ANDEAN SOJURN

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Aircraft approaching the West coast of the South American Continent wisely fly over the blue waters of the Pacific ocean and follow the white, sunbaked sands of the Peruvian desert southwards. This ribbon-like desert runs between the ocean and a forbidding spine of irridescent rock to the east, the Andes. A cliff curtain draped in hues of violet, green and vermillion falls from massive cloud and stretches from Colombia in the North to Tierra del Fuego and the straits of Magellan for a distance of 5000 miles. Peaks at first sight are hidden.

Peru's capital, Lima, a rainless metropolis under the equatorial sun, is the first landing. An enormous city, periodically shaken by earth-tremors and revolutions, throbs with endless crazed traffic. And then there are the carcochas, cannibalized cars put together from the metallic remnants of 5 or 6 vehicles of different make. Lima's center is the glorious Plaza de Armas, colonial Spain at its most opulent. Its cathedral boasts the remains of Spain's most odious conquistador, Francisco Pizarro, resting within gilded baroque, while incense burns before a dark-skinned but victorious madonna.

Before sun-rise the flight continues. The airport of La Paz, Bolivia, and the highest on earth, is closed from dusk, till dawn. Its enormous runway of 6 miles partners after sun-down the nocturnal pastures of llama and alpaca. Again airborne over the Pacific, the Andean rock cascading from dense cloud is inhospitable and uncomfortably close. As the plane veers towards the sunrise, rock and cloud are licked scarlet revealing the first turrets of crimson ice thrusting into the heavens. Banks of convoluted vapour are pierced and the aircraft leaps over the first Andean peaks. Beneath and palpably close a vast sheet of pewter emerges, Lake Titicaca, the world's highest navigable lake. Upon its surface unfold the prism colours of dawn and its shores are gold, the shores of the rainbow children, the people of the sun, the Incas. From Lake Titicaca sprang the gods of the Incas.

Touch-down is upon the Bolivian Altiplano, one of the highest plains on earth, formed on the south-eastern borders of Peru by a cleavage of the Andes into two gigantic ridges of granite about 150 miles apart. A vast plateau in a carpet-like suspension stretches south east towards Chile for 600 miles at a mean altitude of over 13,000 ft. On the eastern ridge live the bulk of Bolivia's sparse and mainly Indian population. The 'royal' eastern ridge, or 'Cordillera real', slopes and tumbles into the "green hell" of Julian Duguid, the jungles, swamps and tributaries of the Amazon. Descent into the sea-level Yungas valley, only 75 miles from Bolivia's lofty capital of La Paz, requires the crossing of a mountain pass with its highest point at La Cumbre 15,000 ft. above sea level and just 15 miles from the center of the capital. From La Cumbre the only road down, unpaved and unguarded, is cut into the mountain side and liable to be swept away by rain or landslide. Two vehicles can barely pass without touching and the one on the outside frequently disappears down a precipitous void, where cloud far beneath you normally obscures the verdure of the tropical Yungas valley, the source of honey, coca and banana. La Cumbre shares its ice and lichen with the condor and the llama.

The Capital

The sudden exposure to an altitude of over 13,000 ft., when landing on a chilly Andean morning at La Paz airport rigorously taxes physical stamina, inasmuch as luggage has to be carried through customs. It also strains the temperament in the face of a somewhat stiff-backed and, on first and superficial acquaintance, truculent officialdom. Happily the wonderful sight of seven enormous wooden

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crates, containing all the research equipment, being unloaded with exquisite care from the same Boeing 707 which brought us to La Paz, effectively dispelled the gloom. Consignments like ours are known to travel unpredictably, particularly between Lima and La Paz, and finding ours reach its destination on the same aircraft called for immediate celebration.

The limousine from the airport speeds along one of the very few asphalted roads in Bolivia, literally to the very edge of the enormous altiplano, and then abruptly descends a serpiginous highway for over 1000 ft. into the vast bowl that is La Paz, the highest seat of government in the world. To the west and the south of the city, tower the steep walls of the altiplano leaving a straight adobe clustered edge on the horizon. In the north, nestling at its base in garlands of eucalyptus, rises the guardian mountain of La Paz, Illimani, a broad massif of ice soaring to 21,150 ft. There is colour in the east where city and desert fuse. A ravine cleft in two by the Rio Obrajes feeds the morning light through prisms of rock and scatters shafts of irridescence, crimson to violet, across a crumblingl craterpitted conglormerate of bluffs and chimneys stemming from the eroding edge of the altiplano. A landscape "created by the unbridled imagination of a lunatic in love with beauty".

La Paz, a city of over 400,000 reverberates with the rumba, romance and revolution. Bolivia the State, founded by Simon Bolivar and Antonio Jose de Sucre in 1825 has had 179 changes of government in the 143 years of her independence. An effervescent experiment in the art of administration of nations. The last major revolution convulsed the nation in 1952 and constituted the only real social revolution on the Continent. Senor Victor Paz Estenssoro, a socialist president, nationalised tin mining, the single source of wealth for the country which provides more than 90% of the foreign exchange, enfranchised the Indians and the women, and destroyed the large holdings and their haciendas. The Indians were able to own the lands upon which they subsisted as serfs since colonial Spain, became rerooted on their native soil, once drained and terraced with exemplary care under the Inca.

The People

Che Guevara, operating at the time of our stay near Camiri in the eastern lowlands of Bolivia, clearly misunderstood the rich significance of this revolution and underestimated the loyalties of a property owning proletariat who, while still living in abject poverty, were redeeming with much toil the bonds of former feudal decadence and social blindness. Che Guevara and Regis Debray found no resonance and their activities were imperceptible in the capital. The local guerilla war was irksome to the soldiery, but the peasantry remained aloof on their own plots and provided little comfort to Che Guevara and his luckless band. The guerilla strategy failed because the Indian peasant had a 15 years' stake in the new fortunes of his country.

In 1964 Paz Estenssoro was deposed in a bloodless coup by the present incumbent, President Rene Barrientos Ortuno, a former airforce colonel and a man of exceptional ability and personal courage. He gained the respect of his countrymen by a singular act of sangfroid, in that he unhesitatingly parachuted with a randomly chosen chute after a number of officers had fallen to their death with parachutes which failed to open. Rumor had rapidly spread through the force that the packing of the chutes could not be trusted. Barrientos' jump dispelled the vicious rumour and cemented the force.

5 — 10% of the Bolivian population are of pure Spanish descent, 30% have both Indian and Spanish blood and are known as "cholos", while the remainder of 60 — 65% are Quechua or Aymara Indian. The Quechua speaking Indians are those of the Inca stock, who like the Incas had their roots near Tiahuanaco on the shores of Lake Titicaca, where a few monoliths from pre-Inca and pre-Christian times testify to former glory.

Three fifth of Bolivia's population of 3i-million are high altitude dwellers. Their roots in history extend beyond the Christian era and although populations have shifted repeatedly across the windswept altiplano the Quechua Indians are known to have resided there throughout the centuries of their known history. Even before the Incas, copper, gold and silver was mined at altitudes approaching 14,000 ft. and the ore was used for decoration. In early Spanish times silver was the most important mineral and Potosi at 13,250 ft. became the richest as well as the highest city in the world. Now Indians are found in mining camps as high as 17,000 ft. It is tempting to assume that residence on the altiplano and above has produced a genetic adaptation

pattern to altitude favoring a people with so long a history of residence there, but exact and convincing physiological data are extremely scanty. The highland Indians have a very striking physique. The chest of the male seems broad and deep, arms and legs are short, while their hands and feet are small. The women, however, are well built and occasionally, unlike the males, become obese. The altiplano Indian performs astounding feats of endurance at high altitude carrying tremendous loads, working long hours in the fields and mines, and often plays a game of fast soccer after work. At 17,200 ft. near Chacaltaya a few men each dawn cut up enormous slabs of newly formed ice, carry them from glaciers across dangerous crevasses to a truck waiting 1000 ft. below them and transport the ice to the hotels of La Paz in time for the arrival of the morning fruit supplies from the tropical valleys. But they stave off fatigue, hunger and thirst for many hours of toil by chewing coca leaves, the source of cocaine. Medical supervision and care in the Altiplano is rudimentary and the toll from silico-tuberculosis is appalling. Until quite recently the average life span of an altiplano miner seldom exceeded the 35th year. The infant mortality is equally atrocious inasmuch as it approaches unofficially 120 per 1000 of live births and prenatal care does not really exist outside the cities. The most important family event even in the capital city is the first birthday of a child, when relatives and friends gather from far and wide and celebrate the great event of survival. While this reflects not only a triumph of survival against disease, tuberculosis in particular, it also depicts a welcome success in the battle of fertility. The early Spaniards of Potosi were without issue for almost 35 years and legend has it that the cathedral bells tolled for three days after the first Spanish infant survived the rigours of its birth at 13,250 ft. in the mid 16th century. Unfortunately, there is not enough information at hand to show if fertility is truly affected by altitude and the diplomatic colony of La Paz with its large brood of healthy and vigorous children clearly denies any obvious handicap in that regard. Congenital anomalies particularly of the heart and lungs are very common, and patent ductus arteriosus in particular has a parabolic relationship with altitude.

The care of children outside the affluent home is clearly determined by the vigour of the mother and the paternal income. Unfortunately, no children's hospital exists at the moment, although construction for the main children's hospital of the country began in La Paz in 1937. Apart from an impressive shell, its completion depends on the vagaries of government, profession and the intermittent support of national and international philanthropies. The most disheartening experience of ward rounds in a La Paz Hospital comes from the vision of an occasional crib wedged between the beds of desperately sick adults. The standards of pediatrics is, in fact, remarkably high and many of the consultants have had excellent training in North America and elsewhere. Alas, their hands are tied by a cynical bureaucracy. In spite of obvious economic and social disadvantages, the altiplano Indian emerges with a magnificent identity. As a supreme individualist he has overcome most alien influences particularly those of Spain. He moves unselfconsciously in dress, art and music through the polyglot cosmopolitanism of the capital. The brightly dressed women with their delightful bowler hats grace the sober scene of the city and the marvellous blend of the pagan and colonial heritage reflects itself in the idioms of the fiestas and in compelling dance. Folklore divested of European symbolisms is gaining powerful expression in literature and gradually the innate talent of the Indian, which has endured 4 centuries of attempted submersion, asserts itself as the major asset for a country like Bolivia. The link with the past is much stronger than the present and nurtures their customs, art and social behaviour. This bridge of a gentle but powerful civilization eclipses the nightmare of colonialism and supports a vitality comparable with the matchless power of the fantastic stones of the Incas upon which the modern and colonial buildings, of Cusco in particular, repose in borrowed time. A renaissance is theirs not to-day but surely in another generation. Meanwhile they move like rainbow children in their ethereal highland home, sailing in dreamlike twilight in balsa-boats upon the azure waters of Lake Titicaca, tilling a stubborn soil under the cumulus clouds beneath the Cordilleras and dwelling in tinted stucco amongst the coca-groves.

The University

Colonial Spain liked the trimmings of learning and the University of San Marcos in Lima was founded in 1551, the oldest in South America. A bare 18 years following the barbarous execution of Atahuallpa, the last of the great Incas and generous host to his own executioners led by none other than Francisco Pizarro himself. The principal Universities in the Andean nations date back to the 16th and 17th centuries and amongst them is the Universidad Mayor de San Andres of La Paz. They were at first Catholic, and although they produced some brilliant men they were narrow in academic scope and enrollment was confined to the blancos. With independence from Spain their scope broadened but Government control was rigid. In 1918 the University of Cordoba in Argentina developed the University Reform Movement which rapidly spread to all universities in South America. The reform movement was aimed at total University autonomy and democratizing of the old institutions. Government of the universities was to be in the hands of the faculty and students, and faculty members' effectiveness in teaching in particular was subject to review by the students. The University Reform Movement was thus responsible for the remarkable emergence **of** democratic institutions within the bosom of strange juntas and personal dictatorships. In fact it became a matter of pride for some of the worst caudillos to point to the University in their capitals as their worst enemies. The ferment which the Universities of South America have bred is now well known and it represents a beacon of light which illuminates the dark and sinister corridors of many a parent institution in the old world. One of the products of this strange phenomenon is none other than Che Guevara, who studied medicine at Cordoba. It is often stated that systems of this sort may endure despite evident political tyranny as a result of educational inequality, profound dissent and above all apathy. Also the subtle maintenance of privilege in the hands of very few and the organisational complexity of a modern state inhibits the emergence of an effective challenge and confines the opposition to those content with the exercise of dissent within the halls of speech and in academic verbosity. It is certainly true that in contemporary Bolivia an experienced establishment of a few families co-exists with an ineffectual but vocal and sometimes courageous intelligentsia, who revel in the joys of verbal opposition. The University becomes by necessity a vent for exuberance and occasional clashes with the State. Nevertheless the State leans heavily on the university intellectual for its outward image and occasionally dispenses patronage on academics who have learned to temper academic freedom with the rewards of political expediency. The student body represents a small section of the total population and occasional Cholos and Indian students leaven the otherwise uniform and middle class ingredients. Yet, they are flamboyant and delight in the freedom of the campus. As iconoclasts their choice of targets centers more often on faculty than the political power of the State. By exercising 52% of the vote in all University affairs, including the election of the rector, they are deeply involved and show much responsibility. Faculty depending on the majority vote of the students for almost everything including their own Chairs, have learned to be skillful in working with student opinion and anticipating student needs. Alas, in so exacting a discipline as medicine, with its formidable demands on the total exchequer of the University, the impact of student power has not been very impressive. No up to date library in medicine exists and research, the victim usually of excessive pre-occupation with politics, is confined to a few and usually foreign-supported individuals. University support of doctors is meager and most teachers have to leave the hospital at mid-day in order to pursue their income at their offices. Unfortunately, this leaves the University hospital patients almost completely without adequate medical supervision for the afternoon and night.

Poverty, political effervescence, and student power not-withstanding there exists a profound desire to learn and master the techniques of modern science. There can surely be few areas in the world where so much satisfaction can be gained from teaching as in Bolivia. The obvious delight with which students exercise their newly found knowledge flatters the foreign teacher. Eagerness to learn and awareness of opportunity in the application of science to the enormous field of high altitude are readily coupled, particularly in those devoted men who forego the call of their offices for a chance to become immersed in research.

Life at High Altitude.

It is currently customary for the study of life at high altitude to be approached entirely from the point of view of the lowlander, the representative of the majority of humanity and the invader of high altitude cultures, witness the Spaniards in the Andes and in our own time the Chinese in Tibet. Comparisons are made between the native of high altitudes and sea level man and the latter marvels at the adaptation to what to him is a hypoxic environment. Adaptation can be regarded in another way if it is realized that all of us share an interuterine heritage of gross hypoxia with those at high altitude and that in fact our adaptation to relatively high environmental oxygen tensions represents an unusual postnatal adjustment. If the rate of scientific development had been reversed and favoured the people and cultures of the mountains, the altiplano Indian might now be studying our adaptation to hyperoxia of sea level with the same surprise and sometimes wonder that we exhibit towards him.

The altitude of the Medical School at La Paz is 12,200 ft. and the atmospheric pressure averages about 480 mm Hg. This provides an inspired oxygen tension of 93 and an average alveolar $p0_2$ of about 60 mm Hg. which corresponds to breathing 13.0 % oxygen at sea level. At the altitude of Chacaltay, i.e. 17,200 ft. the corresponding mean barometric pressure was 395 mm Hg., inspired oxygen tension 73 and alveolar $p0_2$ ranged between 39-44 mm Hg., roughly corresponding to breathing 10.2 % oxygen at sea level. The critical alveolar $p0_2$ at which the average individual loses consciousness in brief exposure to hypoxia is 30 mm Hg. and this is usual at 23,500 ft., the altitude of interuterine life. Inasmuch as the high altitude resident and man at sea level must both make a postnatal adaptation from the hypoxic environment in utero to a relatively higher ambient oxygen tension, it becomes of interest to establish a comparison in order to establish the magnitude of adaptation. Could it be that the high altitude resident achieves adaptation of lesser magnitude than those required of the newborn entering the hyperoxic environment of sea level?

Centrogenic chemoreceptors are probably not concerned with oxygen tension in the arterial blood and the oxygen drive of ventilation covers a relatively narrow range i.e. from 45 to 125 mm Hg. The weak oxygen drive at sea level becomes abolished with 30 % oxygen breathing and at the lower end of the scale the maximum drive levels out at a $Pa0_2$ of 45 mm Hg. causing little if any increase in ventilation below that level. The high altitude resident can thus be expected to have some increase in resting minute ventilation and this stems from an increase in frequency without a change in tidal volume. There is some evidence which suggests that total lung capacity increases as a result in increase in functional residual capacity provided that the lung volumes are expressed at BTPS. If they are expressed at STPD no significant differences emerge. There is no doubt that increasing amounts of air (BTPS) are ventilated for any given amount of exercise with increasing altitude, but if this is once more expressed at STPD the high altitude residents show the same amount of STPD minute ventilation as their sea level companion for a given exercise load requiring oxygen consumptions of less than 2 liters per minute. Once the load is increased and higher oxygen consumptions become obligatory the exercise minute volume rises very steeply and the STPD minute volume per unit of oxygen consumption increases above that of sea level. This is the pattern which applies to sea-level newcomers to altitude exercising at loads requiring less than 2 liters of oxygen per minute. The high altitude resident thus seems to have a ventilatory disadvantage for severe exercise particularly as alveolar-arterial oxygen gradients emerge in the presence of large exercise minute ventilations, suggesting that the diffusing capacity for oxygen is not greater at altitude than at sea level. This is all the more puzzling inasmuch as the oxygen carrying capacity is so very much greater at altitude as a result of the overall increase in haemoglobin. Comparative studies at three levels of exercise were necessary at La Paz and Chacaltaya in male and female residents as well as in male and female newcomers in order to establish meaningful differences in representative population samples.

On acute exposure to a lower inspired oxygen tension, ventilation is stimulated by peripheral oxygen chemoreceptors. The resulting fall in arterial pCO_2 increases CSF pH which results in reduced neural activity in the medullary respiratory hydrogen ion receptors and this in turn partially counteracts peripheral chemoreceptor drive, limiting ventilation to a small increase. The reduced hydrogen ion

activity in the CSF stimulates choroid plexus and glia to restore CSF pH toward normal. This altered CSF with its reduced bicarbonate elevates local hydrogen ion concentration about the medullary receptors allowing ventilation to settle to a new steady state. This continues until CSF pH is restored to normal at 7.328. Were this concept entirely true both the high altitude dweller and the newcomer would sooner or later show the same alveolar and arterial pC0 2. This is not the case. The altiplano Indian has an arterial pCO_2 of 8.5 mm Hg. above that of the adapted newcomer, which suggests that the newcomer continues to have a larger oxygen drive than the native in the presence of an alkaline arterial pH. This difference, suggestive of persistent hypoventilation in the Indian and the reverse in the adapted newcomer, can be readily tested with the elegant single breath technique of Pierre Dejours, which shows that the native Indian has lost some sensitivity of peripheral chemoreceptor to $Pa0_2$. The exercising altitude dweller accomplishes moderate loads requiring less than 2 liters of oxygen consumption with a mild increase in $PaCO_2$ and a moderate drop in arterial pH, contrasted with the adapted newcomer who keeps the paCO2 constant or lower than at rest and tends to increase arterial pH at a corresponding work load. This difference can also be studied with the Dejours technique by allowing subjects to breath single breaths of different air-CO_2 mixtures. CO2 response curves in the high altitude dweller shows some reduction in sensitivity to CO2 loading contrasted with adapted newcomers.

A classical example of loss of both low oxygen tension and CO2 chemosensitivity is provided by high altitude dwellers with Monge's syndrome, who in spite of normal cardio-pulmonary systems exhibit striking alveolar hypoventilation with profound central cyanosis, severe polychythaemia and gross pulmonary hypertension. 43 patients with this syndrome, also known as "chronic mountain sickness", were scrutinized in the course of our 9 months stay at La Paz, in conjunction with 36 patients suffering from a variety of common congenital and aquired heart diseases normally associated with pulmonary hypertension at sea level.

After birth definite differences become evident between infants born and living at high altitude and those of sea level. At sea level a few weeks after birth the pulmonary artery pressure drops to adult level, and between the 4th and 1 1 th months of life the left ventricle acquires anatomical and electrical preponderance. Correspondingly the pulmonary vasculature adopts the adult pattern. At high altitude the pulmonary vasculature and the associated moderate fetal pulmonary hypertension decreases very slowly with age. Similarly the anatomical and electrical preponderance of the right ventricle decreases slightly after the fifth year of age, but the physiological left ventricular preponderance seen at sea level is never attained at altitudes exceeding 10,000 ft.

Catherterization of the right heart had not been previously conducted in Bolivia as a consequence of apparent lack of facilities, and inadequate training of the otherwise excellent cardiologists in that country. Regression equations established by Peruvian investigators showed quite clearly that pulmonary artery pressure varies inversely with alveolar oxygen tension and that significant resting pulmonary artery pressure elevation could be expected at the altitude of La Paz, but this had not been documented for that level of altitude. Once this became understood by our Bolivian colleagues a wonderful effort of co-ordination by physicians and surgeons alike provided the basic needs for right heart catheterization at the Institut° Nacional de Torax, La Paz, and 32 studies were carried out without mishap. A mean resting pulmonary artery pressure of 23 mm Hg. was established for the altitude of 3701 meters. On effort this rose by 109 % without affecting left atrial pressure which remained normal. The highest resting mean pulmonary artery pressures, namely 51.5 mm Hg. were found in patients with Monge's syndrome and this was higher than the mean pressure found in patients with varieties of heart disease normally associated with pulmonary hypertension at sea level. Pure oxygen breathing failed to reduce the mean resting pulmonary artery pressures to sea level control values, and acetyl choline infusions into the pulmonary arteries also produced a drop in mean pulmonary artery pressure but this was less dramatic than that found with oxygen breathing. Adapted newcomers were not studied. Inasmuch as cardiac output and pulmonary capillary or left atrial pressures did not differ from sea level control values, the assumption has to be made that the altiplano

Indian has a hyporeactive pulmonary capacitance vasculature which structurally resembles the fetal type in that cross sectional arteriolar diameters are reduced as a consequence of increased fetal muscle mass. Reactive pulmonary hypertension to alveolar hypoxia clearly plays a part in the genesis of altitude pulmonary hypertension, but it accounts for approximately 55% of the increase in pulmonary arteriolar resistance. Residents of altitude who settle at sea level show almost normal mean resting pulmonary artery pressures after 2 years, but they continue to increase pulmonary artery pressure significantly during modest effort. Thus the hyporeactivity of the pulmonary vasculature acquired over many generations of residence at high altitude persists in the presence of sudden or prolonged exposure to sea level hyperoxia.

Maintenance of a degree of the increased pulmonary vascular resistance stemming from interuterine life seems a logical assumption in the high altitude dweller and appears to be directly related to the inspired oxygen tension of the altitude of his birth. Might there be teleological explanation for altitude pulmonary hypertension? It has been postulated that one beneficial effect of increased pulmonary artery pressure at altitude, particularly if there are diffusion limitations for oxygen, might be sought in the better perfusion of the upper lung zones in the upright posture. This would favour equalization of lung perfusion and lessen reduction in arterial oxygen saturation during exercise. This attractive postulate, alas, fails to stand up to experimental evidence in that upper zone perfusion curves obtained by us with iodinated radio albumin in high altitude residents are qualitatively smaller than those registered simultaneously from the lower perfusion zones of the lungs. They are certainly larger in area than those found in the newcomer, who shows a significantly greater physiological dead space than the altiplano Indian. Particularly striking are the very large dead spaces found in altitude residents with Monge's syndrome and the upper zone perfusion curves in these patients have almost no area even in the horizontal position. And as previously mentioned the Monge's syndrome patients showed the severest pulmonary hypertension at La Paz.

The spectrum of differences from sea level in the altitude dwellers of La Paz and the altiplano is immense and covers all systems. While pulmonary hypertension abounds systemic hypertension is almost unknown in the native population. Gastric acidity varies directly with arterial P02 yet gastric ulceration seems rather common. Diabetes mellitus is infrequent in the Indian population but has a high incidence amongst the residents of Spanish stock who have lived in La Paz for generations and there is the serious problem of altitude pulmonary oedema.

Pulmonary oedema can strike above 10,000 ft. both the unadapted first arriving at altitude and the previously acclimatized person who returns after an absence of a few days to months at lower altitudes. A wide range of ages has been reported but there seems to be a particularly high incidence of pulmonary oedema in children and early teenagers who have been well acclimatized to high altitude and on their return to La Paz from a holiday at the ocean develop pulmonary oedema some hours following arrival. Approximately a dozen children succumb annually in spite of adequate treatment. The mechanism of this scourge remains unknown.

Chacaltaya

The Cosmic Physics laboratory of San Andres University in La Paz has an international reputation for excellence in research and maintains probably the highest field laboratory on earth close to the peak of Mount Chacaltaya. The elevation of the site for the field station is at 17,200 ft and it is also close to the highest ski lift in the world. A treacherous dirt road with numerous close hairpin bends leads from the altiplano to the laboratory and one of the most spectacular mountain views on earth. The snow line in the Cordillera Real starts at 15,000 ft. in the Southern Summer and the ascent to the Chacaltaya laboratory is unpredictable at all times. The buildings are fairly comfortable and have the best power supply in the area, inasmuch as the local generators produce very little fluctuation in voltage. Although trucks donated by the US Air force make the trip up from La Paz on most days they frequently get stuck in snow drifts and have to be dug out close to the steepest drops. Once up at the laboratory contact with the outside world is by radio alone which transmits to the parent laboratory at San Andres every afternoon at 3:00 pm. for 30 minutes. Occasionally a DC 3 plane can be seen 2000 ft. beneath winding its way from La Paz airport past gaps in the mountain chain to

The accompanying table shows the cumulative effect of bonus additions to Standard Life participating policies. This shows the amounts payable on death or maturity in 1968 under policies effected under the Company's Full Reversionary Bonus plan at different dates in the past. It will be noted that policies effected 30 years ago are now assuring a sum of double the original face amount of the policy.

$22,820

20,017 _____

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16,378 _____

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the Yungas valley. The Chacaltaya laboratory is lavishly equipped with a computer and counters for the recording of cosmic energy. Much of the electronics are from MIT and Ann Arbor as well as Japan and from home made sources in La Paz. A bright crew of international scientists spends long periods up there and they are looked after by altiplano Indians who make their home close to the laboratory. The cook has his own ideas of cuisine and remarkable dishes emerge from his section of the laboratory, which occasionally tax unacclimatized palates, particularly those from France.

Physiologists have not previously mingled with the cosmic physicists at Chacaltaya and our intrusion was greeted with considerable caution particularly as it became known that our interest was not in cosmic physics but in the gentlemen pursuing the science. Arranging the transfer of all our equipment from La Paz Medical School to Chacaltaya created no real problems. The director of the Cosmic Physics laboratory very kindly placed an ex-US Air Force 6 wheeled truck at my disposal and the 7 wooden crates were stowed on the truck by a dozen young Bolivian soldiers seconded to the job by Col. Zelada of the Bolivian Army, who also has a distinguished record in problems of high altitude. The truck and soldiers negotiated the 25 miles from La Paz to the Chacaltaya laboratory in 4 hours, having snow drifts and treacherous ice to combat en route. On arrival a dense blizzard hampered unloading, but all instruments were installed and operational by the late afternoon, and there were no breakages. A truly remarkable achievement thanks to the care and stamina of the Bolivian soldiers. Work space was provided in a computation room facing northeast and from its main window volunteers riding the bicycle ergometer were afforded one of the most superb views in the Bolivian Andes, dominated by the graceful peak of Mount Potasi. Rapport with the local and visiting scientists as well as the Indian caretakers and occasional female visitors was rapidly cemented and data unique for this altitude were gathered almost around the clock.

The essential reason for this bustle beyond the midnight oil stemmed from the curious insomnia which most newcomers to Chacaltaya experience and which does not seem to disappear even after weeks of adaptation. One is totally unaware of fatigue while actually working and going to bed becomes a chore as well as occasionally distressing, in that the obligatory hyperventilation enters consciousness. Also the superb surroundings which continuously change colour compel one to interrupt research and to emerge in the open, to bear witness as the peak of Potosi changes to purple at dusk while the piercing amber of sun-light dips beyond the western shores of Lake Titicaca stretched to its full length in an apparent mirage against the Peruvian horizon.

Thirst, weight loss, intermittent claudication, throbbing temples and some retrosternal discomfort on climbing in addition to insomnia remind one of the altitude of Chacaltaya. There is also an annoying amnesia for recently acquired facts and names, which need to be skillfully mastered by committing them immediately to paper. Nonadherence to such a discipline is disastrous in that important information is easily sacrificed to a delightfully curious indifference.

Time races at Chacaltaya and after some weeks the busiest morning suddenly coincided with the prompt and sudden arrival of the departure truck. Exercise studies and blood gas tension analyses were still in progress while the soldiers dismantled the heavy equipment. Pleading for time was parried by fingers pointing to dark and menacing clouds. At dusk the heavily laden truck trundled down the mountain chased by gusts of icy wind and snow. It was dark as we drove through the suburbs of La Paz. The Indian women sitting by the curb of the sidewalks had lit their primus stoves dispensing hot beverages to the men coming home from work. The steam from their kettles rose in ghostly clouds above their bowler hats and the dark figures of the men stood silently against the adobe walls imbibing their hot brew. Walking in La Paz that night was easy; one was not aware of it.

The art of medicine consists of amusing the patient while nature *cures* the *disease.*

Voltaire