K-Rations: How We Got Them
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In the years leading up to World War II, the U.S. Army was faced with a pressing need to modernize its basic food rations. A new kind of assault and combat had emerged since the entrenched fighting in World War I.

To win a modern war, armies needed to be highly mobile, which meant smaller units would have to be out in the field on combat rations for days at a time. To meet the needs of these soldiers, the Army required a variety of easy-to-carry food rations. In 1936 the Department of War founded the Quartermaster Subsistence Research and Development Laboratory in Chicago and charged it with devising combat meals.

One of the first rations developed in the Subsistence Lab, field ration C (shown above), was a kind of meat-and-potatoes dinner packed in a can. Stews and beef-and-noodle combinations were crammed first into a 16-ounce, then a 12-ounce tin for soldiers in the field. Developed simultaneously was field ration D, an emergency supplement designed to supply the "highest possible caloric value in the smallest package," according to a history of the Quartermaster Corps. The three bars contained in the ration comprised chocolate, sugar, oat flour, cacao fat, skim milk powder, and artificial flavoring.
While C and D rations would provide sustenance to many during the war, by far the most famous ration to come out of the lab, and the most widely known field provision used during World War II—the K ration (pictured below)—was devised by a man who previously had nothing to do with the Army.

Ancel Keys was not a nutritionist, didn't work at the Subsistence Lab, and wasn't even in Chicago in 1940 when he received a telegram from the U.S. War Department asking for his assistance in creating a nutritious, easy-to-carry food ration for Army paratroopers. Keys was a physiologist, just beginning a long and remarkable career at the University of Minnesota. In years to come Keys would pioneer the study of the epidemiology of heart disease and the effects of cholesterol on heart health. But back in the days before World War II, he was simply an up-and-coming young researcher, tapped for assistance by the War Department for the most tenuous of reasons.

While Keys' subsequent career would bring him a boatload of honors and land him on the cover of Time magazine in 1961, his effort on behalf of the war brought only modest fame and a measure of controversy. Its impact, however, was lasting and marked by a curious irony: At the beginning of the war, Keys was asked to devise a means of sustenance for thousands of soldiers in the field; at war's end he was overseeing an experiment in which a group of conscientious objectors were willingly starved on behalf of the millions of war refugees emerging from Nazi occupation in Europe.
Born in Colorado in 1904, Keys grew up in California, where he and his family survived the devastating 1906 earthquake and fire in San Francisco. In the aftermath of the quake, the Keys family moved briefly to Los Angeles, where they stayed with Ancel’s uncle, the actor Lon Chaney, before returning to Northern California, where Keys spent the remainder of his youth.

He studied economics as an undergraduate at the University of California, then shifted to biology in graduate school, earning a master's degree in six months and a Ph.D. just two years after that. In 1930 he won a research fellowship in Copenhagen, where he studied, under Nobel laureate August Krogh, the eel's ability to reside in both fresh and salt water.

A second fellowship led to a second doctoral degree, from King's College in Cambridge, England. Then it was on to a research position at Harvard, where he studied the physiological and biochemical effects of high altitudes on the human body. In the mid-1930s Keys led a team of researchers up the slopes of the Andes mountains. The group spent a week at 20,000 feet, taking blood samples and otherwise carefully measuring and examining the body's ability to function at that drastic altitude.

Soon after the publication of his report on that trip, written from a new position at the Mayo Clinic in Rochester, Minnesota, Keys moved for a final time. He became director of the Laboratory of Physiological Hygiene at the University of Minnesota, where the U.S. Army caught up with him and connected the thin thread between the needs of its paratroopers and Keys' altitude studies. "I suppose someone in the War Department had the crazy idea that because I had done research at high altitude I was therefore qualified to design a food ration to be eaten by soldiers who had been briefly a few meters above the ground," Keys wrote many years later.

That someone was probably Col. Rohland Isker, who called on Keys in Minneapolis shortly after Isker had been appointed commander of the Quartermaster Corps' Subsistence Lab in Chicago. Isker was intimately involved in the lab's efforts to create and perfect a variety of field rations, including rations C and D. He also had connections to Minnesota, where he had grown up, studied chemistry at the university, and been stationed during World War I as an officer-in-training at Fort Snelling.
Keys’ challenge

The challenge Isker presented to Keys was to devise a nutritious, nonperishable food ration that could fit in a paratrooper's jacket pocket and sustain him for a couple of days in the field. In response, Keys took Isker to a Minneapolis grocery store, where the two of them pulled a trial ration of hard biscuits, dried sausage, chocolate bars, and hard candy from the shelves. Store clerks bagged 30 separate servings of these items, and Isker charged the works to the War Department. Then he and Keys headed for Fort Snelling, on the southern edge of the city, where the ration was distributed to a platoon of soldiers. Though the soldiers ate "without relish," according to Keys, the provision fulfilled its purpose.

To add quality of life to the provisions, Keys and Isker decided to include a stick of gum, two cigarettes, a packet of matches, and a few sheets of toilet paper. The 2,700-calorie ration with accouterments was taken for a second test to Fort Benning, Ga., where it once again filled the Army's need for a compact field provision by providing "the greatest variety of nutritionally balanced components within the smallest space." In fact, the test proved so successful that the Army as a whole decided to order the combination as an emergency combat ration.

Dubbed the K ration by the Quartermasters' Subsistence Lab in honor of Ancel Keys, the provision was handed over to the Wrigley Chewing Gum Co. in Chicago for the crucial job of packaging. In May 1942 the Army placed its first order for 1 million of the easy-to-carry, wax-coated, and waterproof boxes.
From the outset, the U.S. Army considered K rations an enormous success. Easily transported, easily distributed, easily consumed, they were so popular that the Army frequently misused them, allowing the ration to serve as subsistence for troops for weeks at a time, when it was meant for only two or three days of field use. The Army also provided the ration as meals for soldiers on guard duty and in other noncombat situations when it was expressly designed for emergency work only.

Paratroopers use their emergency K Field Rations for lunch. U.S. Army Signal Corps.

At peak production in 1944, the number of rations produced annually stood at 105 million, with breakfast, lunch, and dinner K rations available. While they were viewed as a mixed blessing by GIs, who grew mightily sick of the meager contents, K rations became one of the great icons of the war and remain an indelible memory of service for hundreds of thousands of former soldiers. While the Quartermaster's Subsistence Lab in Chicago would tinker with the basic combination of foods in the ration several times during the war, the contents of that first test ration, pulled from those grocery shelves in Minneapolis by Keys and Isker, would remain the essence of the K ration through the remainder of the war. In 1948 the Quartermaster Corps declared it obsolete.

Back at the Laboratory of Physiological Hygiene at the University of Minnesota, Keys continued his efforts for the War Department. He was made a special assistant to the secretary of war, and the work of the lab was dedicated to a study of the connection between diet and fatigue for the Army. Originally housed in cramped quarters at the university's Department of Physiology, by 1942 the
Laboratory of Physiological Hygiene had outgrown its surroundings and moved to a large space in the bowels of Memorial Stadium, beneath the campus football field. It was here that Keys conceived the controversial starvation experiment. "My position in the War Department kept me informed on the situation on areas occupied by the German Army," he wrote later. "As the war continued...I thought people in the occupied areas might be near starvation. At the end of the war there would be the problem of rehabilitation. What would be the condition of the people who had been deprived of their normal food supply? What and how should they be fed?"

Though people had suffered starvation throughout history, there was scant scientific study of the phenomenon. To understand the stresses of starvation required a sort of experimentation that was typically beyond the capabilities of the lab. Human volunteers were needed, and conditions would have to be carefully controlled for an extended period of time. Science demanded that they willingly starve themselves.

Keys had an idea for acquiring volunteers. Already working in the lab were several Civilian Public Service (CPS) men. The CPS was a wartime agency founded in the tradition of Depression-era work programs to provide home-front assistance to the war effort. The one big difference was that many of the CPS laborers were conscientious objectors (CO) to the war.

Conscientious objector status had been created by federal legislation in 1940 as a direct result of lobbying efforts by religious groups that had a tradition of pacifism. When the peacetime draft began in October of that year, COs were allowed to register under this new category and were given alternative service with the CPS. They were sent to camps, quite often in rural areas, where they were usually assigned menial labor.

Keys knew that many of these COs were highly motivated, intellectually engaged individuals who were frequently frustrated by the simple tasks assigned to them by the CPS. Many were Quakers or Mennonites who supported the war and were eager to show their support in the fight against fascism but could not in good conscience participate in its violence.
CO volunteers

A photo of the participants of the "Great Starvation Experiment" led by Dr. Ancel Keys. Photo courtesy of Mad Science Museum.

They were just the sort of dedicated volunteers who might work for Keys' study, and in 1944 the Laboratory of Physiological Hygiene created and distributed a brochure to CPS camps across the country. "Will You Starve That They Be Better Fed?" its cover asked beneath a photo of children sitting at a table with empty bowls before them. Inside the brochure was a frank appeal to CPS men who "have been thwarted in their attempts to obtain service which brings help to the war victims of the world."

In a letter to prospective volunteers, Keys described the yearlong program that volunteers would be asked to endure. There would be a three-month period of "standardization" to test the subjects' health and physiology and determine ideal weights. This would be followed by six months of semi-starvation in which volunteers would eat a restricted diet "composed of the type of food most commonly available under European famine conditions...with emphasis on bread, potatoes, turnips, and macaroni." The aim was for volunteers to lose 20 to 30 percent of their original body weight in the six months of the diet, followed by three months of rehabilitation. Learning precisely how to rehabilitate a semi-starved body was a crucial objective of the experiment, so the volunteers would be divided into different groups with different rehab diets to determine which produced the best results.
The volunteers would be housed under close scrutiny in a cramped dormitory in the laboratory itself. They would undergo regular tests and observations and would engage in a challenging physical routine that included daily five-mile walks and exercise on primitive treadmills set up in the lab. Subjects would have access to classes and study at the University of Minnesota, but there was no mistaking Keys' appeal: This was service, and hard service at that. The brochure referred to the potential volunteers as future "guinea pigs."

Despite the hardships, more than 100 CPS men volunteered for the study. By the fall of 1944 Keys had selected 36 who passed a screening that measured physical health and psychological ability to withstand high-stress situations. On Nov. 19 the 12-week stabilization process began.

‘The best food around’

The men received approximately 3,500 calories a day of what one of them described as "the best food around." Their body functions and measurements were tested frequently throughout the standardization period. In February the semi-starvation process began.

The men received two meals a day, one at 8:30 a.m. and one at 5 p.m. Three basic menus rotated, with wheat bread, potatoes, cereals, turnips, and cabbage as staples for a total daily intake of 1,570 calories. Meanwhile, volunteers maintained the physical regimen that included work on the treadmills, daily walks, and assigned jobs within the laboratory.

The volunteers quickly became obsessed with food. They dreamed of it, fantasized about it, savored it through agonizingly slow eating at the dormitory cafeteria. They decorated the dormitory walls with photos of sumptuous dinner spreads and perused cookbooks for hours at a time.

Thirteen of the volunteers, none of whom had previously shown an interest in the occupation, talked of becoming cooks after the experiment was over. One subject, a native Californian, spent an inordinate amount of time comparing the prices of fruits and vegetables in California with those in Minnesota. Another decided to pursue a career in agriculture, with the idea of finding more efficient ways to raise food. And to ward off the pangs of hunger, almost all obsessively chewed gum, smoked cigarettes, or both—including one volunteer who chewed up to 40 packs of gum a day.

Two months into the program the volunteers began to look skeletal (shown below). Energy levels began to slide, and so did spirits. Some individuals developed edema, an excess of fluid in the body. Two subjects were dismissed from the program following a food binge in Minneapolis. Two others were forced
to leave after developing kidney ailments. Sex drives were diminished or nonexistent. "Moodiness, depression, and lack of self-discipline...became more severe as semi-starvation progressed," according to the study that would emerge from the experiment.

As the end of the starvation period neared, "the humor and high spirits which had been an outstanding quality of the group during standardization gradually disappeared," according to the report. The volunteers turned inward, spent "much time and energy collecting recipes, studying cookbooks, contemplating menus." They neglected housekeeping chores in the dormitory. An educational component in the program quietly ended from lack of enthusiasm.

Rehabilitation began at the end of July, but it had its troubles too. Because the subjects were divided into different groups to determine how best to offer relief to the victims in Europe, volunteers were given different diets, some with more calories than others. Not surprisingly, resentments arose.

**Study becomes a classic**

Adding to this difficulty was the fact that, even though caloric intake was immediately increased, the volunteers remained under careful scientific scrutiny and were not free to enjoy the nearby hamburger joints and pizza parlors of Minneapolis. The rehabilitation process was achingly slow and depressing to its subjects, who had spent so many weeks suffering in anticipation of a quick recovery. The bleak atmosphere lifted only as dietary restrictions were lifted, and the experiment neared its end in October 1945.
By this time the war in Europe had ended, and it would be five more years before the results of the research were published in a monumental study called *The Biology of Human Starvation*. The foreword to this two-volume work acknowledges its principal problem while suggesting its ongoing worth: "We regret, of course, that this work was not published when the hunger of the world was more acute than now. But we are not so sanguine as to suppose that these problems have been permanently banished."

Published in 1950, *The Biology of Human Starvation* became an instant classic, providing "the most complete record ever of the myriad physiological changes that come from progressive food deprivation," according to a 2002 article in the *Washington Post*. It has continued to be of value in hunger crises all over the world and remains "a benchmark study of starvation," according to Nathaniel Philbrick, who used it to help describe the starvation of a shipwrecked whaling crew in his recent book *In the Heart of the Sea*.

As time passed, some observers questioned the ethics of the study, suggesting that the pressures felt by the COs to serve the war effort amounted to coercion to join the experiment. But the volunteers themselves remained fiercely proud of their work, gathering with Keys in 1995 for a 50th anniversary celebration of the study. Many, including Washington, D.C., lawyer and diplomat Max Kampelman, went on to distinguished careers.

By the time the study appeared, Keys was already moving into a new area of research. Looking at the obituaries in local newspapers, he'd been struck by how many people were felled by heart attacks. He took blood samples of 283 local businessmen and began to focus on habits and conditions that might be influencing their heart health. In a separate study, he examined the cholesterol levels of male patients in an area hospital.

By 1958 Keys' interest in heart disease and diet had led him to an examination of whole populations. The monumental "Seven Countries Study," conducted at the University of Minnesota, examined the long-term correlation between the dietary customs of a particular region (the seven countries were Italy, Yugoslavia, Greece, Finland, the Netherlands, Japan, and the United States) and the heart health of its population.

The study found that regional diets heavy in saturated fats were more likely to result in a higher incidence of heart attacks than diets light on animal fats. More congenial to heart health was what Keys labeled "the Mediterranean diet"—loaded with fresh vegetables, fruits, pasta, and olive oil. Work on the "Seven Countries Study" brought Keys his greatest fame, including the *Time* magazine cover.
Ancel Keys died at the age of 100 in the fall of 2004—60 years to the month after the semi-starvation study began. While his work for the U.S. War Department during World War II had slipped into the recesses of history, those who were touched by his labors—from GIs to famine victims all over the world—remained legion.