Sagarmatha (Mt. Everest) National Park, Nepal.
- Natural resource evaluation and suistainable development in Nepal: health, tourism and the environment.
- Study on the influence of meteo-climatic characteristics of the Himalayan area on the large-scale pollutants transport.
- Identification, characterization and exploitation of the genetic resources found in natural and agricultural vegetables at high altitude in Sagarmatha National Park and neighbouring areas
- Debris - covered glacier - rock glacier evolution in the upper Khumbu Valley and its climatic and environmental implications.
- Stress and immune system: effects of prolonged exposure to high altitude hypobaric hypoxia.
- Conservation of biodiversity: the large mammal community of modi watershed (Ghandrunk, Annapurna, Nepal).

**2001**: - Limnology and paleolimnology bodies of high altitude in Himalayas.
- Morphology and hydrochemistry of high altitude lakes of Sagarmatha National Park.

**2002**: - RATEAP project - installing a sampler for the study of particulate air pollution.
- Network of meteorological stations of the Pyramid Meteo Network.
- Installation of a station permanent GPS at the Pyramid Laboratory-Observatory.
- Projects of search and cooperation of Echo-Himal: Hospital of Tshome.
- Breath-hold diving at extreme altitude.
- Calculation of the earth geoid in the mountainous areas of the Himalayas, Karakorum, Andes and Alps.
- Tectonic collisional and post-collisional phases in the Himalayan chain.

**2003**: - Launch of SHARE Project (Stations High at Altitude for Research on the Environment).
- Launch of Partnership DSS-HKKH Project.
- Launch of Snow Leopard Project.

**2004**: - Characterization of the underwater UV climate in lakes from the Mt. Everest.
- Region and assessment of DNA damage levels and counteractive mechanisms (photorepair and photoprotection) in planktonic organisms.
- Nitrogen Content in Seasonal Snow Covers in the Himalayas as consequence of the Asian Brown Cloud – Preliminary Study of the Possibility of ReNOxification.
- Research DANPHE PROJECT-Direct Analysis of Nepalese Parks and High Ecosystems Environmental Management System for the Sagarmatha National Park.
- Study and the evaluation of environmental impact as a consequence of farming, zootechnical and tourist activity in the National Park of Sagarmatha (Himalayas).

**2005**: - Prediction of Periodic Breathing at High Altitude.
- Advanced Course of Mountain Medicine.

**2006**: - ABC Pyrmaid.
- Techniques course about Sherpa guide.
- Data collected by ABC Pyramid can be found online, in real time, thanks to a very high-tech.
- Effect of Yoga training in patients suffering from chronic obstructive pulmonary disease.
- Respiratory Health in High altitude residents exposed to indoor pollution.

**2007**: - Chemistry of high altitude wet deposition in central Asia as a tool for studying the long range transport of pollutants.
- Nitrogen dynamic in soil and surface waters of alpine ecosystems in the Sagarmatha (Mt. Everest) National Park.
- Impact of climate change in vegetation distribution in Sagarmatha National Park, Nepal.
- Installation of a broad band seismic station at the Pyramid International Laboratory-Observatory site on Mount Everest (Nepal)".

**2008**: - Expedition SHARE Everest: installation of the highest Weather station in the world (South Col 8.000 mASL).
- Mechanisms of Central Sleep Apnea At High Altitude.
- Demogenetic and demoecologic analysis of the Sherpa population.
- Habitat Use and Overlap of Himalayan Musk deer 'Moschus chrysogaster'.

**2009**: - Nano SHARE (first portable monitoring system) tests among Khumbu Valley.

**2010** :- Creation of the Himalayan Seed Bank.
- Integrating traditional and scientific knowledge for the development of medicinal plant sector in Khumbu region of Nepal.
- UV Photobiology of bacteria and zooplankton from lakes of the Everest Region.
- Study on the influence of meteo-climatic characteristics on glacial and aquatic environments in high altitude areas of the world.
- BAPHIM – BAckground and Polluted atmosphere in the HIMalaya.
- Conservation of biodiversity: the large mammal community and the structure of bird community of Sagarmatha National Park (Solu Khumbu, Nepal) – Vanishing Tracks on the Roof of the World.
-Mass, energy and hydrological balance of Mera-Naulek glacier – relation with climate and impact of soot carbon deposition on glacier melting.
- Study of primary colonisation and soil neogenesis mechanisms in deglaciating environments at high altitude and low latitude.
- Linking geological processes at various crustal levels in the Nepalese Himalaya.

**2011**:
- Expedition SHARE Everest 2011: installation of the highest webcam in the world: Everest live.
- Continuous meteorological observations and study of the mountain weather regimes in the Khumbu Valley, Nepal Himalayas.
- BAPHIM – BAckground and Polluted atmosphere in the HIMalaya.
- Cardiorespiratory health in high altitude residents exposed to indoor pollution.
- Installation of a Permanent GPS Station at the Pyramid International Laboratory-Observatory, Nepal.
- Landscape dynamics in Sagarmatha (Mount Everest) National Park, Nepal: Impacts on selected environmental services and adaptive capacities.

NEPAL

Mount Everest

## Nepal to re-measure Mount Everest .

Nepal has begun a new project to re-measure Mount Everest in an attempt to end confusion about the exact height of the world's tallest peak.

The official overall height of Everest, which straddles Nepal and China, is designated as 8,848 m a.s.l. (29,029ft).

The Nepali Ministry of Land Reform and Management has already begun the process for measuring the height of world's tallest peak.

The process will be completed within two years.
According to the deputy spokesperson at the ministry Gopal Giri, as measurement of the height should be taken from sea level and with the reference to the height of some other places, the process is expected to take that much time.

Nepal generally takes the height of Kolkata, a port in India, as sea level for the measurement, said Giri.

He further informed that the measurement of Namche, Taksindu and PK2 from sea level would be completed within the current fiscal year.

The measurement of the height of Sagarmatha is currently taking place in Udayapur.

Last year the two sides agreed that Mount Everest should be recognised as being 8,848m high.

But Nepal government spokesman Gopal Giri told AFP news agency that, during border talks between the two countries, Chinese officials often use the rock height of 8,844 metres.

"We have begun the measurement to clear this confusion. Now we have the technology and the resources, we can measure ourselves," Mr Giri said.

"This will be the first time the Nepal government has taken the mountain's height."

# This is Everest for us

*Inteview to Prof. **Surendra Raj Kafle**, Vice Chancellor of NAST (Nepal Academy of Science and Technology)*

*Prof. Kafle with at that time the CNR President Francesco Profumo, now Minister of Education, University and Research, during his last visit in Rome.*

***From a scientific point of view what does Mt. Everest represent for you and for your Academy ?***
The Himalaya encompasses gelogical history of about 40 million years, and the biological diversity depicts ecological succession since past. In the wake of proceeding global warming and its impacts, scientific studies in the region will help understand the pattern and intensity of climate change.

Mount Everest is a unique open laboratory in the world for scientific research on the areas such as Earth Science, Glaciology, Climate Change, Environmental Science, Human Physiology, Eco-system, Solar and other Radiations, etc.

***Which are the main projects/activities that NAST has carried out in Mt. Everest area ?***
Establishment of The International Pyramid Observatory Laboratory in Lobuche at 5050 asl and different research activities ranging from human physiology to climate change using the facilities available at the laboratory are being carried in joint collaboration.
A new project on Seed Bank is about to be launched in the joint collaboration of NAST and an Italian group, targeting the seeds in the Himalayan region.

***The Mt. Everest is the roof of the world; it is a symbol, a legend, not only for the Nepali people but for the whole world. The 2012 will be the tenth anniversary of the UN declaration of the international year of the Mountain, which increased the global awareness of the importance of mountains on different level.***
***The Nepal host one of the most beautiful and precious but at the same time fragile mountain range in the world. Which are the strategies that the Government and Institutions of Nepal has developed in order to preserve this heritage ?***
Mount Everest is definitely a world heritage to be protected for different reasons. However, no concerted efforts were made in Nepal in the past to establish it as a site of importance other than that for its scenic beauty and climbing for adventure.
But, in recent years many concerned GOs, NGOs, INGOs are being attracted towards the scientific research based on the facts and events occurring in the Himalayas of which Climate Change is of top priority.

In order to accommodate the local interests and address its actual environmental problems, also considering existing indigenous resource management practices, the existing practices of Sagarmatha (Mount Everest) National Park management were modified.
Thus the objectives of the present management plan have been to ensure the protection of the Park's wildlife, water and soil resources because of their national and international importance; but also to safeguard the interests of the Sherpa resident.

***The mountains can represent an incredible resource also in terms of economic development, I think to eco tourism as well as to a sustainable use of the natural resource and an implantation of the mountain agriculture products; what do you think about these aspects ?***
It is but obvious that majority of the visitors in the Mount Everest region are high mountain trekkers and climbers.
Some of them are also pilgrimage. Such tourism activities surely contribute to economic upliftment of the local people as it creates jobs for many in the area and brings economic activities. However, we should not undervalue the negative impacts of such touristic activities when not controlled.
Other than eco tourism and use of its natural and agricultural resources, our snow covered mountains can be developed into recreational sites for skiing and other high altitude as well as winter sports.
Apart from these different sectors of the Himalayas may be identified as open laboratory for multidisciplinary high altitude research and international research groups may be granted permission to go into those allocated areas to carry out research paying royalty to the Government of Nepal.

***Since twenty years NAST has been collaborating with EV-K2-CNR Committee; the two organizations jointly handle the International Pyramid Observatory Laboratory in Lobuche at 5050 asl on Mr. Everest, which will be the next steps in the framework of this Italian/Nepali collaborations ?***
Although the EV-K2-CNR is the project developed in Nepal as a joint collaboration of NAST and CNR, there is little presence of Nepalese experts in the research activities and the same is reflected in the publications made through the project.
NAST will now encourage more Nepalese Scientists and Technologists to be the part of the research team and make equal contribution as that made by Italian side so that we could share the intellectual property right equally in the days ahead.