Acta Andina (1995) 4:153-157

THE ROMANCE BETWEEN MEDICINE AND MOUNTAINEERINGS[1]

Charles S Houston MD.
77 Ledge Road Burlington Vermont 05401

When I began researching this talk I expected to find the romance between medicine and mountaineering going back for thousands of years. Not so. Only recently has the relationship evolved. Mountain medicine is the child of a marriage which was consummated barely two hundred years ago.

I thought the religious respect for high places would mingle with the religion of healing. But healers did not live on mountains, and the art and science of medicine did not touch the art and science of mountains.

Look first at the beginning of the healing arts. Then see how early exploration necessarily moved onto mountains. As the mountain environment was found to affect health, this became a scientific challenge and mountain medicine was born.

In Egypt more than four thousand years ago illness was though due to imbalance between temporal and spiritual worlds. Physicians were respected tradesmen with a strict hierarchy, specializing in various diseases, coexisting with priests in complicated religious set based on natural forces.

Ancient chinese hearlers thought health was due to the balance between two forces: yin and yang and imbalance between them, together with metereological influences caused all illness. They recognized Qi to be a vital spirit like the Greek pneuma.

Four thousand years ago Ayurvedic medicine combined rituals, sorcery and omens with precise directions for handling trauma and many illnesses. Good health depended on a balance of five elementary substance: fire, earth, water, wind and space which appear in the body as breath, bile, and mucus.

Early Hebrew medicine was based on the belief that life is in the breath, blood is vehicle of the soul. Medicine had preventive and social aspects and was integrated into personal and public life.

In ancient times Hebrews shared medical practices with those of Egypt and Mesopotamia and in medieval days, with the Greco-Roman systems.

Most of that we know about Andean medicine dates only to the 16th century but the Incas understood what Monge has called "environmental aggression". Women who wanted children went to lower altitude; the Incas maintained one army for altitude, one for sea level. Strict laws controlled migration between high and low altitudes.

Greco-Roman medicine stems from Aesculapius and Hipocrates, based on four humors: blood, phlegm, choler (yellow bile) and melancholy (black bile). Galen taught that vital functions were based on fire, water, air, and earth; he also established the basis of anatomy and rudiments of physiology.

But physiology as we know it dates only to the 17th century when Harvey built on Colombo, Ibn al Nafis and others to solve the riddle of the circulation. Mayow did the same for respiration.

Descartes however believed in a "cardiac" fire (the heart) whose action heated the body; Van Heltont thought body heat due to fermentation.

****

Man's feeling for mountains has varied greatly over time and place. Two thousand years

---

Received December 15, 1995; revised and accepted April 25, 1995.
Presented at the First World Congress on Medicine and Physiology of High Altitude. La Paz, Bolivia, September 11 to 16, 1994.
Address for correspondence: Charles S Houston MD.
77 Ledge Road Burlington Vermont 05401.

ago Chinese Emperor Xuandi designated Five Sacred Mountains the abode of celestial beings to whom sacrifices were made by emperors, prayers said by the people, and poems written by scholars. Few climbed them.

In the Andes, mountains were worshipped for many reasons: mountain gods controlled the weather; fertility was an important reason for mountain worship. The souls of the dead were thought to reside on mountains. For closer communion with the gods, Andean peoples built hundreds of shrines and shelters as high as 21,000 feet. Many Himalayan peaks like Kailas and Kangchenjunga are considered holy. But shrines were not built on summits, and pilgrims did not climb them.

Ancient Greeks considered Mount Olympus sacred, the home of the gods. In 650 AD St Augustine described annual pilgrimages to the summit for religious sacrifices. The pagan revels of Dionysus and Bacchus were celebrated on mountains.

Travellers became aware of the hazards of high mountains. Two thousand years ago General Du Qin urged the Chinese Emperor that no envoys be sent to Kashmir over the high passes because the Stilk Road was too perilous:

"...travellers have to climb over Mount Greater Headache, Mount Lesser Headache, and the Fever Hills... they must support each other by ropes..."

Chinese pilgrim Too Kin wandered Asia for 15 years seeking enlightenment. He wrote:

"Fa-Hsien and the two others crossed the Little Snowy Mountains. On them the snow lies accumulated both winter and summer. On the north side... Hwuy-King could not go any farther. A white froth came from his mouth and he said to FaHsien, 'I cannot live any longer. Do you immediately go away, that we do not all die here'; and with these words he died".

Xenophon's Ten Thousand suffered greatly while crossing high passes, and Alexander the Great lost thousands of his men to altitude en route to India. Not surprisingly men avoided mountains when possible, but the recent discovery of a mummified body on a high alpine glacier makes us wonder if there were other mountain climbers like him.

We don't know. Chinese traders sought profit. Poets sought beauty. Pilgrims sought enlightenment. Kings grabbed empires. Scientists sought truth. Very few went onto the mountains for pleasure.

An early direct aid climb was by 300 picked soldiers of Alexander's famous army. To conquer the immense Soghdian Rock, they climbed a precipice which overlooked it using iron tent pgs driven into cracks in the rock and ropes to haul each other up. 30 fell to their deaths.

In 1492 Domp Julian climbed an extraordinary pinnacle called Mont Aiguille, using wooden pegs hammered into cracks; the climb was not repeated for 350 years. Shortly after this physician Conrad Gesner wrote:

"I have determined for the future, so long as the life divinely granted to me shall continue, each year to ascend a few mountains, or at least one...for...bodily exercise and delight of the spirit".

Neither General Du Qin nor Fa-Hsien or other early explorer mountaineers associated the illness that afflicted them on mountains with the quality of the air; many thougt it due to poisonous emanations from plants or minerals.

Marco Polo wrote about the:

"...lofty mountains (Yunan province) which no man may visit in summer at any price, because the air in summer is so unwholesome and pestilential that it is death to any foreigner".

In 1967 an anonymous traveller on the Peak of Teneriffe wrote:

"In this ascent some of our party grew very faint and sick, disordered by fluxes, vomiting and Anguish distempers... but called for some of our wine..."

The seventeeth century saw immense advances in science. Ancient descriptions of

circulation and respiration were proven wrong; speculations about the pulmonary circulation by Ibn al Nafis and Colombo were proven correct. Aristotle was shown in error about the nature of air and a vacuum, and the barometer was invented and used to demonstrate that air really was "thinne" - less dense and lighter as one climbed higher. The Guericke vacuum pump led to fascinating experiments with birds and animals - and once with Robert Hooke - exposed to decreased pressure. John Mayow showed that neither combustion nor life were sustaineed in a vacuum. Theories of a vital spirit, necessary for life and combustion were hatched. The foundations for altitude physiology were laid between 1600 and 1650 by these great scientists.

Although the high Andes have been inhabited for many thousand years, only the remains of religious shrines and mummified remains attest that Andean man climbed to, and perhaps lived for weeks, as high as 20-22,000 feet. In 1590 Jesuit missionary Acosta in the Andes and his contemporary Father Ovalde agreed:"When we come to ascend the highest point of the mountain, we feel an air so... subtile that it is with much difficulty we can breathe,... quick and strong and to open our mouths wider than ordinary so as not to be suffocated".

Others later recognized the benefits of acclimatization gained by long residence. However, only recently has medical research evolved in the Andes hand with mountain climbing.

****

Mountain Medicine really began in a small Alpine Village - Chamonix, on August 2nd 1787 when Horace-Benedict de Saussure made the second ascent of Mont Blanc and wrote:

"...Since the air had hardly more than half of its usual density, compensation had to be made for the lack of density by the frequency of inspirations..."

But he did not know that ten years earlier Priestley and Lavoisier had isolated oxygen and proven that it was necessary for life.

The first to clearly relate decreased atmospheric pressure, lack of oxygen and mountain sickness was Thomas Beddoes who explained de Saussure's symptoms in 1797: "Now in ascending these rugged heigths, the muscular exertion must expend a great deal of oxygen, which the rarefied atmosphere will supply but scantily... independent of its rarefaction, the atmosphere of very elevated mountains contains a far smaller proportion of oxygen than that of the lower regions..."

The Golden Age of alpine climbing ran from 1854 to 1875, and as many climbers described alarming symptoms, many theories evolved: "... a threefold source, viz, a gradually increasing congestion of the...circulatory apparatus, increased venosity of the blood, and loss of equilibrium between the pressure of the external air and that of the gasses existing within the intestines..."

"Mountain sickness is due to (a) decrease in the absolute quantity of oxygen, (b) rapidity of evaporation, (c) intensity of light,(d) expansion of intestinal gases and (e) weakening of the coxo-femoral articulation".

Others argued that diminished atmospheric pressure caused the fluids of the body to expand. An American surgeon blamed earth's magnetism. For several centuries emanations from plants (rhu-barb, marigolds, heather) or minerals (antimony, lead were blamed for what was called damgiri, puna, mareo, or soroche.

Many of these doctors were ardent mountaineers, but the man who put all the pieces together was not. Paul Bert was traineed as a plastic surgeon but caught the attention of the great physiologist Claude Bernard and succeeded him as profesor of Physiology.

Written in partnership with Denis Jourdanet, Bert's book Barometric Pressure remains the seminar work in altitude physiology. From accounts by hundreds of travellers, balloon ascents, and experiments in his decompression chamber Bert showed beyond reasonable doubt, that lack of oxygen was the cause of mountain sickness.

One of his comtemporaries, Angelo

Mosso, who was both doctor and climber, challenged Bert with his own studies. He was convinced that the decrease of carbon dioxide resulting from over-breathing was the cause of mountain sickness for which he coined the word 'acapnia'.

Physician Joseph Vallont examined the effects of altitude in his small laboratory near the summit or Mount Blanc. Astronomer Jules Janssen had himself pulled up the mountain on a sled and felt none of the unpleasant symptoms than affected the 42 men who dragged him. A young Chamonix doctor. Etienne Henri Jacottet hurried up to join Janssen, and died of high altitude pulmonary edema - the first martyr to high altitude science. Hugo Kronecker arranged for seven men and women to be carried up in chairs. Like Janssen, They did not have symptoms.

Meanwhile a mountain in Tibet had been found to be 29,028 feet high. Naturally mountaineers wondered if it would ever be climbed. Many believed that spending a nigh above 22,000 feet would be fatal. Balloonists had gone much higher with supplementary oxygen, but some had died.

Mountaineer-chemist Alexander Kellas calculated that a well acclimatized climber could reach the summit, but he died in route to Everest in 1924, at the start of the expedition when Mallory and Irvine disappeared near the summit and Norton reached over 28,000 feet.

In the first years of this century scientists and physicians climbed mountains all over the world. J.S. Haldane argued that the alveolar cells could secrete oxygen, making the oxygen pressure in the pulmonary vein higher than in the alveolus. Joseph Barcroft disagreed, and showed that his arterial blood always contained less oxygen than alveolar air.

None of these men had read the clinical descriptions of altitude illness written in 1913 by Tomas Ravenhill at high Andean mining community. Scientists were studying mountain sickness, but no higher than 15,000 feet and whithout attention to the needs of aviation.

In the First World War Victory in the air depended on altitude. Most effort went to developing oxygen equipment, and tests to select those aviators best suited for high altitude flight, and little attention was given to basic physiology.

By 1920 mountaineers were again going to the highest mountains but few were interested in science. In 1924, Hingston collected unique data about the heart and blood up 22,000 feet on Everest, and Norton came very close to the summit. Hurtado and Monge published important clinical work on mountain sickness and acclimatization. Andean research was born.

Cournad and Richards perfected a special cardiac catheter enabling direct measurement of cardiac dynamics, a major advance in basic studies of high altitude illnesses. Millikan developed the ear oximeter.

As Hitler developed his military machine, the air arm was emphasized and altitude physiology flourished for the next decade. Ulrich Luft published studies of acclimatization made on a Himalayan expedition, supported by the German air force. Then, while mountain expeditions were halted for several years the imperative of air combat stimulated many advances in hypoxia.

Soon after there was attention turned back to Everest. In 1946 a study called operation Everest showed that man could survive at a simulated altitude slightly than Everest, but the question remained: would the climber be able to do the strenuous work neccesary to reach that high cold point?

Today hundreds of men and women have climbed all the highest mountains without supplementary oxygen; hundreds of thousands climb mountains thought impossible a century ago. Millions sojourn among the lower mountains. What is left for the mountaineering scientist to accomplish?

More that ever! We are only beginning to grasp the interrelationships of neurotransmitters, hormones and enzymes. We understand only incompletely the factors that control ventilation, circulation, muscle energetics and the release of scores of hormones. The

effects of both short and long term hypoxia on the central nervous system remain uncharted and controversial. We do not understand why some individuals are peculiarly sensitive to even moderate altitude, while others are very tolerant. We do not know why one person may have mountains sickness on one day and not on another. We do not understand the problem of re-entry HAPE, first described thirty years ago. For the clinician parallels between normal man hypoxic at altitude, and impaired man at sea level cry out for attention.

In short, we have advanced from one small piece of territory to the boundaries of other, larger, almost limitless lands, and we have ever better instruments with which to explore these dazzling prospects.

****

I have emphasized the past which we often ignore. You are the present about which there is too much to tell here. The future is yours to explore. As we probe the mysteries of life we recognize that there are always further frontiers as the poet Flecker wrote:

> We are the pilgrims master We must go
> Ever a little further, it may be
> Beyond that last blue mountain
> Rimmed with snow