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 aridflach 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.

Mount 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. Mountain expeditions to Mount Everest and on other "8000" Nepali peaks have certainly given impulse to the first official contacts to obtain authorization 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 (CNR).

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. Ardito 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 sportive 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, ecologically efficient technologies and environment management system.

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 reservoir of biodiversity, a treasure of traditions, cultures and cooperation. In this sense, the start of those investigations has been born.

In 1986 an Italian expedition explored the area of the Pyramid Laboratory, opening the way for other scientific and mountaineering missions 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...
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 PORETTE, 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 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 provided for Mount Everest an elevation of 8872 metres.

Since 1991 Dr. Bradford Washburn, the founder of the Boston Museum of Science and one of the founders of the National Geographical Society, attempted a new measurement of Mt. Everest, providing some commercial expedi-
Himalaya

A moving mountain chain

From Everest (1843) to present

by Gabriele Previtali

E
verest fully felt satisfied when he arrived with his triangulations at Dahr Dun on the Himalaya slopes in 1843. His life’s work was completed after 25 years. He had his observatory built in a near-by location, Kalianpur, to obtain accurate astronomical observations to complete a project that would certainly go down in history.

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 Kalianpa and Kalianpur (another observatory 180 km southward), the triangulation and astronomical measurements did not coincide. In fact, there was a difference of $5\,\pm\,2$ 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.

However, Pratt did not stop there, but considered 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 rate of $2,7\,\text{cm/yr}$, he calculated that the plumb line would have deviated by $27.85$ cm at Kalianpur, with a difference of $15\,\text{cm}$, almost triple the limit 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 heavier the emerging part, the deeper the submergence. Pratt’s only reply in the following years was to embrace Everest’s theory affirming in various writings that the lithosphere beneath those mountains had the same thickness as the plains but forced 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 et al. 1983).

It can be deducted 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, thus thrusting itself, contrary to what happened in the flanks. 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.

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 inter-teral 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 conclusions 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 with a different pattern 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 station, which can be reached by the geometric leveling lines linked to the Indian leveling network. This opportunity may one day link the summit point with the leveling lines bench mark near Base Camp. Another improvement can derive from a new GPS survey for the calculation of the depth of the snow under the summit crossed by a larger number of profiles.

As confirmation of the scarce attribution 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 term of topographic engineers (Verband Vermessungstechnik), 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, even the Pope would have been happy to mention our data).

Nor did we receive much acclaim in England; an article 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.
...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".

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.

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 meters 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.

1960
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 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. (29035 feet) for the first time.

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 -28,74 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 2000 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

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.
### 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 SOSTEG, the researchers of the University of Pisa 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 easy penetration signals in the snow and good resolution, it was also produced by IDS, in anticipation of a slow “snail’s pace” drilling and the availability of GPS positioning every 1 sec, pre-programmed to memorize 10 signals per second with 20MHz samples at 16 bits per signal, using industrial compact Flash Card-type memories of the industrial type (reliable option available at the time). 10 signal per-second sampling requires that a position string coming from the GPS component be inverted. For the latter, the final choice was a Leica MM421s 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 specially rechargeable lithium battery is used that is particularly resistant to low temperatures and may be used continuously for more than 7 hours.

### Measuring Equipment

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**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 memories. 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 technology that is on the cutting edge of electronic technology, weighing less than 4 kilos compared to the 20 kilos for georadars on the market at that time.

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**Deviation of Geoid from the idealized figure of the Earth**

(difference between the egm96 geoid and the WGS84 reference ellipsoid)

- Red areas are above the idealized ellipsoid.
- Blue areas are below.

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MEASUREMENTS

The importance of geodetic research

Prof. Desio’s tools
One more “lesson”

by GABRIELE PREVITALI

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 where the surroundings are not. The obvious answer is that they are higher and the higher they are, the nearer the snow, quite simply, 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 geographical 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 neighboring flatlands. It is therefore important to know their positions, masses and heights.

We must bear in mind that as height varies, so does the air density and pressure, the quantum and gravity which will cause the lift of an aircraft also varies. Therefore, passing over a mountain chain comes 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 geographical 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 been possible through the terrestrial ellipsoid to be defined as reference surfaces for flat coordinates.

The height of a mountain is a factor in determining the terrestrial grid and subsequently the topology of the sea, 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 of the substance of which the mountain masses surrounding them are made. One must keep in mind the challenging effect that mountains have on those who look at them from a distance as well as up close. It is a real challenge to climb and measure them with maximum precision, trying to do something optically 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.

I n tracing the surveying history of the world’s tallest mountain - MOUNT EVEREST - we can only consider the tools adopted by the “distinguished scientists who undertook this “arduous” and as of today, not totally complete endeavor. Even if our “player” never dealt directly with Chomo Lungma (the mother of the earth), we must honour the person who was the mainstem behind the EVK2-CNR Laboratory-Pyramidal which was always a fundamental landmark for our surveys and observations during our expeditions to Mount Everest.

In this remembrance of him, we will reproduce several images of the instruments that Prof. Desio used since the very beginning of his professional 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 of the scientist whose name is included in the history of the profession: Antonio Desio.

(*) Technical notes:
- It consisted of a small portable table (13x18x1 cm) suitable for expeditions. Devices for surveying, graphic and calculation applications were found in the mountains.

The surveying devices
- allowed directions and distances to be measured.
- the angle created by the local vertical
- were sent, after many years of practice by engineers and technicians, those with calculation applications assessed horizontal distances and altitude differences.

(a) Lens, thermometer, goniometer, rock pick, compasses and altimeters.
(b) The priceless Monticolo surveying device with personalised case and the professor’s name (*)

It was in the valley on the starting point of the expedition to Mount Everest and was manufactured by the Officina Galli in Florence.

Classical measuring

When the value of the elevation is determined by leveling at a benchmark near the Pyramid Laboratory, some caution must be taken into consideration, 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 region covered by the GPSs is as large 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.
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 governmental 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.

Everest is the debt of gratitude from us all from Ev-K2-CN towards this mountain and the institutions and population of Nepal and of the Nepali Himalayan valleys. We may summarize the results 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. Thousands 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 equaled again.
- **Tests and results of great scientific significance in the framework of the SHARE project (Stations at High Altitude for Research on the Environment)**, ob- tained 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 acro- bic capacity at high altitude**.

Records are many, strictly scientific but also regarding advanced technology, like the experience that, last May, allowed to head to Everest Lhotse – via South Col – Northeast Ridge.

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 indispensable 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, 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 - Peak XV
history & legends (and a few tall stories)

By GABRIELE PREVITALI

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 lights».

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 topographical map of Tibet published in Paris in 1733 bears the name "TSCHOUMOU—LANCMA"), which, according to the German explorers, who also discovered the Tibetan term: "CHINGOPAMARI." A toponymical 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, Sr 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 m) 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-M-

For the entire Western world, E V E R E S T was soon to be established and identified as the WORLD’S H I G H E S T MOUNTAIN (nowadays even the Chinese call the mountain Everest and the massif CHOMOLUNGMA).

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 moun tain 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 sign 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
The mount Sagaramatha or Chomolungma 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 behaviors, culture activities and religions 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 Tibetan border so we can see direct reflect with Tibetan religious and Tibetans Buddhism.

Among many historical and religious place, Khumba is also one of the most important place from a religious point of view. In These days Khumba is directly connected with westerns so they are not deadly religious but they believe on mountain god and pray everyday for a very auspicious day. World height summit is called Sagaramatha by the official authorities of Nepal and Chomolungma by the Tibetan 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 somewhere 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 shall Zang ma, meaning (fair blue-faced). I don’t know which mountain is this.

The 4th sister Chopen Drinzingma Mt Makalu.

The 5th sister Taker Drozangma (this mountain is in Khambu). 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 Rumbuk 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 Khumba my grand mother’s (just passed this year ago of 99) is Last people who escape from Rumbuk 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 herbs with rice and salt and clothes. But all other season they crave the stone with ritual and enlighten words. Like Don’t Kill animal (Alha sha saa ma hay), Om ahh hum (keep clean) and many long history on the stone, until these days you can see old stone carve up to Namxe 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 worshiping style. One is community based and one is individual. Community also be divide two parts, one by the groups of villagers and one is done by Monastery. Damjee, Manirmudu, Chokjen, Bumiyo, Nagnie, Yairchung, Kengur Tengayur rhouce, are example of annual ritual programme performed by villager. Lha chherok, Kurim, Kengur Shihlalak, Yum norhoeue, Serkim bulu, Youngap bulu, are example done at home. These are done at home on daily monthly or 3 monthly or bimanaal basis. Tibetan based Buddhism believes on reincarnations, Sherpa community is flower of Tibetan custom and culture so they deadly believe on previous and next life. Ritual performances (community or worship style is different on each monastery so below I submit information is based on Khumjung Gompa, Damjee: There are several saying about this festival some people says this is total offer to Guru Padmasambhava 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 damjee festival is celebrate very year on summer (between June & July) at Khumjung Namche Pangboche, Thame & Rimiung at same date. Forche and Lukla on same date (mid May – June) The Damjee festival is same but offering book is different.
The 1992 and 2004 expeditions

Measuring for “science and mountaineering”

By GABRIELE PREVITALI

The 1992 and 2004 expeditions to Everest were the culmination of a long process of preparation and planning. The potential doubt that the world’s highest mountain might not be Everest persisted. Prof. Desio to involve the CNR in a “re-survey” of the world’s highest peaks (Everest and K2). The new geodetic survey expedition led by Marco Lipizer at the intersection point for the advanced base camp, is the target to aim at for the traditional expeditions tasks. During the next decade other surveys followed with results that did not deviate much from the 1992 surveys. As the 50th anniversary of the K2 conquest by the Italian 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?

"K2 2004 – fifty years later"

The new geodetic and geophysical research project, which included two distinct and parallel lines, longitudinal to the crest, and crossed lines, transversal to the crest, with profiles on both slopes, in order to cross the rock crown covered by the snow. Our climbers work laboriously for almost two hours to make the geodetic 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, visible only 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 advanced fighting mission. It is necessary to open up operations as much as possible in order to reduce the time of extreme stress our climbers are now under. Ok, finished! You now go down, no, on the contrary you can’t... an unexpected request has come from Padua, sent by satellite directly from Italy, and I have to pass it to our heroes on the summit: a special message 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.

"Log my Book"

"In my memory is part of my story 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 receivers, one at 1200 m at the edge of the snow, where bedrock appears on the surface, 20 metres near to the summit. The geodolient is then activated, starts correctly, also with a preheating system, while a good gas signal is received. As the instrument is operating correctly, our climbers start with the first GPS profile in the direction of the summit, but suddenly they communicate that the GPS led is blinking.

"Giorgio and I, for a moment, felt real panic, but there was no reception. As the instrument is operating correctly, our climbers started the GPS. When on the walky-talky he read loud the words of the viewes: “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 measurement. The classical measurement was also rich of suspense 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. As the 50th anniversary of the K2 conquest by the Italian 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?"

Ev-K2-Cnr 1992

In 1990, the construction of the pyramid began, and it soon became inhabitable and autonomous. 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 the scientific surveying in the region north of 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 approximate due to the lack of electric power and environmental interferences."

"Every mountain has its own language, and it seems that the Sherpas of K2 are speaking a different one."

Prof. Giorgio Poretti, head of "Ev-K2-CNR" geodetic and geophysical research project 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 geodetic surveying, to let it fall along a maxima 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 peaks 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 to 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.
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 Bastrentaz, 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 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 characterizes 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 fantasy 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 complete yet because we still had the “fateful” surveying 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 price-less 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 - mountaineers and researchers - 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 bush: “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 bad out! Now everything can continue safely with 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 knocked down to some hard work, accompanied by a gorgeous day, and after having positioned the instruments was situated to launch the initial set up for the surveys. A couple of anecdotes:

* when Claudio (Bastrentaz) summit, he found a photo-graph of the Dalai Lama, the traditional Tibetan shawl and flags tied to a stake: they had been left by Alain Robert Manuhel VIPK2Cnr 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 down. These stones would also do that from K2 to K2; they can be given to specialists for analyses that had never been done before.

Summit and survey undertake: on that occasion, Angelo D’Artigis (the great companion and also the one that “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, al-lowed us to work at that height (still incomplete) for two 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 searched for so long, but which was linked to a series of unpredictable and unmanageable events (weather, men, luck, human choices, etc.) I have studied, in the memory of those friends who, step by step, followed him in his wonderful missions and have tried to describe them at best.

Roberto MANDLER

(geologist, coordinator of the setting up of the prototype geo-satellite 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 bad out! Now everything can continue safely with 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 knocked down to some hard work, accompanied by a gorgeous day, and after having positioned the instruments was situated to launch the initial set up for the surveys. A couple of anecdotes:

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http://www.sogestgeo.it/ Ev-diario/Ev-diario.htm
1992 The Italians and the Chinese

High altitude memories
New measurements on Everest

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

A

sum 1992, the Ev-K2-CNR Pyramid is now two years old and its data and advanced technologies are moving forward, including numerous achievements. The Pyramid has reached the full performance of its potential. This thanks to the tireless efforts of Italian scientists who, working with the Chinese have progressed and the joint measurement of Mount Everest becomes a reality. Italian geodesists establish 3 measures in 1400 meters. The Chinese 3 others in Tibetan territory; each of these measurements with the others and also with the Nepalese and Chinese networks. Simultaneously a determined mountain parking expedition is closed, and the presence of an optic sight, light refraction and a dual frequency GPS receiver. The 6720 meters is taken contemporaneously from the 6 points using the most advanced tech devices.

- the optics of the theodolites and laser distance meters that guarant

- the use of the weather balloon-pyramids to assess the temperature, humidity and pressure profiles amongst the average 5000 meters height and the summit at almost 9000 meters.
- GPS radio signals received on the double frequencies of the transmis

- geodetic georadar receivers.

The tougher the conditions of the operation? Not just climbing to the top of Mount Everest, but assembling the equipment, integrating the antennas and the measurements, and as if that were not enough, weather must be good for correct visibility of the peaks. In order for measurements to be precise, they must be taken in that very same instant simultaneously. Today, an operation of this nature would require us to assure the climate, temperature, humidity and pressure profiles amongst the average 5000 meters height and the summit at almost 9000 meters. We install the radio link. It is not only a medium coherence, computerised and coded objects they use today, but it's a simple, sturdy and reliable system made by an Italian company. The company no longer exists but the repeater still stands.

The antenna is in South Col; after having given up the continu

- the antenna was linked to the geodetic

South Col. We

- the thickness of the snow cap.

Doris antenna remained active, the measuring points on Mount Ever

- the official inauguration took place in October of the same year.

The missions come one after the other, always coordinated on

- In 2004 did our expedition bear a georadar from the top of the moun

- the Himalayan and Karakorum hi

- the security of Desio's presence in Isla

- the Himalayas, the central Himalayas, Tibet, South America and Antar

- the news aroused immediate interest, yet not wi

- the news was immediately picked up by newspapers and Italian tele

- the Himalayan and Karakorum hi

- the Himalayas, the central Himalayas, Tibet, South America and Antar

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- the Himalayas, the central Himalayas, Tibet, South America and Antar
**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 EvK2/CNR and Department of Hydrology and Meteorology (Dkmn), 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 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/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:

1. **On the first level there are services for common use**, laboratories, warehouses and switchboards, divided as follows:
   - Two large laboratories, equipped with: decomposable and dismantled sections, provided with canalization for power supply, panels for the tools connection and lighting, custom-made metal dismantled containers, pliable metal sheets.
   - 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 dismantlable 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 manometer.

   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
- Videocconference

### TECHNICAL SERVICES

- Electric laboratory
- Electronic laboratory
- Photovoltaic alimentation set for countryside works (Photovoltaic with AC retraction)
- Field broadband internet connectivity set
- “Virtual presence set”: rucksack which allows to make an AV connection via satellite with a local field 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

### 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

### 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
- Mobile satellite data stations
- GPS Master station (not working at the moment)
- Data station for ground movements measurement
- 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

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*Ev-K2-CNR*

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Everest: glaciers, water, climate
The challenge of the future
By CLAUDIO SMIRAGLIA, University of Milano, Ev-K2-CNR Committee, Italian Glaciology Commission

Mount Everest is not only the world’s tallest mountain but is an important glacier junction. Its slopes are indeed covered by imposing icefields, of which the most interesting from a scientific, landscape and tourism standpoint are the glaciers: Khumbu (12 km long, 45 km² 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 mass of the structures, beneath high and extensive rock and ice faces; they are mainly fed by monsoon precipitation, but derive at least two-thirds of their water from the monsoon cycle 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 is their connection to climatic dynamics. When the detrital cover exceeds the threshold level of a few centimetres, it modifies the energy exchange between ice and the atmosphere, practically reducing melting.

The evolution of some of these glaciers has long been studied with 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 PA-PRKA project coordinated by the Ev-K2-CNR commission). The aims of these research projects are to understand the climatic and topographic 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 recently discovered have on them such as black carbon, under-scoring the risk factors they represent (in particular, the overflow of supra-glacial lakes), and engineering response and survival times. As 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 Alp (in the last fifty years, the overall area of Everest’s glaciers has decreased by 9%, whereas the surface that is free of detritus has dropped by 10%); the reduction in thickness has intensified at rates of 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 has seen the present to grow 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 lacustrine basins and fragmentation of the tongues into 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 recognize the need for much greater engagement and coordination with all our neighbours which share the Himalayas.

Everest: the environmental climate monitoring roof
By PAOLO BOASONGI, SHARE Project, Isaac-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 Ev-K2-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 a member of the 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 Himalayas. 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 Committee 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 gigantic cloud that covers Southern Asia called the Atmospheric Brown Cloud. The Khumbu valley winds from the foothills south of Everest, in the eastern Himalayas, 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 gateway to Everest climbing expeditions. This long valley, running South to North, is one of the main routes that alpine expeditions cross to reach Base Camp and, from here, to climb the highest peak on the planet called Chomolangma (Mother of the universe) and Mout Everest (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 in the pre-monsoon period to then rise up the Himalayan chain.

These are the only continuous observations currently conducted by a ground station at this height and, for example, the temperature variations that at altitude 8,000 m (see illustration) and the thermal response to the monsoon cycle always wane 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 Pattar (5,600 m), NCO-P (5,879 m), Pyramid (5,850 m), Pheriche (4,700 m), Namche (3,500 m) and Lukla (2,660 m).

To better understand the atmospheric circulation in the Khumbu valley, meteorological measures were recently taken at 5,000 m altitude, at Everest’s South Col under the SHARE project.

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 lacustrine basins and fragmentation of the tongues into 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 recognize the need for much greater engagement and coordination with all our neighbours which share the Himalayas.
Our conclusion

To achieve a new measurement of the height of Mount Everest, it is necessary to have an accurate knowledge of the mountain's height, including the influence of the snow summit and the rock. The measurement will be based on the analysis of satellite data and the Global Positioning System (GPS).

New determinations of the geoid under the Everest summit

Satellite measurements obtained by GPS receivers can provide important information about the Earth's geoid and its changes over time. The geoid is a reference surface that is used to define the elevation of the Earth's surface.

The geoid can be determined using satellite data, which can provide information about the Earth's gravitational field. The geoid is an important parameter for understanding the Earth's shape and its evolution over time.

Conclusions

Our conclusion is that the measurement of the height of Mount Everest will be based on the analysis of satellite data and the Global Positioning System (GPS). The geoid is an important parameter for understanding the Earth's shape and its evolution over time. The measurement will provide important information about the mountain's height, including the influence of the snow summit and the rock.

In summary, the measurement of the height of Mount Everest will be based on the analysis of satellite data and the Global Positioning System (GPS). The geoid is an important parameter for understanding the Earth's shape and its evolution over time. The measurement will provide important information about the mountain's height, including the influence of the snow summit and the rock.
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 the 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 Udyaypur.

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 Nepalese government has taken the mountain’s height.”

**This is Everest for us**

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

From a scientific point of view what does Mt. Everest represent for you and for your Academy?

The Himalaya encompasses geological 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, Ecosystem, 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 and 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 levels.

The Nepali has 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 international importance other than that for its scenic beauty and climbing for adventure.

But, in recent years many concerted efforts were made in Nepal to establish it as a site of importance other than that for its scenic beauty and climbing for adventure.

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.

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