

# **The Economics of Innovation: Mountaineering and the American Space Program**

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“The Economics of Innovation: Mountaineering and the American Space Program,” a research report submitted by Howard E. McCurdy, Ph.D., School of Public Affairs, American University, 4400 Massachusetts Ave. N.W., Washington, D.C., 20016, in fulfillment of NASA contract NNX12AQ63G, 11 March 2013; revised and resubmitted, 18 May 2013.

*Following page: An expedition 8 crewmember on the International Space Station took this photograph of Mt. Everest in 2004. Mt. Everest is 29,035 feet high. Passengers in a commercial jetliner flying over Everest at an altitude of 35,000 feet would be too close to the mountain to experience this view. The photograph is taken from the north. In the foreground appears the Tibetan plateau. To the south, clouds cover much of Nepal. Everest is the darker mountain peak to center right with the perennial cloud plume. The first expeditions attempting to climb the mountain approached from Tibet, traveling up the Rongbuk glacier, turning east, then moving back toward the V-shaped spot below and to the left of the summit. That is the North Col, a low point between Everest and Changtse. From the North Col, climbers proceed up the north ridge to its junction with the wind-swept northeast ridge and from there toward the summit. Most commercial outfitters approach the Everest from Nepal on the mountain's southern side. This route follows the Western Cwm, visible as the deep cut stretching out to the right of the mountain. Upon reaching the South Col (behind Everest in this photograph), climbers turn north and head directly toward the space station.*

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## **Executive Summary and Findings**

Mountain climbing in the Himalayas is a risky and expensive activity. Like space exploration, it began with large expeditions in which climbers assembled pyramids of people and material that allowed a few skilled individuals to reach the top of the world.

In roughly seventy-five years, mountain climbing in the Himalayas moved from a phase characterized by large expeditions to a commercial enterprise wherein well-prepared people paid to go. An activity once thought available only to select parties able to raise vast sums of money became a commercial endeavor.

This report examines the history of mountain climbing on Mt. Everest in search of lessons the activity might contain for the process of space exploration. The study is based on reports from twenty-five expeditions organized by twelve different nations. It identifies the forces of innovation that allowed Everest climbs to move from costly expeditions through a transitional stage to the less expensive commercial era. The report focuses on the means by which each set of trips were financed and organized.

Advances in transportation, climbing technology, equipment, communication, knowledge of the terrain, and weather forecasting encouraged the transition from big expeditions to self-financed commercial climbs. So did the emergence of a lightweight “alpine approach” to mountain climbing and changes in the manner by which local governments regulated the activity.

As innovation occurred, the cost of conducting an expedition fell. While cost fell substantially, the price or charge to individual customers fell modestly. The gap between substantial cost reduction and modest price reduction helped to create a commercial market for the activity. The presence of a market encouraged competition which led to further reductions in cost, price, and risk.

As in space exploration, early advocates of climbing organized themselves into clubs. Space advocates formed rocket societies, mountaineers formed climbing clubs. Both groups tried to raise money from a variety of sources. Mountaineers were successful; the rocket clubs less so. Government agencies came to dominate the provision of space policy; mountain climbers maintained a mixed funding strategy. As a result, climbing advocates were able to maintain more direct control over the activity to which they were so strongly committed and make the transition to commercialization more easily than advocates of space flight.

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Many of the people who envisioned the unfolding of space exploration anticipated that it would evolve in a manner akin to similar terrestrial activities. Visionaries often recalled the history of aviation when seeking analogies to explain space exploration. Just as advances in aeronautics made atmospheric flight cheaper, safer, and more accessible to ordinary people, so would advances in astronautics. Commenting on the future of the NASA space shuttle, one NASA planner announced that “by 1990 people will be going on the shuttle routinely—as on an airplane.”<sup>1</sup>

Advocates offered the history of other transportation technologies as justification for investments in space. After welcoming the crew of the space shuttle *Columbia* back to Earth, President Ronald Reagan likened the completion of the space shuttle test program to the driving of the golden spike that marked the completion of the transcontinental railroad. Railroads opened new territories to human settlement and increased national wealth. So would space travel. During the Apollo era, NASA officials encouraged historians to study the transcontinental railroad as an analog to space exploration.<sup>2</sup>

Advocates of space exploration presented the history of terrestrial exploration as justification for missions beyond. Terrestrial exploration had fueled human creativity and enlarged national power. In a similar way, advocates insisted, space exploration would do the same. Announcing his support for the construction of a large Earth-orbiting space station, NASA Administrator James Beggs recalled the voyages of Meriwether Lewis, William Clark, Robert Peary, Richard Byrd, and Charles Lindbergh. The achievements of Christopher Columbus figure prominently in space rhetoric. When President Ronald Reagan’s budget director objected to the cost of the proposed space station, Attorney General William French Smith remarked that Queen Isabella must have heard the same argument from her advisors.<sup>3</sup>

Based on the concepts contained in these analogies, the people promoting space exploration suggested that it would occur in phases. In the earliest phase, achievements would require vast assemblies of people and material. To build the first large space station, to visit the Moon, to send the first humans to Mars—these activities would require humans to marshal resources on a heroic scale. The expenditures required would far exceed the capacity of the individuals involved. Thousands of people would work so that

a few explorers could reach their destinations. The resulting enterprises would resemble vast pyramids of money, people, and material and be waged in the style of military campaigns.

In the second phase, technology and knowledge would improve. Advances would occur in areas such as transport, personal equipment, communication, meteorological forecasting, biomedical knowledge, and understanding of the terrain. Most important, costs would begin to fall. Advancing technology and economies of scale would allow people to do more with less, thereby permitting more frequent visitation and a larger human presence in distant places.

In the third phase, cost and technology would improve to the point where ordinary people could participate. This was the message contained in the history of aviation, anticipated and realized for atmospheric flight and thereafter promised for space. The promise appears in a wide number of sources, from official government documents to the space colonization movement and more recently the effort to commercialize space.<sup>4</sup>

To gain insight into the process by which such innovative transitions occur, this report examines the evolution of a terrestrial activity thought to contain analogies to space exploration. The activity in this case is mountain climbing—and more specifically the efforts to ascend the highest point on the surface of the Earth, Mt. Everest. The report investigates whether we can learn something about space exploration and the economics of innovation from the history of mountaineering – whether its cost and difficulty did indeed fall and if so what lessons that history might contain for space travel.

The periods characterizing climbing on Everest are analogous to the ones anticipated for space exploration. The first expeditions to Mt. Everest required substantial pyramids of people and material. The cost was high. The expeditionary period began in 1921 as advocates of the venture organized large, military-style campaigns of conquest. After a half century, the expeditionary model fell into disfavor and a transitional period began. In the transitional phase, technologies improved. Costs fell. New methods appeared. As costs and difficulty fell, entrepreneurs appeared. In the third stage, the activity became commercial. Ordinary people (in excellent physical condition) paid commercial outfitters to lead them to the top of Mt. Everest. By 1995, the commercial era was in full bloom.<sup>5</sup>

In 1953, two people reached the summit—part of the only expedition allowed on the mountain that year. In 2011, five hundred and thirty-seven climbers stood on top, a few of them more than once.<sup>6</sup>

This report is based on an investigation of twenty-five expeditions to Mt. Everest undertaken between 1921 and 2013 for which the best financial and organizational information is available. A list of the climbs appears in table 2. The expeditions represent a cross section of climbs undertaken by

twelve different nations. Much has been written about the challenge of Everest from a technical, rock-and-ice point of view. This report focuses on finance and the process of innovation.

The report relies upon primary sources—books, articles, and expedition summaries that present information on the organization and financing of each trip. Climbers themselves or support staff wrote these materials.

The findings of this study are as follows. The cost of climbing Mt. Everest fell dramatically during the ninety year period from the first expeditions to the modern era. The cost fell by the much-touted objective for space—a factor of ten. Cost reduction occurred because of changes in climbing-related technologies and knowledge of the terrain. Of equal significance, reductions occurred because of alterations in approach, changes in government policy, and the possibility of commercialization.

While the *cost* of conducting an expedition fell dramatically, the *price* fell modestly. This is an unexpected finding. Price refers to the ability or willingness of climbers to pay. The per-member share of expeditionary expenses exceeded the personal resources available to early climbers. Most could not afford to go. The most devoted advocates of mountain climbing are not poor, but neither are they on the whole a wealthy lot. They often engage in careers that promise time to climb rather than great wealth. Lacking extensive personal resources, early climbers sought outside funding for their most ambitious trips. They sought it from any person or organization that would provide it: philanthropists, geographic societies, scientific foundations, government agencies, industrialists, media outlets, and small-cash donors. Unlike space exploration, where advocates of extraterrestrial adventures came to rely upon government help, no single source of funding dominated the high altitude mountaineering frontier. Conditions attached by outside sources as a requirement of their participation frequently caused the overall expense of expeditions to rise. The cost of climbing Mt. Everest increased as the expeditionary period matured, especially as different countries competed to place their climbers on the mountain top.

After a half-century of climbing, the attraction of the Big Expedition waned. Fund-raising became harder. Innovators experimented with alternative climbing approaches and a few expedition leaders cut their costs below those of the earliest expeditions. As the price of climbing fell, a transitional period began. The price of climbing did not need to fall by much to attract a steady clientele willing to pay. It fell by less than a factor of two. The gap between rapidly falling cost and modestly falling price created the prospect of healthy profits. That attracted new suppliers, which encouraged competition, which in turn caused prices to fall further. The transitional



period gave way to an era of commercialization. Seventy-five years after the first attempts to scale Everest, the commercial period was fully underway.

Through all of this, the most devoted advocates of mountain climbing prospered. In the expeditionary era, outside groups contributed funds. In the commercial era, clients paid the strongest climbers to guide the way. The most skilled climbers did not need to pay much for their own climbing at any time. In the beginning they found sponsors, later they found customers. The innovations that made this possible, moreover, improved access and reduced cost. In the end, far more people found the means to climb Mt. Everest and that created a steady market for the activity.

### Falling Cost

In 1963 an expedition from the United States sought to place the first Americans on the summit of Mt. Everest. This was the eighteenth official expedition to the mountain since the first British reconnaissance effort in 1921, not counting four clandestine attempts to sneak in. Ten years earlier, a British-led team had placed Sir Edmund Hillary and Tenzing Norgay on the summit.

The American team kept detailed records of their expenses, an obligation imposed by the funding bodies. Charles B. Huestis, part of the support staff for the expedition, summarized the results. According to his records, the expedition recorded total costs of \$405,263 through the end of November, 1963. That would amount to slightly more than \$3 million in 2012 dollars.<sup>7</sup>

The budget supported an expedition team of twenty climbers, plus Sherpa people added to the team in Nepal. On 1 May, 1963, American James W. Whittaker and Sherpa Nawang Gombu reached the summit. Whittaker became the first American to stand on the top of the world. Before the end of May, Americans Barry Bishop, Luther Jerstad, Thomas Hornbein, and William Unsoeld followed. For the equivalent of \$3 million, five members of a climbing team of twenty individuals plus one Sherpa reached the summit of Mt. Everest.

The expedition was not without peril. On their return from the summit, the latter four climbers endured an overnight, open-air bivouac above 28,000 feet without tents or sleeping bags. Darkness fell before they could return to the safety of their high altitude camp at 27,450 feet. Mt. Everest is more than 29,000 feet high—the most accurate survey places it 29,035 feet above sea level. All four climbers survived despite their overnight exposure. One member of the twenty-person team, John Breitenbach, was not so fortunate. He died when a section of the Khumbu icefield “about the size of two railroad cars” collapsed on a portion of the climbing party during the early stages of the climb.<sup>8</sup>

Nearly fifty years later, in 2012, Daniel Mazur led a climbing team of fourteen clients and four climbing Sherpas to Mt. Everest, approaching the mountain from the Tibetan plateau on the north side. This was a commercial operation. Four members of the climbing team paid for the opportunity to attempt the summit. Three succeeded, including a 68-year old Australian, Janice Smith. She became one of the oldest individuals to accomplish what had seemed nearly insurmountable a half-century earlier. The four climbing Sherpas reached the summit with the three mountaineers. Mazur directed the climb from a camp just below the summit.

In the aggregate, the 2012 team paid roughly \$165,000 to Mazur's commercial firm. Mazur conducted the climb for a fraction of the inflation-adjusted cost of the 1963 expedition. In 2012 U.S. dollars, the 1963 expedition cost about \$3 million. Counting both clients and Sherpas, Mazur placed seven members of his party on the top of Mt. Everest. Using the same counting method, the 1963 American expedition placed six.

Early expeditions cost a great deal of money. One record may have been set by a 1970 Japanese expedition, which exhausted ¥100 million to place three members of its party and one Sherpa on the summit. The Canadian expedition of 1982 spent \$3 million in their own currency to summit two climbers and four Sherpas. (See Table 4) Those sums are stated in current year value, not adjusted for inflation.

Mazur directs the U.S. arm of a commercial for-profit organization called SummitClimb and SummitTrek. The organization operates from Bristol, England, and Washington State. It is one of the most successful and cost-effective climbing operations in the commercial field. It offers expeditions to paying customers wishing to climb mountains in Nepal, Tibet, China, Africa, and South American and engage in back-country treks. Mt. Everest is the operation's pinnacle climb. Its price for a north side climb is \$27,450. The most expensive commercial climbing organizations charge \$65,000. (See Table 5)

As the cost of conducting climbs fell, so did the risk. Everest is a dangerous, even deadly mountain. The British reconnaissance effort of 1922 lost seven Sherpas in an avalanche near the North Col. The 1924 British expedition lost George Mallory, Andrew Irvine, and two members of its support staff. Seven Sherpas and one climber died during as a result of the two Japanese expeditions on the mountain in 1970. Risk in mountain climbing is commonly measured in the proportion of people who die on climbs relative to the number of individuals who reach the summit. In spite of some particularly deadly years, the risk has steadily declined.

During the expeditionary period (1922 – 1969), eight participants died for every ten persons who reached the summit. The proportion fell to half that level during the early transitional phase (1970 – 1979): roughly four

deaths for every ten summits. It fell again during the later transitional phase (1980 – 1995): one fatality for every eight summits. By the commercial era (1996 – 2010), it was down to one for thirty-three. Viewed another way, the chances of an average climber dying once that person travels above an Everest base camp is about 1 percent. That statistic incorporates all climbers: prepared, unprepared, guided, and independent.<sup>9</sup>

When they occur, fatalities on commercial climbs receive a great deal of publicity. The loss of two trip leaders and three clients during the Spring, 1996, climbing season prompted numerous books, films, articles, and documentaries, including Jon Krakauer's classic *Into Thin Air*. Statistically speaking, however, a client climbing with a big commercial outfitter is pretty safe. Most of the modern Everest climbers who die do so while on non-conventional routes or independent climbs. Of the ninety-five individuals who died on Everest from 1966 through 2012, only seven were clients being guided by large commercial outfitters.

Concurrently, the time required to climb Everest has declined. Early expeditions spent more than three months approaching and climbing the mountain. Commercial operators typically take a bit more than two. The difference arises from improvements in transportation that significantly reduce the time necessary to reach base camp.

Commercial operators and modern climbers made simultaneous improvements in cost, risk and time. They did not need to trade risk for cost or cost for time. This is contrary to expectations in space exploration, where astronautic engineers with government funding commonly insist that cost, performance, and schedule require trades. Commercial operators for mountain climbs, like many other business managers, do not embrace that expectation.

#### Organizing an Expedition

In the beginning, efforts to climb Mt. Everest resembled military-style expeditions of conquest. Expedition leaders sent out reconnaissance teams to survey the challenge. Key members of the team assembled sufficient supplies to support a force in the field for the duration of the campaign. Gather the supplies at a base of operations. Send an expeditionary force into hostile territory. Establish a military-like logistics chain. Create an advanced base camp, then a series of smaller camps, each of diminishing size, ending at a camp close enough to the objective that a few members of the team acting from "the point of the spear" could reach the destination. On Everest, the camps typically resembled a pyramid, rising in altitude above the base. A member of the 1952 Swiss expedition confessed the inevitability of this approach for early teams.

I, who had always smiled at this military language when I found it in stories of the Himalaya, was using it too! Whether I wished

it or not, the concept of a campaign was forced upon me more strongly every day....The distances are too great, the defences too powerful. It is necessary to occupy the conquered terrain, that each camp established shall be sufficiently provided with equipment and food to become in some degree another base camp. This involves, for all the lower camps, problems of transport which can only be solved by numerous parties the personal needs of which considerably increase the difficulty they have to overcome, that of weight. To put a party of four men in fighting condition above 26,000 feet requires three hundred men at the start in Katmandu. More or less the proportions of war.<sup>10</sup>

The earliest expeditions assembled themselves and their supplies in Darjeeling, to the east of Mt. Everest in India. Nepal was then closed to foreign travel. The expeditions marched out of India and across Tibet, some 300 miles, setting up a base camp on the north side of Mt. Everest. The 1924 British expedition that failed in its objective followed this route. The trek from assembly point to base camp took more than a month, from 25 March to 28 April 1924.<sup>11</sup>

The British expedition of 1953 employed the more conventional route, the one eventually chosen by most commercial firms. Mid-way through the twentieth century, Nepal opened its borders, while the Chinese closed theirs following the Communist advance into Tibet. The 1953 British expedition that placed the first climbers on Mt. Everest assembled in Kathmandu. The distance from Kathmandu to Mt. Everest by air is 100 miles, twice that by land. The British expedition walked from Kathmandu to the mountain.

Records from the 1963 American climb ten years later allow a detailed reconstruction of the undertaking and its scale. The American team moved roughly twenty-seven tons of equipment from Seattle, Washington, to Kathmandu. Packed in 900 cartons, each filled container weighed about sixty-five pounds. The cartons contained food, medicine, tents, cooking equipment, oxygen canisters, folding aluminum chairs, umbrellas, brooms, hot water bottles, and other material. The Georgia-Pacific Plywood and Lumber Company manufactured the containers. The company used reinforced cardboard. Jim Whitaker, who oversaw what the team called the Labor of Hercules, explained that "the cardboard was processed to withstand the monsoon rains and rough handling and carries, and it held up better than wood under the shocks of dropping and jarring." Working with fellow expedition member Dan Doody, Whitaker and a team of professional packers stenciled each box with a number indicating the elevation at which the team needed to open the container.<sup>12</sup>

The containers traveled to Calcutta by sea. From Calcutta, the containers moved to Patna by truck. Patna is a medium-size Indian city along the Ganges River near the border with Nepal. From Patna the cartons moved to Kathmandu by air transport, except for inflammable items such as butane, gasoline, kerosene, and oxygen that could not be sent by air and had to complete the journey in trucks.

Trucks carried the containers, plus an additional amount of material purchased in Kathmandu, from Kathmandu to the village of Banepa, fifteen miles east of the Nepalese capital. At the time of the 1963 expedition, Banepa was the end of the drivable road. In a field outside Banepa, the team assembled. Team member James Ullman described the scene.

There were ourselves. There were our Sherpa and baggage. There was a great crowd of seer-offers, most of them from Kathmandu's American community, all of them laden with cameras and good wishes. Most essentially for the job at hand, there was our horde of low-level porters now joining us for the first time—hillmen and valley men, male and female, children, oldsters and in-betweeners—and through the whole of the morning they filed past in jostling, jabbering process while their loads and identification tags were assigned to them....And now, slowly but surely, all those tons began to move. In single file, bent under their burdens and headstraps, our armless army moved out of the field at Banepa onto the trail beyond, in a file so long that it took two hours to pass a given point.<sup>13</sup>

Leaders of the American expedition hired 909 porters to carry what now amounted to nearly twenty-nine tons of material. Each porter carried about sixty-five pounds, plus personal items. The entourage was so large, the Sherpas joked, that the Sahibs required a half-dozen porters just to carry the boxes of money needed to pay the bearers.<sup>14</sup> The story has a truthful origin, though not with the American expedition.<sup>1</sup>

James Roberts, a retired British army Lt. Colonel and expedition member, described the organization of the 1963 march.

For control, we divided the porter corps into nine legions of 100, each under a *naiki* (headsmen), Sherpa or Tamang, assisted by one of our own "climbing" Sherpa. The *naikis* brought up the rear, while a Sherpa went ahead and checked the loads as they arrived in camp. In camp each porter party had its own separate dump, and thus the stacking of loads in the evenings and

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<sup>1</sup> The actual incident apparently arose as the result of a misunderstanding on the 1953 British expedition. Someone told the treasurer of the expedition that porters recruited from the Nepali countryside would not accept paper currency. The treasurer converted half of the funds for local expenditures into coin, which required twelve porters to carry.

distribution in the mornings was simplified. Each porter had a tag, numbered from 1 to 909, and the tag number was noted against the load number in a much-thumbed book.<sup>15</sup>

In an odd way, the procession resembled a rocket launch sending people or satellites into space. Just as a rocket burns fuel as it ascends, thereby losing mass, the mountain processions consumed stores as they advanced. The Americans ate about thirty pounds of food a day, a half container. Sherpas and porters consumed more. As the load lightened, the expedition shed porters. The reduction in mass allowed expedition leaders to dismiss about fifteen porters “every few days,” explained Roberts.<sup>16</sup>

The procession left Banepa on 20 February 1963 and arrived at Namche Bazar on 7 March, a span of fifteen days. Namche Bazar is a small village that serves as the administrative center for the Everest area, about twenty-eight miles (47 km) from Mt. Everest base camp. To account for the loss of low-altitude porters who had dropped away as the procession gained altitude, expedition leaders hired 300 new bearers more accustomed to higher altitudes beyond Namche Bazar.<sup>17</sup> The average elevation of Kathmandu is 4,430 feet (1,350 meters). Namche Bazar sits at an altitude of 11,300 feet (3,440 meters) from which the trail rises more than 6,000 feet to the site of Everest base camp at 17,600 feet (5,364 meters).

The procession moved up the Khumbu valley to Tengboche, at which point the character of the procession changed. Mid-March produced wintery weather in the mountain country. Beyond Tengboche, the American expedition team set up a series of relay camps and organized brigades that passed supplies from camp to camp. Thirty days after leaving Banepa, on 21 March 1963, the expedition established its base camp along the Khumbu glacier at the foot of the mountain the group hoped to climb.

Contrast this venture to the Mazur 2011 SummitClimb to Mt. Everest along the same route. In 2011, Mazur led a commercial climb from the south. Climbers and trekkers assembled in Kathmandu on 29 March, more than one month later than the 1963 American team had left Banepa. Mazur and his clients flew into Kathmandu. Two days after assembling in Kathmandu, they flew to Lukla, a small town about nine miles (14.5 km) south of Namche Bazar. A 40-minute ride, the flight ends with an attention-gripping landing at a 500 meter runway perched on the side of a hill. The airstrip, called Tenzing-Hillary Airport, is considered one of the most dangerous in the world.

A steep hill rises abruptly at the far end of the airfield, so an airplane once committed to landing must touch down. Likewise, a departing aircraft must lift off since the hill at the lip of the runway drops steeply into the river valley below. Work on the airfield began in 1964.

The day following their landing at Lukla, the Mazur team trekked to Namche Bazar. The group rested one day, acclimating to the altitude, and

then trekked to Tengboche on 3 April. That night, it snowed. Yaks helped carry the loads. After more acclimation and sightseeing, the party moved to Everest base camp on 9 April, nine days after departing Kathmandu.<sup>18</sup>

Mt. Everest stands on the boundary between Tibet and Nepal. Falling off one side of the mountain, a climber tumbles into Nepal. Falling in the other direction, the climber comes to rest in China/Tibet. The mountain is triangular in shape, with faces that point to the east, southwest, and northwest. Climbers from Nepal typically cross a massive icefall on the Khumbu glacier and ascend through the Western Cwm to a steep section that leads toward the mountain's southeast ridge. From a pass on the ridge named the South Col, they advance toward the summit.

Climbers on the Tibetan plateau set up camp along the Rongbuk Glacier, ascend to the North Col, and make their final push toward the summit along the northeast ridge. This was the approach used by the British in the 1924 expedition that lost Mallory and Irvine.

Having arrived at base camp, Everest climbers establish a pyramid of camps leading toward the summit. The climbers on the 1963 American team established a total of six, one approximately every 1,600 vertical feet. Camp 1 sat at 20,200 feet at the top of the Khumbu Icefall. Although not a great distance beyond the 17,800 foot base camp, the route to Camp 1 was one of the most dangerous parts of the trip. The Khumbu glacier drops like a waterfall over that distance, creating crevasses, ice towers, and building-size walls. The ice moves. On 23 March 1963 three of the climbers from the American team plus two Sherpas sought a route around a 30-foot tall ice wall. "Just then there was a noise, and everything under, around and above us started moving." Part of the ice wall "about the size of two railroad cars one on top of the other" broke loose. Debris buried three of the team members. The remaining members dug out two; the rope attached to Jake Breitenbach showed that he rested "twenty to thirty feet down" under the massive collapse, where the team sorrowfully left him.<sup>19</sup>

Assisted by their high-altitude Sherpas, the climbers crossed the Khumbu Icefall with the use of ropes, logs, and six-foot long aluminum ladders. Ladders are an important tool for bridging the icefall, and the 1963 team brought six all the way from Seattle. Above Camp I at the top of the icefall, the first contingent of the American team established two more camps along the Western Cwm. The Western Cwm is a broad glacial basin that ends around 22,300 feet at the Lhotse face. Lhotse is a nearly 28,000 foot high companion to Mt. Everest. At that point, climbers must ascend a steep 3,700 foot wall of glacial ice broken by the Yellow Band and the Geneva Spur to reach the South Col. The American team established a fourth camp at 25,000 feet and a fifth at the South Col. With help from their Sherpas, the climbers

stocked the camps with supplies in an up-and-down carrying process that also helped the climbers become acclimated to the high altitude.

At roughly 26,000 feet, the South Col traditionally marks the beginning of the “death zone,” the altitude at which the human body begins to consume itself as a source of energy. Digestive systems begin to shut down; climbers experience difficulty eating and sleeping. Since it acts as a high altitude pass between the eastern and southwestern sides of the mountain, the South Col can generate exceptionally strong winds. Twenty-three Sherpas worked at or above the South Col for the 1963 expedition—more than the full contingent of American climbers on the team.<sup>20</sup>

If the trek to Everest base camp could be seen as consisting of the foundation of the pyramid, then advance camps could be viewed as more layers ascending to the peak. The number and placement of camps varies with different expeditions.

The American expedition of 1963 established one more camp to complete the pyramid of supply. Team members located Camp VI at 27,450 feet, some 1,300 feet above Camp V at the South Col and 1,600 feet below the summit. Of the twenty-nine tons of supplies that had left Banepa in late February, the team planned to place thirty loads of approximately fifty pounds each at the South Col, a total of 1,500 pounds. At Camp VI, the team planned to leave two tents and an adequate supply of oxygen cylinders. Four cylinders of oxygen totaled fifty-two pounds, a single load.<sup>21</sup>

There was no such thing as a level place on the ridge, and it took ten men two hours to carve out a platform and pitch two 2-man tents side by side. One was on snow, one on rock, and both were anchored as securely as possible by ropes, pitons, and such heavy objects as were available. Everyone worked without oxygen. The [oxygen] cylinders were stacked nearby in the snow.<sup>22</sup>

Camp VI served as the shelter within which four climbers would attempt to sleep on 31 April and the protection to which they would return on 1 May after attempting to reach the summit. At that altitude, “even the slightest effort caused a gasping for breath.”<sup>23</sup> Although the summit is only a short distance away, it took Jim Whitaker and Mawang Gombu nearly twelve hours to reach it and return. Whitaker and Gombu reached the summit; Norman Dyhrenfurth and Ang Dawa turned back. When Whitaker and Gombu returned to Camp VI at 5:45 PM, they found the other two climbers preparing hot food and drink. Whitaker and Gombu made “a soundless sign of victory. ‘All I could do,’ said Norman, ‘was croak my congratulations.’”<sup>24</sup>

The second contingent of the American team attempted Everest by climbing the treacherous west ridge. This is not a preferred route. The contingent departed the usual pathway at the base of the Western Cwm and



established alternative camps at 24,000, 25,000, and 27,000 feet. Via the west ridge, Thomas Hornbein and William Unsoeld reached the summit at 6:30 PM on 22 May. For the descent, they joined Barry Bishop and Luther Jerstad, who had arrived at the summit three hours earlier using the South Col route. The four climbers spent the night unprotected at 28,000 feet, then continued their descent to base camp via the less demanding South Col and Western Cwm.<sup>25</sup>

Like astronauts returning from a distance orb, expedition members now had to retrace their steps to Kathmandu. Mountaineers receive credit for climbing Mt. Everest only if they return safely. Members of the 1963 American expedition packed their equipment and scientific instruments, recruited porters, and abandoned their base camp on 25 May. As they descended into early summer monsoons, the climbers shed the clothing that had kept them warm above, giving most of it to their Nepalese companions. The Americans found a use for the umbrellas brought from Seattle. "The monsoon rains now beat down, drumming at night on the nylon of the tents, drumming by day on the mud of the trail."<sup>26</sup> The trek back to Kathmandu from Namche Bazar took thirteen days. The 1963 expedition members left the village field outside Kathmandu on 20 February and returned to the city on 9 June, having placed five climbers and one Sherpa on the summit over a period exceeding three months.

The 2011 Mazur group, following roughly the same route forty-eight years later, departed Kathmandu on 31 March and returned on 5 June. Six members of the party reached the summit.<sup>27</sup>

#### Financing the Expeditions

When the leaders of the German Rocket Society (*Verein für Raumschiffahrt*) undertook their first steps toward space travel, they adopted a strategy similar to the one utilized by European mountaineers. The rocket pioneers sought financial support from a wide range of sources. They solicited funds from new members, wealthy patrons, and industrialists. They offered lectures. They produced rocket shows, documentaries, and films. In 1930, they set up a launch site or *Raketenflugplatz* on an abandoned army garrison outside Berlin. The German army allowed club members to lease the garrison for a small sum. The club received tax subsidies from the Berlin tax office and wage subsidies from the German equivalent of the U.S. Works Progress Administration. An ocean away, leaders of the American Rocket Society (founded as the American Interplanetary Society) sought financial support for their New Jersey proving ground experiments from industrialists, the Guggenheim School for Aeronautics, the Smithsonian Institution, the U.S. Weather Bureau, and their own members. The American group won the 1935 REP-Hirsch Prize from the French Astronomical Society, which carried a small cash award.

In spite of the enthusiasm of club members, the money drives undertaken by rocket clubs proved disappointing. In America, local industrialists provided rocket parts and club members contributed time, but the big donors declined to participate. Robert Goddard received financial support from a mixed group of sources, including the Smithsonian Institution and the Guggenheim family, but he worked essentially alone. While the German club's 1927 charter unabashedly identified the society as a money-raising enterprise, the financial status of the society was never secure and it was forced to disband in 1934.<sup>28</sup>

Only in fiction did the entrepreneurial strategy seem to prevail. In the classic 1950 science fiction film *Destination Moon*, space travelers win financial support from industrialists after government officials cancel support for what they view as an excessively risky project. Evil business executives bully their way into a German Moon expedition in the 1929 silent film *Frau im Mond*.<sup>29</sup> Outside of fiction, the practice of building partnerships for space travel worked less perfectly. The sums were too great; the ongoing depression too severe. The individuals most successful at building rockets capable of reaching space allied themselves with governmental sources once war departments began to show interest in the military applications of large rockets. To promote their interest in space travel, both Wernher von Braun and Sergei Korolev and the teams they led depended upon governmental sponsorship. Attention shifted to these sources. Said von Braun, "the issue in these discussions was merely how the golden cow could be milked most successfully."<sup>30</sup>

Early advocates of mountain climbing faced a similar conundrum with respect to Mt. Everest. The climbers wanted to go, but lacked the financial resources to fund their own expeditions. Like early advocates of space exploration, they sought outside contributions. Unlike the space enthusiasts, the mountaineers were successful. Perhaps the sums were less forbidding; perhaps their timing was more conducive. For whatever reasons, mountaineers received funding from a variety of sources, including governments. Significantly, this allowed members of the mountaineering community to retain control over the expeditions they promoted. (See Table 3)

The British expeditions of 1921, 1922, and 1924 relied upon funds supplied by geographic societies, the news media, government subsidies, speaking tours, and private donations. The Swiss expeditions of 1952 and 1956 relied upon a philanthropist, a foundation, private donations, business firms, and the Canton of Geneva. The government of India supplied most of the materials used during that country's 1965 ascent. The Japanese Ministry of Education and the country's news media supported that country's expedition of 1970. The Canadian expedition of 1982 received major funding

from Air Canada. A non-profit foundation provided funds for the Everest International Peace Climb of 1990. Organized to celebrate the 20<sup>th</sup> anniversary of Earth Day, the foundation in turn received a major grant from the L. L. Bean Company. Climbers typically received clothing and equipment from manufacturers that in turn publicized their participation. Expedition leaders commonly sold media rights to newspapers, broadcasters, magazines, and book publishers.

Basically, expedition leaders accepted support from anyone that would provide it. It was not uncommon for a single expedition to bundle contributions from a wide range of sources representing the private, non-profit, and public sectors.

The experience of the 1963 American expedition is again instructive. The expedition was organized by Norman Dyhrenfurth, a Polish-born (then part of Germany) mountaineer and film-maker who had been raised in Switzerland and moved to southern California to teach at UCLA and further a film-making career. According to the treasurer for the expedition, Dyhrenfurth “not only invested all of his own personal resources in the enterprise but completely divorced himself from all income opportunities for a period of almost two years.”<sup>31</sup> One of the expedition members described the difficulty of raising money for the undertaking.

In the great and wealthy United States it is harder to raise money for mountaineering purposes than in any other major, or even minor, country on earth. In Western Europe, with the Alps as its fulcrum, the climbing of mountains has long been a highly popular and organized activity, with funds for expeditions available from governments, foundations, Alpine Clubs, and various other sources. Since the beginning of large-scale Himalayan climbing early in this [the twentieth] century, nations like Britain, France, Germany and Switzerland have sent out expedition upon expedition to the Roof of the World. Even in classically poor countries like Italy and Austria, mountaineers have found little trouble raising the funds to get them to their objectives and back. In nations of the non-Western world, such as Russia, India, and even China, interest in mountaineering, though new, has recently become intense, and here the expenses of expeditions have been borne entirely by governments.<sup>32</sup>

The American expeditionary team did not want to rely primarily upon the U.S. government for its primary source of funding. “An expedition financed by a government—whether democratic, communist, or indeterminate—is certain, to a degree, to be *run* by that government, with all of the inevitable concomitants of bureaucracy, red tape, regimentation and ‘official’ status.” Instead, team leaders sought funding from a range of

sources. (See Table 6) The process, wrote the member, “proved only slightly less difficult than, say, soliciting funds for a statue of Karl Marx on the White House lawn.”<sup>33</sup>

The National Geographic Society provided the largest bloc of funding—\$114,719 or nearly 30 percent of the expended funds. The National Geographic Society is a non-profit scientific and educational institution with headquarters in Washington, D.C. Formed in 1888, it seeks to increase geographic knowledge and conserve world resources. It had supported earlier expeditions to the poles, publishing results in its widely-distributed *National Geographic* magazine, and saw the Everest expedition as an extension of this work. At the point when the Geographic Society made its commitment, the contribution made up more than half of the budget target originally set for the expedition.

In spite of their misgivings about red tape, expedition members also approached governmental officials for financial help. Senators Warren Magnuson and Clair Engle, along with Interior Secretary Stuart E. Udall, “helped clear the way to federal agencies that might help us.”<sup>34</sup> Magnuson represented Washington State, the home of Jim Whittaker, who would be the first American to reach the top of Mt. Everest. Engle represented California, Dyhrenfurth’s place of residence. The expedition received significant grants from military departments, the National Science Foundation, and the U.S. State Department. The total sum of governmental grants and contracts eventually exceeded the Geographic Society contribution and in part accounted for a substantial expansion of the expedition’s budget and activities. The more money the expedition received, the more work its members had to do. In the seventeen months between the summer of 1961 and the end of 1962, the expedition’s planned budget grew from \$186,524 to \$403,307.<sup>35</sup>

As with other expeditions, the American team happily accepted donations in kind—food, supplies, and services whose value the team’s treasurer estimated to exceed \$73,000. The Alfa Candy Corporation of New York contributed Jel Bars, while the Collins Radio Company of Cedar Rapids, Iowa, provided a KWM-2 Transceiver. Wilson & Company of Chicago, Illinois, provided freeze-dried pork chops, while the Acme Iron Works of Seattle, Washington, supplied six aluminum ladders. Whittaker, who had helped launch the Recreational Equipment Company (REI) of Seattle, Washington—he was sales manager at the time—got that supplier to provide climbing equipment, cooking gear, pack bags, and clothing. The list of in-kind contributors fills eight and one-half pages of the expedition’s report.<sup>36</sup>

The British followed a somewhat similar process in organizing their 1921, 1922, and 1924 expeditions. Members the Alpine Club proposed the expeditions. Mountain climbers from Great Britain active in climbing the

European Alps had formed the association in 1857. (It is reputed to be the oldest mountaineering club in the world.) The Club could raise only about one-third of the £10,000 thought necessary to start the venture. For additional support, they approached the Royal Geographical Society. Formed in 1830, members of the Geographical Society viewed themselves as a scientific organization devoted to geographical research.

Members of the Alpine Club viewed mountaineering as an activity worthy of pursuit for its own value. George Mallory famously captured this impulse by explaining that he wished to climb Everest “because it is there.”<sup>37</sup> To enlist support from the Geographical Society, leaders of the Alpine Club had to broaden their appeal, creating a coalition of interests analogous to the joining of scientific and human flight advocates that helped to motivate early space flight.

In the Geographical Society there still lingered the notion that climbing Mount Everest was sensational but not “scientific.” If it were a matter of making a *map* of the region, then the project should be encouraged. If it were a question of merely climbing the mountain, then it should be left to mountaineers and not absorb the attention of a scientific body like the Royal Geographical Society.<sup>38</sup>

Members of the Geographical Society joined the venture and eventually contributed about £3,000. The two societies formed a joint committee called the Mount Everest Committee that oversaw the expeditions. To fill out the funding necessary to start the first expedition, a reconnaissance of routes, the committee arranged for the sale of information about the venture. *The Times* and the *Philadelphia Ledger* received the right to publish the expedition’s telegrams, while the *Graphic* won the right to publish photographs. “So eventually the financial position of the Expedition was assured.”<sup>39</sup>

No single financial approach characterized the large Everest expeditions organized along traditional lines. Some of the organizing groups sought support from scientific and geographic societies; others turned to philanthropists and non-profit organizations. Some relied on governmental financing. Many sold rights to the media. Commercial involvement occurred. Business firms offered food and equipment. One weary expedition leader likened the process to standing outside a sporting goods store “with a tin cup.”<sup>40</sup>

As a whole, contributors were motivated by most of the same reasons that governmental officials supported space exploration: science, commerce, national prestige, and a personal desire to explore. Yet in seeking sponsors for their ambitions, mountaineers with the desire to scale the highest point on the Earth adopted a different strategy. The major findings from the examination of financial sources follow.

- The people who possessed the highest motivation and skill to climb Mt. Everest invariably lacked the resources to do it. They needed outside support.
- Expedition leaders obtained funding from wealthy individuals, societies, foundations, commercial firms, the news media, and government agencies. Groups often mixed sources in creative ways. The preferred method of financing, especially for early and transitional expeditions, was to solicit funds from all of the above.
- In Europe and America, government agencies rarely provided the sole support for an expedition, even within nations for which mountaineering was a source of great national pride.
- The entities that financed expeditions were invariably separated from the entities that carried out the expeditions.

The process for financing Everest expeditions differed from the process for space exploration. In the latter, exploration advocates eventually turned to governments for sole support and then permitted the funding agencies to organize and lead the projects.

#### Transition

The expeditionary approach to climbing Mt. Everest eventually became impractical. The approach proved increasingly costly and cumbersome. The technology of mountain climbing changed. Expeditions became harder to finance.

The 1971 International Expedition was a disaster. It began as a trip to Antarctica, with representatives from Norway, Great Britain, the United States, and Argentina involved. Due to difficulties in gaining support for that destination, the group changed its objective to Everest and not just a normal route but the terrifying southwest face. To organize the expedition and secure its financing, the team enlisted Norman Dyhrenfurth, who had led the 1963 American expedition. Dyhrenfurth expanded international participation to include climbers from Austria, West Germany, Italy, France, India, Japan, and Switzerland. Rather than appeal to the nationalistic pride of a single nation, he sought to demonstrate the advantages of international cooperation “under conditions of extreme hardship.”<sup>41</sup> By expanding the number of nations, Dyhrenfurth thought, he would expand the donor base and make the expedition financially feasible.

The strategy failed. National institutions that might have been inspired to back a national expedition refused to support an international one. Dyhrenfurth approached a number of national organizations without success, including the U.S. National Aeronautics and Space Administration. Dyhrenfurth hoped that NASA might contribute \$30,000 toward his work on oxygen supply. NASA officials refused on the grounds that the expedition was not a national one.<sup>42</sup>

The expedition gained traction when the British Broadcasting Corporation agreed to contribute the equivalent of \$110,000. As a requirement, however, the B.B.C. insisted on adding seven climbers to the expedition. "By the time it was in the field there were thirty-three members from thirteen different countries, including the media men—some of whom were good climbers in their own right. It was not, however, a team," wrote one observer. "Few of them had climbed together and those who had tended to cleave together as a natural defence [sic] against the ambitions of the rest....Dyhrenfurth was like a philatelist garnering the cream of the world's rare stamps - only to discover that they didn't make matched sets and some of the specimens were no longer in mint condition."<sup>43</sup>

The expedition gathered thirty-five tons of equipment, 450 porters, and fifty-five Sherpas. Aircraft flew half of the equipment to the new airstrip at Lukla; porters carried the rest. The crampons contributed by Austria did not fit the boots made in Germany. The standard-issue *Oriental* oxygen masks manufactured to U.S. Air Force specifications did not fit the high-altitude Sherpas. The masks, expedition members learned, were designed to fit Vietnamese facial characteristics, not people from Tibet or Nepal. One of the key members of the climbing group withdrew. The group, he feared, was too large, inadequately financed, and lacking in cohesion. (He withdrew before the group reached Nepal.)<sup>44</sup> The Icefall was unstable. The weather went bad. While completing a traverse above the Icefall, a popular Indian member of the expedition slipped and fell. The rescue team lacked the equipment to lower him safely, leaving the climber to die at the end of his rescue line. Two more members of the climbing group resigned. The group could not decide whether to attempt the original objective of climbing the southwest face or make a conventional climb. In the end, not a single member of the group reached the summit.

The 1971 expedition repeated conditions that had afflicted the Japanese expedition one year earlier. The Japanese expedition of 1970 was a massive affair, organized by the Japanese Alpine Club and financed by the Ministry of Education, the Japanese Broadcasting Corporation, and the Mainichi Newspapers. The undertaking cost 100 million Yen, which included the main expedition as well as two reconnaissance trips in 1969 to help locate the climbing route.<sup>45</sup> In 1970, the exchange rate for the Yen in U.S. dollars was 360 to one, making the expedition the equivalent of a \$2.8 million affair in the currency of the time. This was a huge expenditure by mountaineering standards.

The expedition enlisted thirty-nine climbers, including nine reporters. Like the International Expedition the following year, the Japanese planned to attack the forbidding southwest face. They also planned to place a team on the South Col for a more traditional summit attempt. Concurrently, they

shared the mountain with a separate Japanese team of thirty-four individuals. The second team was on the mountain to attempt and film a ski trip down the steep slope below the South Col. The skier, Yuichiro Miura, used a small parachute to slow his descent. After skiing tentatively down most of the slope, Yuichiro slipped on an icy patch and skidded more than 1,000 feet to the lip of a crevasse. The resulting documentary, *The Man Who Skied Down Everest*, won an Academy Award.<sup>46</sup>

Including the high-altitude Sherpas assisting them, the Japanese placed an estimated 150 people on various spots of the mountain. The first expedition brought thirty tons of material, half of it transported by air and half by porter caravan. With so many people at base camp and above, moving numerous times through the icefall, the risk of an accident rose. A collapse killed six Sherpas, then one more. A young member of the Japanese expedition died of a heart attack. Loose rock on the Southwest face forced that contingent to retreat. Three Japanese climbers and one Sherpa reached the summit from the South Col.

Attitudes within the mountaineering community began to turn away from the concept of the large expedition. As the technology of mountain climbing improved, more people climbed. As more people climbed Everest, the process of finding a novel approach that might attract outside funding became more challenging. General public interest in Everest climbs waned after the initial summits were achieved. The mountain had been climbed and now people were trying to raise more money for big expeditions by promising new routes and silly stunts. Was an overly-dramatic documentary film and four more climbers on the summit really worth the death of eight people and the financial costs involved? Commenting on the 1971 International expedition, Walt Unsworth, a British climber and premier historian of Everest climbs, summed up the general feeling within the community of mountaineers at that time.

More cogent...was the growing mood of revulsion that the climbing world was beginning to feel towards the whole concept of the huge super-marathon expedition....There was hostility towards the wheeler-dealer tactics necessary to raise the huge sums involved, the show-biz attitude of the media, the prima-donna attitude of the climbers. *If this is expedition climbing*, the mood ran, *then we want no part of it*. Indifference turned to positive antagonism, and it is fair to say that a large section of the climbing public were looking forward to the failure of Dyhenfurth's expedition with malicious glee.<sup>47</sup>

The methodology for conducting Everest climbs began to change. Concurrently, the interest in climbing revived. Changes in methodology



allowed more people to join the venture and as they did, the cost of conducting climbs started to decline.

Toward the end of the 1980s, a pair of climbing enthusiasts attempted to organize an Everest expedition in the traditional way. Walter McConnell was a New Jersey physician and Robert Reynolds a scientist working at the U.S. Department of Agriculture (USDA) research center in Beltsville, Maryland. Both were highly motivated, but not familiar with the Everest terrain. They recruited Scott Fischer, an experienced climbing leader, by offering to pay his expenses but not a salary. Fischer agreed to guide the climb. Six members of the party, assisted by four high altitude Sherpas, attempted to reach the summit. Three succeeded: two Sherpas and Ricardo Torres Nava, a citizen of Mexico. One of the Sherpas died on the descent. As Torres was the first Mexican citizen to ascend Mt. Everest, the team formally recorded itself as the American-Mexican Expedition. Informally, people called it the Nutrition Expedition.<sup>48</sup>

McConnell and Reynolds received endorsement for their venture from the USDA. The department agreed to provide staff time and pay for the experiments the team proposed to conduct on Everest, but not fund the expedition. The experiments measured the body's ability to absorb nutrients at different altitudes, from which ten scholarly papers appeared. The evidence for the research consisted of brown plastic bags into which the climbers were obliged to urinate and record their names. Sherpas refused to carry the frozen specimens.

In addition to the experiments, one of the more astounding features of the expedition was its low cost. McConnell and Reynolds raised sufficient funds to cover the basic expenses of the expedition. They received a generous grant from Malaysian Airlines, which agreed to cover their transportation and major shipping costs. They received donations from the usual collection of business firms. Because of changes in climbing approaches and technology, they needed to ship only two tons of food, equipment, and supplies from the United States to Nepal. The 1963 American expedition, by comparison, shipped twenty-seven tons. The basic cost of what became known as the Nutrition Expedition was \$205,000. Even adjusting for differences in accounting, that was significantly less than the amount spent by the 1963 expedition.<sup>49</sup>

### Innovation

Practitioners of mountaineering achieved cost reductions during the late twentieth century that somehow eluded advocates of human space flight. Space advocates hoped to cut the expense of human space travel by a "factor of ten." The origin of this legendary objective can be traced back to the early debate over the value of building a NASA space shuttle. In the early 1970s, people seeking to place payloads in low-Earth orbit paid about \$1,000 per

pound for delivery. A Titan IIC, for example, delivered a 23,000 pound payload at a 1972 cost of about \$24 million. NASA engineers estimated that they could deliver a 55,000 pound payload on a reusable space shuttle frequently flown by human pilots for as little as \$5.5 million (1972 dollars). When President Richard Nixon approved the effort to build the space shuttle, he embraced the objective by announcing that the space shuttle “may bring operating costs down as low as one-tenth.” In the press conference that followed, NASA Administrator James Fletcher stated the “factor of ten” commitment more directly.<sup>50</sup>

Although the space shuttle did not achieve this objective, the phrase attained an immortal status, thereafter used by space advocates as a primary test of success at innovation. When Robert Zubrin first proposed a plan for simplifying a human mission to Mars, the press reported that it would cost “one-tenth of previous estimates.” Zubrin established the Mars Society to promote the initiative and doubled down on his estimate. If private individuals instead of the government did the work (Zubrin proposed awarding a cash prize), the out-of-pocket expenses would fall by another factor of ten.<sup>51</sup>

Innovations in mountain climbing allowed significant reductions in cost. To place a few climbers on the summit, leaders of early expeditions could easily spend the equivalent of two million U.S. dollars (2012 value). Modern commercial outfitters achieve the same result for roughly one-tenth the cost. As with space, supporting innovations occurred in both mission architecture (the approach taken to climbing) and supporting technology.

Comparative analysis of overall mission cost masks a curious feature of the economic gains. The *price* per climber did not fall as rapidly as the *cost* per expedition.<sup>2</sup>

Early expedition leaders sought outside sources of funding because expedition members typically could not afford to pay their own shares. The charge would have been too high. Yet in the process of securing outside sponsors, expedition costs grew. The 1963 American expedition cost more than a simple summit expedition because of government grants. “The original budget had included no costs for scientific programs whose performance depended on receipt of funding.” Those grants caused the expedition team to grow from fifteen to twenty climbers and increased the planned budget two-fold.<sup>52</sup>

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<sup>2</sup> Cost per expedition represents the total sum of expenses necessary to conduct the venture (cost of production). Shares refer to the cost of the expedition divided by the number of climbers on the expedition team (not including high altitude Sherpas). Price refers to the willingness of individuals to pay for the experience of attempting to reach the summit. Price is a function of supply and demand, while cost is a function of technology and factors of production.

Similar tendencies affected the International Expedition of 1971 and the Japanese expedition of 1970. The International Expedition added seven climbers to an already large group as a condition of a media grant. The Japanese expedition, which had access to government funds, assembled thirty-nine climbers and spent five times as much as the American expedition seven years earlier. In an extension of Parkinson's law, spending expanded to fill the funds available to the expedition.<sup>53</sup>

Had the 1963 American expedition kept to its original plan (\$187,000 for fifteen climbers), the charge per climber would have been about \$12,500. That is the equivalent of about \$94,000 in 2012 dollars. Experience suggests that actual charges per climber would have been more. Nevertheless, when confronted with the estimated price the climbers concluded that the sum lay beyond their personal capacity to pay. Therefore the climbers sought outside funding. This precipitated an increase in activities. The expedition cost grew from \$187,000 to \$405,000. The number of climbers rose from fifteen to twenty. The charge per climber rose to \$20,000 or the equivalent of \$150,000 in 2012 currency. While expedition members could not afford to go for \$94,000 (2012 dollars) using their own funds, they were delighted to undertake the venture for \$150,000 using someone else's money.

The threshold for attracting people who could pay their own way at the start of the commercial era was nowhere near the one-tenth goal. Top outfitters calculated that people would pay as much as \$65,000 per person for the chance to climb Mt. Everest. (See Table 5) Adventure Consultants began its business in 1992 with a \$35,000 charge. Sensing the demand, their price quickly rose to \$65,000 per client for the infamous 1996 climb.<sup>54</sup> That is the equivalent of \$95,000 in 2012 dollars—essentially the same as the first predicted cost of the 1963 American expedition.

Under the pressure of competition and the commencement of an economic downturn, prices fell. Rainier Mountaineering listed its 2013 Everest summit at \$59,000, while Himalayan Experience found twenty-three clients willing to spend \$57,000 for the chance to summit Mt. Everest in 2012. These are the most expensive operators. SummitClimb's standard rate for an ascent from the Tibet/China side is \$27,450.

Analysis suggests a number of forces at work concurrently. First, innovation allowed expedition cost to fall dramatically. It fell from a high of 100 million Yen for the 1970 Japanese expedition to \$50,000 for Reinhold Messner's 1980 climb. Messner climbed the mountain with little more than a few tents, help from his girl friend, three yaks, a pair of lorry drivers who drove the couple to their starting point, and a government climbing permit.<sup>55</sup>

Commercial operations would not subject their clients to the conditions that Messner faced. Messner nearly froze on the descent. He had no margin for error. He could have died. He found the bottom of the cost

curve, but most people would not want to join him there. Nevertheless, costs fell dramatically as the approach to climbing changed and technology improved.

Second, falling costs in the presence of a viable market encouraged commercial firms to enter the field. Commercial operators could make a profit attracting clients to Mt. Everest (and other destinations). The revenues also provided a new source of revenue for the expert climbers who wanted someone to pay them to climb mountains. The best climbers became organizers and guides. Profits attracted more outfitters, which increased the supply of guide services. In the Spring of 2012, on the Nepal side alone, twenty-eight teams with 290 high-altitude Sherpas led 247 climbers toward the top of Mt. Everest.<sup>56</sup>

Third, in a classic demonstration of competition theory, the appearance of new outfitters caused prices to stabilize and fall. In 2012, Adventure Consultants charged \$65,000 for an Everest climb—the same amount they had charged in 1996 and an effective decline of nearly one-third in constant purchasing power. RMI Expeditions dropped their price from \$74,000 to \$59,000.

Fourth, as innovation occurred and prices fell, the activity became more affordable to potential climbers. The price per climber did not need to fall too far to create a commercial market. It did not need to fall by a factor of ten. The cases presented here suggest that the price needed to fall by as little as 33 percent for commercialization to begin. Once competition began, competition drove the price lower.

The emergence of a market for high-end adventure travel assisted the process. Disposable personal income among the people who make up the adventure-travel market grew significantly during the last half of the twentieth century. The time required for such people to earn the funds necessary to buy a place on an expedition declined. An average wage earner wishing to join the expedition that put the first Americans on the top of the world in 1963 would have needed to work nearly two and one-half years to pay the \$12,500 charge per climber based on the original cost estimate. None volunteered. To cover a \$57,000 charge with Himalayan Experience in 2012, an average U.S. wage earner would have needed to work one and two-thirds years. For people in the U.S. high-end adventure travel market (top 5 percent of earners), the decline was even more dramatic—from roughly nine months of work in the 1960s to less than four months in 2012. At the lower equivalent, six Americans signed onto the 2012 Himalayan Experience party, along with climbers from Great Britain, Russia, New Zealand, France, Australia, Latvia, Norway, Mexico, and South Africa.

As the price of a place on an expedition fell (a function of supply, demand, available income, and willingness to pay), the cost of conducting the

climb fell faster. Innovations in mountaineering allowed the average cost of production to fall steeply. The marginal cost of adding additional clients fell as well. The British expedition that achieved the first ascent consisted of fourteen climbers and twenty-eight high-altitude Sherpas.<sup>57</sup> They were the only group on the mountain in 1953. The expedition cost the equivalent of roughly \$480,000 in 2012 U.S. dollars. By 2012, sixty-one years after Hillary's first ascent, climbing Everest had grown into a multi-million dollar enterprise involving climbers, trekkers, climbing guides, Sherpas, and support staff on the mountain that year. That is the process by which innovation occurs.

Innovation on Everest benefited from improvements in technology. When Hillary and Norgay reached the summit of Everest on 29 May 1953, the news was carried by *The Times* correspondent James Morris who ran down the mountain from Camp IV. At base camp, Morris handed the written message to a runner who sped it to Namche Bazar. A radio operator in Namche transmitted the message to the British Embassy in Kathmandu, which relayed it to the government in London, which alerted editors at *The Times*. To prevent interception, Morris wrote the message in code. "Snow conditions bad stop advanced base abandoned yesterday stop awaiting improvement." The message famously reached the British public on the day of the Queen's coronation, 2 June 1953. Decoded, it read: "Summit of Everest reached on 29 May by Hillary and Tenzing."<sup>58</sup>

The American expedition of 1963 took an eighteen-pound Collins KWM-2 transceiver powered by gasoline-fuel generators and nickel-cadmium batteries. To notify the outside world of their success, the mountain team located a ham radio operator in Ceylon, who transmitted a message to a rear guard group in Kathmandu. Like the British communiqué ten years earlier, the achievement was transmitted in code. "Two mail runners left at 1300 hours May one."<sup>59</sup>

Modern climbing teams communicate with the outside world through satellite telephones and internet connections. Outside parties interested in the climb receive daily reports via the internet. Cellular service is available throughout the south side and from the summit of Everest. As part of the application process, clients are asked whether they plan to bring their own computers.

The quality of climbing equipment has improved enormously. Photographs from the 1953 expedition show Hillary and Norgay dressed in baggy cotton-blend clothing, climbing a steep slope with wooden-handled ice axes and forty-four pound climbing packs. Modern climbers carry shorter aluminum ice axes, wear streamlined mountaineering suits, and carry climbing packs that usually weigh half as much. They carry lightweight telephones, cameras, iPads, tents, and energy gel food. Sleeping bags weigh one-third as much and are comfortable to minus 20 degrees.<sup>60</sup>

Advances in satellite technology allow pin-point weather forecasting. For a very short period just before the summer monsoons begin, the persistent Everest winds diminish, the sky clears, and the weather warms. This “Spring Window,” as it is typically called, usually occurs for a few days in late May or early June. The ability of outfitters to accurately predict the timing and duration of this climbing window allows them to position their clients in high altitude camps ready to move toward the summit when the weather allows.

Transportation to and from the mountain has advanced immeasurably. The second group of climbers to reach the summit on the 1963 American expedition suffered severe frostbite. Two of them, William Unsoeld and Barry Bishop, needed immediate medical attention. Their toes, observed one expedition member, “were dead white, hard as iron, and icy to the touch.” Expedition members radioed the situation to Kathmandu and descended from the mountain to Namche Bazar with the injured men. A helicopter appeared early the following morning approaching a 12,300-foot high landing spot above the village. To the climbers who had been on the mountain for three months, it seemed like “a visitation from another world—an almost forgotten world.”<sup>61</sup> Helpers carried Unsoeld and Bishop to the helicopter; by nine a.m. they were at the United Mission Hospital in Kathmandu, an American-run facility. The rest of the expedition team, their porters and remaining equipment, marched back to Kathmandu, a thirteen-day trek.

Today, aircraft routinely land and take off using the airstrip at Lukla (9,383 feet). During the climbing seasons, high-altitude helicopters land daily at two special helipads at Everest base camp on the south side of the mountain (17,600 feet). It is risky, but helicopters can rescue climbers from as high as 23,900 feet. That record was set on Annapurna, an 8,091 meter peak in north central Nepal, in 2010. In 2005, the pilot of a specially-modified helicopter actually touched the summit of Everest with his machine and lived to tell his story.<sup>62</sup>

Routes and terrain are much more familiar than they were ninety years ago. The Royal Geographic Society agreed to support British Alpine Club for its expeditions in the 1920s because no decent maps existed for the area. Map-making activities in part motivated the Himalayan expeditions of the Swiss Foundation for Alpine Research in the mid-twentieth century. Some of the maps are still used today. Sir Edmund Hillary, along with Tenzing Norgay, scouted the way up the nearly vertical rock face that bears his name. The forty-foot high Hillary Step blocks the route to the top of Mt. Everest just a few hundred vertical feet below the summit on the southeast ridge. The British climbing team had seen the face with binoculars and found it formidable. Said Hillary: “The rock itself, smooth and almost holdless, might have been an interesting Sunday afternoon problem to a group of expert rock

climbers in the Lake District, but here it was a barrier beyond our feeble strength to overcome.”<sup>63</sup> Hillary found a route up a narrow crack. Modern climbers wait their turn to ascend and descend the Hillary Step using ropes fixed for the season by Sherpas along a pathway now well known.

Scott Fisher expressed his optimism regarding progress on Mt. Everest climbs to writer Jon Krakauer in the following way. “We’ve got the big E figured out, we’ve got it totally wired. These days, I’m telling you, we’ve built a yellow brick road to the summit.”<sup>64</sup> Fisher, the Seattle-based mountaineer who founded the well-respected Mountain Madness climbing firm, died in a 1996 climb.

Fisher’s assessment of the remaining risks notwithstanding, his statement drew on an acute understanding of the transformations underway. Not only had the technology of high altitude mountain climbing changed, but so had the approaches to doing it.

Most significant among these changes was the growing interest in the alpine approach to climbing. Promoted by Reinhold Messner and others, the alpine style depreciated the expedition model founded on its massive pyramids of people and material. To advocates of the alpine approach, the expedition style was not only inefficient, it was somehow unpure. Advocates of the alpine style believed in climbing mountains quickly, using lightweight equipment and a minimal support staff. The movement gained attention in the European Alps, where Messner and fellow climber Peter Habeler demonstrated the technique by ascending the north face of the Eiger in less than twelve hours. In 1975, Messner and Habeler climbed Gasherbrum I in the Himalayas in just three days. Gasherbrum I is a 26,500 (8,080 meter) companion to K-2 in the western Himalayas. No one had climbed an 8,000 meter peak using the alpine approach prior to their ascent. The pair climbed the mountain with a single depot above a minimal base camp. In 1978, linking themselves to an Austrian team that had a permit to climb, Messner and Habeler climbed Mt. Everest without supplementary oxygen. Physicians who had studied high altitude climbing in the so-called “death zone” did not believe that this could be done. In 1980, Messner completed his solo ascent of Everest, without oxygen and without any assistance above 6,500 meters (21,300 feet).<sup>65</sup>

The alpine style is now widely accepted in mountaineering circles. To prove that it could be applied to other realms, Messner pulled a sled across Antarctica. In space exploration, the alpine style is the equivalent of lightweight, simple spacecraft developed rapidly and inexpensively by relatively small teams. The technique has been applied to Discovery-class spacecraft missions. So far, it has not been used for human missions although it has been proposed for space flight missions as complicated as human journeys to Mars.<sup>66</sup>

The commercialization of Everest climbs benefited from economies of scale. A single expedition alone on Everest had to set its own ropes, log crossings, and ladders. It had to bring its own equipment and its own physician. At the conclusion of the three-month long assault, in principle at least, the team had to remove all of this material.

Once set and maintained for a climbing season, ropes and ladders could be used by other teams. The marginal cost of allowing a second or third team to use an established route was small. This realization led to the establishment of “ice doctors”—Sherpa teams that set and maintained aids to climbing and charged a fee for their work. The work of ice doctors is most obvious in the Khumba Icefall, although the concept is practiced on other sections of the mountain as well. One climber blogging from Everest base camp praised the work of the ice doctors in the following way.

On our last trip down we saw five of them including the head of the team. Four of them had five or six foot ladders strapped horizontally across their backs which they were steadily taking up the icefall. We will see where they've been used tomorrow. Along side all the ladder crossings are two fixed ropes either side of the ladder. These are used for clipping into to protect you should you fall off the ladder and also to act as handrails. The idea is that you'll just dangle a few feet into the crevasse rather than tumbling to the bottom never to be seen again. The trouble with using them as handrails is that you have to put some tension into [the] ropes. Personally I think [they] are more for confidence rather than aiding balance. The ladders range from being horizontal to vertical depending upon the obstacle. As the glacier moves about 8cm a day, a) there is less of the ladder resting on the ice either side of the crevasse and b) the handrail ropes get closer and closer to the ground meaning you have to stoop down when crossing the ladders. So far the ladders have ranged from single to doubles stripped together at their midpoint. I understand that on previous years there have been as many as five ladders strapped together to span a particularly wide crevasse. So the ice doctors are constantly having to adjust the existing ladders as well as forge a new route when an avalanche occurs.<sup>67</sup>

The advantage to climbing teams is substantial. Teams do not need to bring in all the heavy equipment needed for difficult parts of the climb. They do not need to spend time setting ropes and ladders. By minimizing the time spent on treacherous sections like the icefall, team members reduce the odds of a bad outcome. The process works like a toll road, benefiting both climbers and Sherpas. Everest historian Walt Unsworth reports that the practice



began around 1992 when expedition leaders met, distributed the responsibility for fixing ropes and ladders, and charged each team for their share of the cost.<sup>68</sup> Everyone is supposed to pay, although cash-poor groups occasionally try to avoid the toll.

Everest base camp on the Nepal side—a virtual village at the height of the Spring climbing season—has its own emergency medical facility in addition to the heliport and ice doctors team. All of these common facilities benefit from the large number of climbers and trekkers camping at the site.

In another application of the principal of economies of scale, mountain outfitters commonly bundle their trips. Having established their food tents, communication centers, and advance camps, the outfitters allow additional clients to experience the adventure without having to try for the top. Some clients only go as far as base camp—a trek rather than a climb—and pay much less for the privilege. The large Spring 2012 contingent from Himalayan Experience consisted not just of the twenty-three climbers who paid for the attempt to climb Everest, but six additional climbers seeking to ascend Lhotse, eight heading for Lobuche, three aiming for Nuptse, and twenty-five base camp trekkers—a total of sixty-five clients.<sup>3</sup> They were supported by nine mountain guides, three trek leaders, thirty-one high altitude climbing Sherpas, and nineteen persons to cook, staff the camps, and support the trekkers. The contingent totaled 127 individuals: a logistical nightmare but profitable for the firm.<sup>69</sup> The practice increases outfitter revenue with a small outlay of additional equipment and food.

Concurrent with these changes, governmental regulation of Everest climbs changed. In the beginning, governmental authorities strictly regulated access to the mountain. Before the British expeditionary force of 1921 could set out to scout the mountain slopes, they needed permission from the Secretary of State for India and either the government of Tibet or Nepal, the countries from which the expedition would approach the summit. “The first barriers were human,” the chairman of the Mount Everest Committee observed. Local officials “held the view that travelers caused trouble and should be discouraged.”<sup>70</sup> The Kingdom of Nepal, an independent nation, barred foreign expeditions seeking to approach Everest from the south. The Dalai Lama, who had recently declared Tibet to be an independent state, was likewise anxious about outside powers approaching from the north. So long as Britain ruled India, the leaders of these two countries resented the prospect of military-style expeditions marching across their territories. Representatives from the Royal Geographic Society and the British Alpine Club won support from the Secretary for India, the British Viceroy, the British

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<sup>3</sup> Lhotse is an 8,500 meter peak that shares the South Col with Everest, Nuptse is a 7,860 meter multi-peaked that rises above Everest’s Western Cwm, and Lobuche is a 6,100 meter peak southwest of Everest base camp.

army commander for India, and the local agent for Tibet. The latter delicately influenced his friends in the Tibetan government to approve the 1921 expedition.

Thereafter the local governments, when they had not entirely closed their borders to climbing parties, generally allowed only one expedition per year. The Kingdom of Nepal began accepting applications in 1949, two years after India's independence relieved local fears of a British presence.<sup>71</sup> The British and Americans sent a joint reconnaissance party in 1950, followed by a British team in 1951. The Swiss won approval for two attempts in 1952—one in the Spring climbing season, the other to follow after the summer monsoon. The British team, with New Zealander Edmund Hillary as their lead climber, was next in line with a permit for 1953. The practice of allowing only one or two parties on the mountain per climbing season continued until 1980. Nepal briefly closed its mountain frontier to foreign climbers for four years in the late 1960s and—except for a few clandestine attempts—Tibet was closed to most climbers for nearly thirty years following the Chinese takeover in 1950.

The one-at-a-time permit system disappeared as demand for access to the mountain grew and officials in the two countries became less suspicious of backcountry travel. In 1979, the governments of Nepal and China/Tibet separately allowed only three expeditions on the mountain. Nepal staggered the two permits it issued so as to allow only one team on the mountain at a time. The following year, the two governments dispensed ten permits, including one to a huge seventy-three person Sino-Japanese team. By 1991, the number of permits had grown to thirty-two. Government officials in Tibet and Nepal discovered that foreigners were willing to pay large sums of money—in hard currency—for the opportunity to climb. Unsworth reports that the Nepalese government charged each climbing party \$2,300 U.S. in 1991. "Cash became the chief criterion for obtaining a permit, and the demands of the authorities increased exponentially." As interest in climbing rose, so did the fee. By the end of the 1990s, Nepal was charging \$70,000 for teams using the popular Southeast Ridge route, with a surcharge for parties larger than seven climbers.<sup>72</sup>

The government of Nepal through its Ministry of Culture, Tourism, and Civil Aviation currently maintains a variable fee structure. For the most popular route in the Spring pre-monsoon season, the basic fee is \$25,000 for one person climbing alone. The charge increases incrementally to \$70,000 for a seven person team, then \$10,000 per person thereafter. Parties willing to climb in the less popular post-monsoon Autumn climbing season receive a 50 percent discount, while those hearty enough to attempt an off-season winter or summer climb receive a 75 percent reduction. Less popular routes and lesser mountains require smaller amounts. To climb an 8,000 meter

mountain like Lhotse, for example, the fee for a seven person team going out in the Spring declines to \$10,000. Nuptse, which tops out at 7,860 meters, costs just \$4,000 for a seven person team. Nuptse is 5,000 feet higher than Mount McKinley in Alaska, but Nepal has no shortage of 7,000 meter peaks.

Within these parameters, Dan Mazur set out to conduct a commercial climb in the Spring season of 2012 within the \$165,000 contributed by his clients. To cut costs, he chose a commercially less popular route to the summit, one that took his climbing party into China/Tibet. Climbing fees on the north side of Everest that year were less than on the more popular southeast route. Moreover, the northern route was less crowded than the mob scene above Namche Bazar. Mazur chose the approach discovered by George Mallory in 1921 and used by Jim Whittaker's International Peace Climb expedition in 1990.

Next, Mazur bundled his client group. His Everest team consisted of four climbers attempting Everest, five climbers engaged in a training climb (they would go high on the mountain but not all the way to the summit), and five individuals trekking to advance base camp on the north side. Adding himself, that made a nice sized group of fifteen and spread the costs of the venture more broadly.

The group gathered in Kathmandu in early April. Participants traveled north from Kathmandu to Kodari, a mountain town on the Chinese border to the west of Mt. Everest. Leaving the greenery of Kodari, they crossed onto the brown Tibetan plateau. The group paused overnight in Nyalam and Tingri to help clients acclimate to the altitude and proceeded to their base camp "comfortably seated in nice vehicles on bumpy roads."<sup>73</sup> The entire journey, traveling from Kathmandu at 1,400 feet to base camp at 17,000 feet took four days.

Loading their supplies on rented yaks, the expedition moved to an interim camp along the Rongbuk glacier and from there to an advance base camp at 6,400 meters. The expedition party at this point consisted of Mazur, his fourteen clients, an expedition manager and cook from Tibet, five Tibetan assistants, and four high altitude Sherpas from Nepal hired to guide the Everest clients to the top. This was a relatively small group by expedition standards.

By choosing the northeastern route, Mazur's party avoided the dreaded Khumba icefall. "It was a long and beautiful walk on the miracle highway surrounded by towering iced pilgrims," reported one group member.<sup>74</sup> The fifteen-mile trail from base to advance base camp follows the Rongbuk glacier past a large moraine lake, then onto a thin strip of rock in the middle of the East Rongbuk glacier on which people and yaks can comfortably walk. Climbers call the natural rock strip the miracle highway. The group took seven days to trek to advance base camp, leaving time for acclimation and an

interim camp in the middle. North side climbers setting their tents at advanced base camp (6,400 meters) are at roughly the same altitude as climbers on the southeast route who have crossed the Khumbu icefall and ascended the Western Cwm. At the north side advance base camp, Mazur's five trekkers achieved their destination, returned to base camp, and took a jeep back to Kathmandu.

From advance base camp the remaining participants practiced climbing steep slopes to the North Col, using fixed ropes and ladders locally provided for parties on the mountain that year. At slightly more than 7,000 meters, the North Col is a natural pass between two forks of the Rongbuk glacier. It marks the beginning of the final 1,800 meters (5,900 feet) needed to reach the summit.

In early May, the training group departed, leaving the four Everest climbers, Mazur, the five climbing Sherpas, and their Tibetan camp staff on the mountain. The remaining members of the team worked to establish two camps above the North Col. When the weather periodically worsened, the climbers retreated, sometimes as far as base camp. By mid-May, the group had established a series of depots: base camp (5,200 meters), interim camp (5,800 meters), advanced base camp (6,400 meters), camp 1 at the North Col (7,045 meters), camp 2 (7,500 meters), and camp 3 (8,300 meters) slightly below the summit (8,848 meters).

On May 20, working with his radio from advanced base camp, Mazur received word that a window of relatively calm, sunny weather might open in four days. Most of the team retreated from the winds blasting the higher camps, but client Jacques Puyo and Sherpa Jangbu pushed ahead and reached the top. On May 26, during the weather window, Beow Lim with Sherpa Pasang Nurbu followed. Australian Janice Smith reached the summit the following day with Tenji Sherpa and Gyalje Sherpa. Smith stepped onto the summit at 6:30 AM on the morning of her sixty-eighth birthday. The trio radioed the news to Mazur at camp 3 ten minutes after they arrived. The climbers returned to camp 3, where they spent the night. Smith quickly fell asleep. Over the next few days, Mazur directed a slow but safe descent to advance base camp. The group was back in Kathmandu by June 5.

Working together, these factors made obsolete the traditional style expedition. Commercial firms could place a higher proportion of their climbers on the summit at less cost, less risk, and more profit.

### Summary

Exhausted by the ordeal of making the first ascent, Edmund Hillary reported that he and Tenzing Norgay doubted whether anyone would ever want to repeat the act. "We couldn't have been more wrong," Hillary observed.<sup>75</sup>

Yet in many ways the groups that followed did not repeat that first achievement. The British expedition of 1953 made a 200 mile trek with 350 porters carrying thirteen tons of equipment just to reach the base of the mountain. Thirty-nine Sherpas helped the fourteen-member expedition team establish a base camp and from there a series of glacial crossings and eight more camps up the mountain to what was eventually unfamiliar terrain.<sup>76</sup> On top of this massive pyramid of people and equipment, one Sherpa and one member from the 1953 expedition party reached the top.

Modern climbers fly to Lukla or drive to their north side base camp. They bring lightweight equipment and climb using ladders and ropes fixed by other people. They employ guides who know the most frequently used routes. Parties carry modern communication equipment and have access to detailed meteorological forecasts. Individual climbers purchase insurance and can be flown out by helicopters if necessary.

If modern climbers had to endure the ordeal that Hillary and Tenzing faced, fewer would go. More than one half-century of innovation has made the process safer, cheaper, faster, and so accessible that a commercial industry has grown up around the activity.

The activity is analogous to space exploration in many ways. The most devoted advocates formed clubs to promote the activity. Club members could not afford to do it alone. Initially, they sought financial contributions from a variety of sources. The advocates saw the activity as worthy of pursuit for its own sake (“because it is there”). They enlisted the support of other parties that, while not always sharing in the metaphysical visions motivating the original advocates, found reasons to support the endeavor. Those other groups were motivated by science, the desire for national prestige, and commercial gain including the sale of newspapers, books, films, and seats in various lecture halls.

The original advocates learned that the involvement of outside groups carried a price. Outside groups (especially government agencies and the news media) contributed resources, but they made demands on the expeditions that caused them to be larger than they needed to be for the human experience alone. In an eerie repetition of the spacefaring experience, the cost of expeditions grew as experience accumulated.<sup>4</sup> In constant dollars, later expeditions like the 1963 American and 1970 Japanese ventures cost more than the earliest British and Swiss climbs.

Purists grew disgusted with the big expedition model. The big climbs cost too much; they required fund-raisers to invent ever more challenging

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<sup>4</sup> Although post-Apollo activities like the space shuttle were undertaken to reduce the cost of space flight, total spending often exceeded the cost of the systems they were designed to replace. In inflation-adjusted dollars, the total cost of the space shuttle program exceeded the money spent to send Americans to the Moon.

objectives or silly stunts to elicit funds from a public grown accustomed to conventionally repetitive climbs. Purists experimented with alternative approaches: quick, high-risk “alpine” sprints and efforts at commercialization.

Under the pressure of these factors, innovation occurred. The cost of conducting a basic expedition fell. Falling costs in the presence of an emerging market placed the price of a trip within the reach of individual customers. Prospective profits—and the realization that clients would cover the costs that allowed the most devoted mountaineers to climb—attracted commercial providers. More providers (and tighter economic conditions) encouraged further innovation along with cost and price reduction. Technology improved: communication, climbing equipment, weather forecasting, transportation, maps and knowledge of routes.

The activity benefited from economies of scale and changes in government regulation. Many people followed paths established by a few people setting ropes and ladders, the route-keepers reimbursed by the climbers for the effort involved. Commercial firms bundled their services, offering less ambitious (and less expensive) adventures in conjunction with the Big Climb. Instead of restricting access to the mountain, governments encouraged it and drew profits from their change in policy.

With time and experience, the activity became less risky. The risk did not disappear. Climbing Mt. Everest is a dangerous activity. It can be fatal for the unlucky and unprepared. In spite of some highly publicized disasters, the risk of being on the mountain declined during the commercial era.

In other ways, the mountaineering experience on Everest differed from space exploration. Most obvious, it cost less, being more accessible to individual clients as a result. Partly as a consequence of that factor, mountain climbing advocates maintained a mixed funding strategy. They never went through a period where they had to rely primarily upon government agencies to raise the funds and do the work. Mountaineers cobbled together funds from a variety of sources, including governments. Space advocates depended much more upon tax-financed government bureaus to conduct their expeditions.

With a mixed funding strategy, climbing advocates were able to maintain better control over their activities than if a single outside source provided the funds and organized the climbs. Especially in Europe and American, private groups never lost control of the activity. Even in India, where public officials funded Everest ascents, the government maintained the tradition of allowing private organizers to conduct the climbs.

Private control in this case created a powerful incentive to innovate and keep expenses low. Private control produced multiple providers. Multiple providers produced competition. Competition forced commercial operators to watch their competitors, innovate, and keep costs low. Low

costs meant more climbs. All of these factors kept the activity in the hands of people most devoted to the original cause.

Commercial provision came easily to mountaineers already accustomed to fund-raising through private funding partnerships. In space exploration, the process was less familiar. Though space policy is moving in that direction, especially through the provision of commercial launch services, the transition from large aerospace contracts to public-private partnerships is challenging for people involved.

In mountain climbing, public-private partnerships led to innovation, cost reduction, and commercial provision. Through this process, hundreds of people—paying customers—came to experience life on the roof of the world. An activity that Hillary and Tenzing Norgay thought nearly impossible came within the reach of well prepared individuals on a scale unimaginable at the beginning of the venture.

Table 1  
 American Expedition to Mt. Everest: 1963  
*Actual costs recorded through November 30, 1963*  
*U.S. dollars (1963)*

Equipment and clothing	92,850	
Oxygen equipment	22,203	
Food	20,532	
Travel and accommodations	45,872	
Freight and handling	37,745	
Wages	36,189	
Medical	3,595	
Contingency and miscellaneous	3,427	
Subtotal		262,413
Documentary film	37,237	
Still photography	4,047	
Scientific programs—direct costs	32,920	
Sherpa Tour of United States	13,104	
Subtotal		87,308
Overhead: organization & administration	52,283	
Mt. Rainier camp	3,259	
Subtotal		55,542
Total		405,263

Source: Charles B. Huestis, "Finance," in *Americans on Everest: The official account of the ascent led by Norman G. Dyhrenfurth*, by James Ramsey Ullman (Philadelphia: J. B. Lippincott, 1964), 321.

*One U.S. dollar in 1963 had the same purchasing power as \$7.52 in 2012. Source: U.S. Bureau of Labor Statistics consumer price index.*



Table 2  
Summary of Expeditions Examined as a Basis for this Study

### Traditional Expeditions

British expeditions of 1921, 1922, and 1924: The first recorded attempts to survey a route to the summit and climb it, the third expedition resulted in the loss of George Mallory and Andrew Irvine without the apparent attainment of the objective.

British expedition of 1953: Led by Colonel H. C. J. Hunt, this well-equipped expedition resulted in the first successful ascent of Mt. Everest and safe return by Sir Edmund Hillary of New Zealand and Sherpa Tenzing Norgay.

Swiss expeditions of 1952 and 1956: Knowing that the British had received permission to make a summit attempt in 1953, the Swiss sent two expeditions to Mt. Everest the year before. After failing to reach the summit in 1952, the Swiss team of 1956 became the second group to ascend Mt. Everest. Four members of the Swiss team reached the summit and safely returned.

American expedition of 1963: James Whittaker, accompanied by Sherpa Nawang Gombu, became the first American to reach the top of Mt. Everest. Four more Americans followed. One member of the climbing team died in the Khumbu Icefall.

Indian expedition of 1965: Climbers from India attempted to climb Mt. Everest in 1960 and 1962. On their third attempt, in 1965, they succeeded. Nine climbers reached the summit.

Japanese expedition of 1970: A large, costly, and fatal expedition that sent climbers to the treacherous Southwest face. Three members of the expedition team and one Sherpa reached the summit on the traditional South Col route. Seven Sherpas and one Japanese climber died on this and an unrelated Japanese expedition.

International expedition of 1971: A large, costly and unsuccessful expedition that illustrated the difficulties of Big Climbs. An Indian member of the climbing team died during a nasty storm. No climbers reached the summit.

British south-west face expedition of 1972: What began as a lightweight plan morphed into another large expedition, again to tackle the Southwest face. No one reached the summit. During the retreat, one of the base camp helpers disappeared in the icefall.

### Transitional Climbs

Austrian expedition of 1978: Reinhold Messner and Peter Habeler became the first climbers to reach the summit without supplemental oxygen. Originally planning to climb alone, they joined the Austrian expedition after they failed to obtain a

climbing permit. In addition to Messner and Habeler, seven members of the group ascended the mountain. One Sherpa died in the Icefield.

Messner solo of 1980: Supported by his girl friend and a minimal store of supplies, Reinhold Messner sprinted to the top of Mt. Everest in three days without the use of supplemental oxygen. His minimalist climb demonstrated for the first time that Everest could be climbed alone, though at great risk to the climber.

Canadian Everest expedition of 1982: This overly large expedition lost three Sherpas and one cameraman in the Icefall. Six climbers quit the team. The remaining members placed six individuals on the summit.

New Zealand expedition of 1985: A fourteen person team attempted to forge two new routes to the summit during the post-monsoon season. Encountering avalanches and horrific weather, no member of the team reached the summit.

The American-Mexican expedition of 1989: Also known as the Nutrition Expedition, the organizers of this effort conducted research on the effects of altitude on the ability of the body to consume food. Fourteen persons participated in the expedition, of which six attempted to reach the summit with the help of four Sherpas. Two Sherpas and one climber reached the summit—the first citizen of Mexico to do so. One of the Sherpas died while descending.

Everest International Peace Climb of 1990: Led by American Jim Whittaker, this large and ambitious expedition attracted climbers from the United States, the Soviet Union, and China/Tibet. Twenty individuals achieved the summit.

### The Commercial Era

Adventure Consultants (based in New Zealand, 1992, 1996, 2012): Created in 1991 and incorporated in 1992, Adventure Consultants is one of the longest running commercial operations featuring high altitude climbing. Company co-founder and trip leader Rob Hall along with one of his guides and two of his clients died on the 1996 Everest expedition. The disaster inspired Jon Krakauer, a 1996 expedition member, to write *Into Thin Air*.

IMEX film climb (United States, 1996): A mountaineering team led by David Breashears financed its expedition by producing an IMEX film of the climb. Five climbers and five Sherpas reached the summit.

SummitClimb/SummitTrek (based in England and the United States, 2011, 2012, 2013): Founded as a climbing and trekking organization in 1990, SummitClimb/SummitTrek conducts one of the more successful and cost-effective Everest operations. It offers expeditions on both the Nepal and Tibet/China side. Daniel Mazur led 2011 and 2012 Everest climbs that placed a combined total of six clients and seven Sherpas on the summit.

Himalayan Experience (Europe, 2012): Himalayan Experience is a commercial guide service established in 1996 with administrative offices in Argentiere, near Mont Blanc in the French Alps. It offers a range of Himalayan climbs and treks. In 2012 company guides led a large group to Everest, noteworthy for the action of climb leader Russell Brice who pulled the team off the mountain due to what he perceived to be dangerous conditions.

Rainier Mountaineering Inc. (RMI) (based in the United States, 2012, 2013): Lou Whittaker (the twin brother of Jim Whittaker, the first American on Everest) and Jerry Lynch founded RMI in 1969 to teach climbing as well as guide clients to the top of Mt. Rainier. RMI guides led private expeditions to the Himalayas beginning in 1982 and later entered the Everest commercial field. RMI enlisted David Hahn, who has climbed Everest fourteen times, to guide its 2013 trip.

Table 3  
Cost of Expeditions and Prime Sources of Funding

Traditional Expeditions

British expeditions of 1921, 1922, and 1924: The British Alpine Club and the Royal Geographical Committee formed a Joint Himalayan Committee to organize and conduct the earliest expeditions. The expeditions were financed from a combination of private sources: the sale of media and photography rights, donations from club members, and lecture tours. Expedition leaders estimated the expenses necessary for the 1921 reconnaissance at £10,000. The 1922 expedition cost £12,538. The 1924 attempt cost about £12,500. (Howard-Bury, 1922, 19; Isserman and Weaver, 2008, 118; Mount Everest Committee financial report, 26 November 1923, Blakeney Collection, British Library, London; Younghusband, 1926, 142)

British expedition of 1953: Secondary reports suggest that the climb cost £20,000. *The Times* of London contributed half of this sum and received exclusive rights to expedition news as a result. The British government paid the salaries of some team members, contributed rations, provided transportation, and funded research. The expedition received assistance from individuals and donations of equipment from business firms. (Hansen, 2001, 61-62; Isserman and Weaver, 2008, 278-279; Hunt, 1953)

Swiss expeditions of 1952 and 1956: The Swiss Foundation for Alpine Research organized the 1956 expedition. Karl Weber, president of the foundation, provided financial support, as did the business firm that he directed (Neue Warenhaus AG). Firms, banks, and clubs provided additional support. Each member of the expedition contributed 5,000 Swiss Francs, which Weber reimbursed after the team returned. The total budget for the 1956 expedition was 360,000 Swiss Francs. (Oelz, 2006, 158; Eggler, 1957, 40). The city, Canton, and University of Geneva supported the first 1952 expedition. No budget totals were available for the two expeditions sent in 1952. (Swiss Foundation, 1972)

American expedition of 1963: The expedition cost \$405,541, funded through a grant from the National Geographic Society, government support, the sale of media rights, donations in kind from business firms, and a small number of private donations. (Huestis, 1964, 321)

Indian expedition of 1965: The Indian Mountaineering Foundation and cabinet officers in the government of India promoted the expedition, which was financed largely by the Indian government. The Indian Department of Defence Production provided most of the equipment and food, with additional amounts from private firms. The Ministry of Education provided a small grant. Expedition leaders spent Rs. 100,000 (\$21,000 in 1965) on items not available in India. Sources provided no accounting of the value of government supplied goods. (Kohli, 1969, xx, 267)

Japanese south-west face expedition of 1970: The Japanese Alpine Club raised funds from the Ministry of Education, the Mainichi newspapers, and the Japanese Broadcasting Corporation. The budget totaled ¥100 million. (Ohtsuka, n.d.)

International expedition of 1971: The prime contribution for this expedition came from the British Broadcasting Corporation (B.B.C), with additional funds from the Mainichi Newspapers of Japan and Trans World Airlines. The total cost of the expedition exceeded \$250,000. (Unsworth, 2000, 404)

British south-west face expedition of 1972: Working with his agent, expedition leader Chris Bonington and friends received support from suppliers; sold television, newspaper, and book rights; and received grants from the Mount Everest Foundation and the British Mountaineering Council, the latter supplying funds provided by the Sports Council. The expedition cost £60,000. (Bonington, 1973, 84)

### Transitional Climbs

Austrian expedition of 1978: The Austrian Alpine Club received funds from the Tyrolean Provincial Government and newspapers, journals, radio stations, and television broadcasters. Industrial sponsors provided equipment and material. Expenses totaled 1,776,000 Austrian Schillings. (Habeler, 1979, 33-35)

Messner solo climb of 1980: Messner's biographer reports that Messner spent \$50,000 on his climb, although this is likely the fee assessed by the Chinese government for the permit. The Chinese also insisted that Messner take three helpers with him to base camp, which he declined. Messner apparently financed the climb from his book sales and lecture tours. (Faux, 1982, 159-160)

Canadian Everest expedition of 1982: What began as a low-cost expedition promoted by climber Roger Marshall and sponsored by the Alpine Club of Canada, this first-Canadian expedition to Everest turned into a three million Canadian dollar undertaking. The expedition received a major grant from Air Canada with additional support from "a long list of corporations," including Teleglobe Canada, which allowed Canadians to watch the expedition's progress via two communication satellites. (Patterson, 1990, 32)

New Zealand expedition of 1985: The budget for the expedition totaled a bare-bones NZ\$165,000 or 132,740.50 Yen (the budget submitted to Chinese authorities). Team members enlisted sponsors, held raffles, and solicited food and equipment. They received modest grants from the New Zealand Alpine Club and the New Zealand Ministry of Foreign Affairs and Ministry of Recreation and Sport. Each team member contributed \$5,000. (Dingle and Perry, 1986, 26; Brooks, 1986, 162-165)

The American-Mexican expedition of 1989 (also known as the Nutrition Expedition): Expedition leader Walter McConnell, a physician, enlisted the support of the U.S. Department of Agriculture. The U.S. government provided the time of

USDA researchers participating in the expedition and paid expenses associated with the nutrition experiments. Team member Ricardo Torres-Nava became the first citizen of Mexico to reach the summit, hence the formal name of the expedition. The expedition received a major grant from Malaysian Airlines and contributions from a variety of commercial firms. Expenses totaled \$205,000. (Correspondence with Walter McConnell and Bob Reynolds.)

Everest International Peace Climb of 1990: A special Earth Day 20 Foundation, a nonprofit organization set up to celebrate the 20<sup>th</sup> anniversary of Earth Day, raised millions of dollars for a variety of activities. The foundation provided the expedition with its \$1.1 million budget, raising roughly half of the funds from the outfitter corporation L. L. Bean. (Feder, 1989; Whittaker, 1991, 47)

### The Commercial Era

Adventure Consultants (based in New Zealand, 1992, 1996, 2012): For their first commercially-led climb in 1992, Adventure Consultants charged \$35,000 U.S. The firm enlisted ten clients, six of whom attained the summit. In 1996, it attracted eight clients and charged \$65,000 U.S. Two clients and two guides died, including co-founder Rob Hall. The firm led eight clients in 2012 at a charge of \$65,000 U.S. (EverestHistory.com: Rob Hall; Krakauer, 1997, 24; adventureconsultants.com: archives; Adventure Consultants: Mount Everest 2012: Expedition Notes)

IMEX film climb of 1996 (United States): In a twist on the customary commercial approach, the IMEX group received a \$1.65 million grant from the U.S. National Science Foundation and made an IMAX film of the climb. The film grossed more than \$100 million in its first two years of screening. (National Science Foundation Award Abstract 9614740)

SummitClimb/SummitTrek (United States and Great Britain, 2011, 2012, 2013): American climber Dan Mazur led four clients to Mt. Everest from Nepal in 2011 and four additional clients to Everest from the north side in 2012. Three clients reached the summit each time, along with three Sherpas in 2011 and four Sherpas in 2012. The price was \$33,550 for the south side climb and \$27,450 for the less-crowded north side. Mazur led another south side climb in 2013 for \$35,450. (summitclimb.com)

Himalayan Experience of 2012 (France): This European outfitter led a large group of sixty-five clients to the south side of Mt. Everest in the Spring climbing season. Twenty-three signed up to attempt Everest for €43,000 each. (himalayanexperience.com)

Rainier Mountaineering Inc. (RMI) (United States, 2013): In spite of its reputation for enlisting some of the world's most experienced guides, RMI dropped the price of its Everest trips from \$74,000 to \$59,000 in 2013. (rmiguides.com)

Table 4  
Approximate Cost of Expeditions in 2012 U.S. Dollars

British 1921 reconnaissance (about £10,000)	490,000
British expedition of 1922 (£12,538)	760,000
British expedition of 1924 (about £12,500)	740,000
British expedition of 1953 (about £20,000)	480,000
Swiss expedition of 1956 (360,000 Swiss Francs)	695,000
American expedition of 1963 (\$405,263)	3,000,000
Indian expedition of 1965 (Not Available)	N.A.
Japanese south west face expedition of 1970: (¥100 million)	16,400,000
International expedition of 1971 (\$250,000+)	1,400,000
British south-west face expedition of 1972 (£60,000)	825,000
Austrian expedition of 1978 (1,776,000 Austrian Schillings)	415,000
Messner solo climb of 1980 (\$50,000)	140,000
Canadian Everest expedition of 1982 (3 million Canadian dollars)	5,800,000
New Zealand expedition of 1985 (NZ\$165,000)	174,000
American-Mexican expedition of 1989 (also known as the Nutrition Expedition) (\$205,000)	380,000
Everest International Peace Climb of 1990 (\$1.1 million)	1,900,000
IMEX film climb of 1996 (United States, \$1.65 million)	2,400,000

*For commercial climbs, see Table 5*

*Methodology: U.S. dollars were converted to their 2012 value using the U.S. Bureau of Labor Statistics consumer price index. Non-U.S. currencies were converted to U.S. dollars based on average currency exchange rates for the year of the expedition using*

*Pacific Exchange Rate Service and measuringworth.com, then adjusted to 2012 values using the U.S. consumer price index calculator.*



Table 5  
Commercial Trips to Mt. Everest  
Cost per climber/client in current and 2012 U.S. Dollars

	<u>Cost per climber (2012 dollars U.S.)</u>
Adventure Consultants (1992) (10 Everest climbers @ \$35,000 U.S.)	57,000
Adventure Consultants (1996) (8 Everest climbers @ \$65,000 U.S.)	95,000
SummitClimb/SummitTrek (2011) (Four Everest climbers Nepal – \$33,550)	34,000
SummitClimb/SummitTrek (2012) (Four Everest climbers North side – \$27,450)	27,000
Himalayan Experience (2012) (23 Everest climbers @ €43,000)	57,000
Adventure Consultants (2012) (8 Everest climbers @ \$65,000 U.S.)	65,000
RMI Mountaineering (2013) (Advertised price \$59,000 U.S.)	59,000

Table 6  
 American Expedition to Mt. Everest: 1963  
*Sources of funding through December 31, 1962*  
*U.S. dollars (1962)*

National Geographic Society		114,719
Government support		
U.S. State Department (exchange program)	82,000	
Office of Naval Research	35,190	
National Science Foundation	24,700	
National Science Foundation (psychology)	11,600	
Air Force Office of Scientific Research	10,000	
Quartermaster Corps (general support)	10,000	173,490
Donations in kind		
Equipment	54,950	
Food	12,378	
Services	5,723	73,051
Media		
<i>Life</i> magazine	9,750	
J. B. Lippincott Company (book)	6,750	
Life and N.G.S. (film processing)	1,500	
Sawyer's Inc. (3-D photography)	2,500	
Ski magazine (article)	1,000	21,500
Contributions		
General contributions	13,961	
Explorer's Club	1,000	14,961
Other		
University of California at Los Angeles	3,520	
Other	4,300	7,820
 TOTAL		 405,541

Source: Charles B. Huestis, "Finance," in *Americans on Everest: The official account of the ascent led by Norman G. Dyhrenfurth*, by James Ramsey Ullman (Philadelphia: J. B. Lippincott, 1964), 321.

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## Notes

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<sup>1</sup> Robert Freitag, quoted in Rick Gore, "When the Space Shuttle Finally Flies," *National Geographic*, March 1981, 317. See also, Joseph J. Corn, *Winged Gospel: America's Romance with Aviation* (Baltimore: Johns Hopkins University Press, 2002) and Review of U.S. Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program Worthy of a Great Nation* (Norman R. Augustine, Chair), October 2009, 13-14.

<sup>2</sup> Administration of Ronald Reagan, "United States Space Policy: Remarks on the Completion of the Fourth Mission of the Space Shuttle Columbia," *Weekly Compilation of Presidential Documents*, July 4, 1982, 870; Bruce Mazlish, ed., *The Railroad and the Space Program: An Exploration in Historical Analogy* (Cambridge, Mass: MIT Press, 1965).

<sup>3</sup> James M. Beggs, "Why the United States Needs a Space Station" (remarks prepared for delivery at the Detroit Economic Club and Detroit Engineering Society), 23 June 1982, *Vital Speeches* 48 (August 1, 1982) 615-617; Howard E. McCurdy, *The Space Station Decision: Incremental Politics and Technological Choice* (Baltimore: Johns Hopkins University Press, 1990), xiii, 184.

<sup>4</sup> See National Commission on Space, *Pioneering the Space Frontier*. New York: Bantam Books, 1986; Gerard K. O'Neill, "The Colonization of Space," *Physics Today* 27 (September 1974) 32-40; Isaac Asimov, *Foundation*. Garden City, N.Y.: Doubleday, 1951; Lou Dobbs with H. P. Newquist, *Space: The Next Business Frontier*. New York: Pocket Books, 2001.

<sup>5</sup> Elizabeth Hawley lists the eras as the expeditionary period (1950-1969), the transitional period (1970-1989), and the commercial period (1990-2009). Hawley is the official score-keeper for Everest climbs, well known to persons in the field. See [www.himalayandatabase.com](http://www.himalayandatabase.com) (accessed 3 February 2013).

<sup>6</sup> Three hundred seventy-one reached the summit from the south side; 166 from the north. The estimate of 537 includes individuals who reached the summit more than once that year. The total number of different climbers was estimated to be 525. Source: Elizabeth Hawley, referenced in [Climbing@alanarnette.com](http://Climbing@alanarnette.com) [www.alanarnette.com/everest/everest.php](http://www.alanarnette.com/everest/everest.php) (accessed 11 August 2012).

<sup>7</sup> All conversions of U.S. dollars are calculated using the Bureau of Labor Statistics CPI Inflation Calculator. United States Department of Labor, Bureau of Labor Statistics, Databases, Tables & Calculators by Subject, CPI Inflation Calculator, n.d. [http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm) (accessed 14 January 2013).

<sup>8</sup> James Ramsey Ullman, *Americans on Everest: The official account of the ascent led by Norman G. Dyhrenfurth*, (Philadelphia: J. B. Lippincott, 1964), 108.

<sup>9</sup> Summits and Deaths by year, EverestHistory.com, n.d. <accessed 2 March 2013; see also Richard Salisbury and Elizabeth Hawley, *The Himalaya by the Numbers: A Statistical Analysis of Mountaineering in the Nepal Himalaya* (Seattle: Mountaineers Books, 2011), 168.

<sup>10</sup> René Dittert, Gabriel Chevalley, and Raymond Lambert, *Forerunners to Everest: The Story of the Two Swiss Expeditions of 1952* (New York: Harper, 1954), 67.

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- <sup>11</sup> Francis Younghusband, *The Epic of Mount Everest* (New York: Longmans, Green, 1926) 187-200 (U.S. edition). See also Walt Unsworth, *Everest: The Mountaineering History*, 3<sup>rd</sup> ed. (Seattle: Mountaineers, 2000) 107-111.
- <sup>12</sup> James W. Whitaker, "Clothing and Equipment," in *Americans on Everest*, by Ullman, 334. See also Ullman, *Americans on Everest*, 42.
- <sup>13</sup> Ullman, *Americans on Everest*, 56.
- <sup>14</sup> The story was repeated by Jamling Tenzing Norgay, the son of Tenzing Norgay who climbed Mt. Everest with Sir Edmund Hillary in 1953. For the origin of the story, see John Hunt, *The Conquest of Everest* (New York: E. P. Dutton, 1954), 64.
- <sup>15</sup> James O. M. Roberts, "Transport and Sherpa," in *Americans on Everest*, by Ullman, 336.
- <sup>16</sup> *Ibid.*, 336.
- <sup>17</sup> Ullman, *Americans on Everest*, 83.
- <sup>18</sup> SummitClimb.com, "News of our recent expedition: Everest Nepal, Lhoste, Camp 3 Training Climb, & Everest Basecamp Trek Nepal, 29 March to 5 June, 2011," 1 April, 2011 [www.summitclimb.com/new/default.asp?linktype=r&nid=153#24May](http://www.summitclimb.com/new/default.asp?linktype=r&nid=153#24May) (accessed 26 January 2013).
- <sup>19</sup> Ullman, *Americans on Everest*, 108.
- <sup>20</sup> Roberts, "Transport and Sherpa," 342.
- <sup>21</sup> Roberts, "Transport and Sherpa," 338 & 340.
- <sup>22</sup> Ullman, *Americans on Everest*, 178.
- <sup>23</sup> Ullman, *Americans on Everest*, 180.
- <sup>24</sup> Ullman, *Americans on Everest*, 190.
- <sup>25</sup> Thomas F. Hornbein, *Everest: The West Ridge* (San Francisco: The Sierra Club, 1965). See also Ullman, *Americans on Everest*.
- <sup>26</sup> Ullman, *Americans on Everest*, 284.
- <sup>27</sup> SummitClimb.com, "News of our recent expedition: 29 March to 5 June, 2011," n.d. (accessed 29 January 2013).
- <sup>28</sup> See Frank H. Winter, *Prelude to the Space Age: The Rocket Societies: 1924-1940* (Washington: Smithsonian Institution Press, 1983), 35-54, 78-85.
- <sup>29</sup> George Pal, *Destination Moon* (Eagle Lion, 1950); Fritz Lang, *Frau im Mond* (*Woman in the Moon*) (1929, available from Kino Video and other sources). For other examples of industrial interest in extraterrestrial exploration, see James Cameron, *Avatar* (Twentieth Century Fox, 2009), Ridley Scott, *Alien* (Brandywine Productions, 1979), and Duncan Jones, *Moon* (Sony, 2009).
- <sup>30</sup> Quoted from Michael J. Neufeld, *The Rocket and the Reich: Peenemunde and the Coming of the Ballistic Missile Era* (New York: Free Press, 1995) 22. See also Howard E. McCurdy, *Space and the American Imagination*, 2<sup>nd</sup> ed. (Baltimore: Johns Hopkins University Press, 2011).
- <sup>31</sup> Charles B. Huestis, "Finance," in *Americans on Everest*, by Ullman, 319.
- <sup>32</sup> Ullman, *Americans on Everest*, 20.
- <sup>33</sup> Ullman, *Americans on Everest*, 20-21.
- <sup>34</sup> Ullman, *Americans on Everest*, 26.
- <sup>35</sup> Huestis, "Finance," in *Americans on Everest*, by Ullman, 321.
- <sup>36</sup> Appendix I, in Ullman, *Americans on Everest*, 413-422.

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<sup>37</sup> See "Climbing Mount Everest Is Work for Supermen," *New York Times*, 18 March 1923.

<sup>38</sup> Younghusband, *The Epic of Mount Everest*, 24.

<sup>39</sup> C. K. Howard-Bury, *Mount Everest: The Reconnaissance, 1921* (London and New York: Longmans, Green, 1922) 19.

<sup>40</sup> Ascribed to Robert Reynolds, one of the leaders of the 1989 American-Mexican expedition, in Robert Birkby, *Mountain Madness: Scott Fischer, Mount Everest & a Life Lived on High* (New York: Citadel Press, 1986). For a similar comment, see Ullman, *Americans on Everest*, 21.

<sup>41</sup> Walt Unsworth, *Everest: The Mountaineering History*, 3<sup>rd</sup> ed. (Seattle: The Mountaineers, 2000) 404; see also Chris Bonington, *The Ultimate Challenge: The Hardest Way up The Highest Mountain in the World* (New York: Stein and Day, 1973), chap. 3.

<sup>42</sup> Unsworth, *Everest*, 404.

<sup>43</sup> *Ibid.*, 404-406.

<sup>44</sup> The climber who withdrew was Chris Bonington. See Bonington, *The Ultimate Challenge*, 31.

<sup>45</sup> Hiromi Ohtsuka, "The Japanese Mount Everest Expedition 1969-1970," Japanese Alpine Club, Expeditions, n.d. [www.jac.or.jp/english/kiroku/1970/eve70\\_e.htm](http://www.jac.or.jp/english/kiroku/1970/eve70_e.htm) (accessed 13 November 2012).

<sup>46</sup> Bruce Nyznik, "The Man Who Skied Down Everest" (1975).

<sup>47</sup> Unsworth, *Everest*, 406-407.

<sup>48</sup> Isabel B. McConnell, "On Top Everest, 1989," *Himalayan Journal* 47 (1989-90) 162-165.

<sup>49</sup> Personal correspondence with Walter McConnell (29 September 2012) and Robert Reynolds (13 November 2012); Isabel B. McConnell, "On Top Everest, 1989" *Himalayan Journal* 47 (1989-90) 162-165; see also Robert Birkby, *Mountain Madness: Scott Fischer, Mount Everest & A Life Lived on High*. (New York: Kensington, 2008), chap. 14.

<sup>50</sup> Office of the White House Press Secretary (San Clemente, California), The White House, Statement by the President, 5 January 1972; Office of the White House Press Secretary (San Clemente, California), Press Conference of Dr. James Fletcher and George M. Low, San Clemente Inn, California, 5 January 1972, 27-28; both in NASA History Office.

<sup>51</sup> Robert Zubrin, "The Mars Prize," National Review Online, 1 February 2012 [www.nationalreview.com/articles/289775/mars-prize-robert-zubrin](http://www.nationalreview.com/articles/289775/mars-prize-robert-zubrin) (accessed 3 February 2013).

<sup>52</sup> Huestis, "Finance," in *Americans on Everest*, by Ullman, 318.

<sup>53</sup> C. Northcote Parkinson, *Parkinson's Law* (Boston: Houghton Mifflin, 1957). The original law states that "work expands so as to fill the time available for its completion."

<sup>54</sup> "Rob Hall 1961-1996," EverestHistory.com, n.d. [www.everesthistory.com/climbers/robhall.htm](http://www.everesthistory.com/climbers/robhall.htm) (accessed 19 November 2012). See also Jon Krakauer, *Into Thin Air* (New York: Villard, 1997) 24.

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- <sup>55</sup> Reinhold Messner, *High Ambition: A Biography of Reinhold Messner* (London: Victor Gollanca, 1982), 158-166. Elizabeth Hawley suggests that the cost may have fallen to just two to three percent of the cost of a really expensive expedition. See Hawley, "Seasonal Stories: A Contrast of Styles," in Salisbury and Hawley, *The Himalaya by the Numbers*, 122.
- <sup>56</sup> 2012 Spring Everest and Lhotshe Expeditions, Radio Frequencies, spreadsheet in possession of author.
- <sup>57</sup> Hunt, *Conquest of Everest*, xv, 108.
- <sup>58</sup> Unsworth, *Everest*, 339-340; see also Jan Morris, *Coronation Everest* (London: Faber and Faber, 1958).
- <sup>59</sup> Allen C. Auten, "Communications," in *Americans on Everest*, by Ullman, 373-378; Ullman, *Americans on Everest*, 194-195.
- <sup>60</sup> Stephen Regenold, "Everest Climbing Gear—Then and Now," National Geographic, Everest 2012, <[adventure.nationalgeographic.com](http://adventure.nationalgeographic.com)> (accessed 7 February 2013)
- <sup>61</sup> Ullman, *Americans on Everest*, 278 & 282.
- <sup>62</sup> Nick Heil, "Giving Everest the Bird," *Outside* (May, 2012).
- <sup>63</sup> Sir Edmund Hillary, "The Summit," in *Conquest of Everest*, by Hunt, 204.
- <sup>64</sup> Krakauer, *Into Thin Air*, 66.
- <sup>65</sup> Faux, *High Ambition*.
- <sup>66</sup> See Howard E. McCurdy, *Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program* (Baltimore, MD: Johns Hopkins University Press, 2001) and Robert Zubrin, "The Mars Prize," National Review Online, 1 February 2012 [www.nationalreview.com](http://www.nationalreview.com) (accessed 24 January 2013). See also proposals for a one-way trip to Mars. Buzz Aldrin with David Noland, "Buzz Aldrin's Roadmap to Mars," 14 December 2005 [www.popularmechanics.com](http://www.popularmechanics.com) (accessed 7 February 2013).
- <sup>67</sup> Ian Ridley, Everest 2012, "The Ice Doctors," mountain-skills.com, 22 April 2012 <[ian-mountain-skills.blogspot.com/2012/04/ice-doctors.html](http://ian-mountain-skills.blogspot.com/2012/04/ice-doctors.html)> (accessed 9 February 2013).
- <sup>68</sup> Unsworth, *Everest*, 533.
- <sup>69</sup> Himalayan Experience, "Everest 2012 Members," Newsletters – Everest South 2012, 2 April 2012, <[himalayanexperience.com/newsletters/everest-south2012/everest-2012-members](http://himalayanexperience.com/newsletters/everest-south2012/everest-2012-members)> (accessed 9 February 2013).
- <sup>70</sup> Youngusband, *The Epic of Mount Everest*, 21-22.
- <sup>71</sup> Hunt, *Conquest of Everest*, 4-5.
- <sup>72</sup> Unsworth, *Everest*, 533.
- <sup>73</sup> SummitClimb.com, "Recent News – From Our Expeditions Around The World: Everest Tibet Expedition, Training Climb & ABC Trek," 14 April 2012, [www.summitclimb.com/new/default.asp?linktype=r&mtype=smenu&vid=17&nid=184#roster](http://www.summitclimb.com/new/default.asp?linktype=r&mtype=smenu&vid=17&nid=184#roster) (accessed 10 February 2013).
- <sup>74</sup> *Ibid.*, 21 April 2012.
- <sup>75</sup> David Roberts, "1953: First Footsteps – Sir Edmund Hillary and Tenzing Norgay," National Geographic, Everest 2012, April 2003 <[adventure.nationalgeographic.com](http://adventure.nationalgeographic.com)> (accessed 28 February 2013).
- <sup>76</sup> Hunt, *Conquest of Everest*, 63, 108, 236; Isserman and Weaver, *Fallen Giants*, 279.