Severe Malnutrition

The first of these ranges represents a very severe state of malnutrition and corresponds to weight losses experienced in certain prisons and mental institutions in German-occupied Europe during World War II, and may even be equal to the usual range of weight loss in Japanese prisoner-of-war camps in World War II. (18) This description of the behavior of civilian prisoners at Louvain, Belgium during World War II (mean weight loss, 13.2 per cent) is typical.

The inmates suffered from severe hunger pangs much of the time. They consumed their day’s entire allotment of bread (225 gm.) at breakfast... To allay their sharp and ever-present hunger they ate vegetable parings, potato peelings, carrot tops, and even decayed leaves of cabbage. A prisoner working in the garden was seen to suck on a bone retrieved from a garbage can. Another man mixed sawdust into his soup to thicken it. Still another prisoner ate a bird raw, which he caught during exercise in the prison courtyard. (19)

The effects on children of malnutrition as severe as that implied by our “high estimate” of caloric intake for the population as a whole are particularly harsh.

Protein malnutrition in infants and young children is often called kwashiorkor, whereas caloric deficiency is referred to as marasmus. Kwashiorkor is an African term meaning the “displaced child” who is no longer breast fed and must fend for himself as a member of the family. This protein deficiency syndrome is characterized by loss of appetite, apathy and peevishness, pigment changes in the skin and hair, and growth failure. The liver becomes enlarged and the digestive and other body enzymes decrease. The proteins in the blood fall to low levels and massive edema develops.

Acute diarrhea can be a dangerous illness for well-nourished infants in the United States; for the weaned infants of the less developed areas of the world who are consuming a grossly inadequate diet, it can hasten the appearance of kwashiorkor, with an appallingly high mortality. In many cases, decreased intake and poor absorption of food are intensified by infestation with intestinal parasites, brought on by poor sanitation and the reduced resistance of the malnourished child.

The common infectious diseases of childhood are catastrophic in the malnourished infant. In 1960, measles caused 0.2 deaths per 100,000 population in the United States. In India in 1960, it caused approxi-
mately 20 deaths per 100,000 population and in Chile in 1960 it caused 27.7 deaths per 100,000 population. These figures take into account only the deaths immediately related to the acute illness and do not portray the deaths from severe malnutrition precipitated by measles, which occur weeks or months later. In most reported studies of kwashiorkor, measles had preceded by a matter of weeks a fourth to half of the total number of cases.

In the United States, accidents account for more fatalities after the first year of life than the next six causes combined. In the developing countries, the mortality rate among pre-school children between 1 and 4 years of age is 10 to 30 times higher than that in the United States, the large difference is attributable to malnutrition and complicating infections. In the adolescent and young adult groups of these nations, undernutrition contributes to the high incidence of tuberculosis.

In the United States approximately 25 of every 1,000 liveborn infants succumb before the age of one year. Most of these deaths result from prematurity or congenital defects. In Southeast Asia, Africa, and Latin America, published infant mortality rates (generally underestimates) are often more than 100 per 1,000 live births, most of the excess being a direct or indirect result of poor nutrition. Early weaning and the use of unbelievably inadequate substitutes for human breast milk such as rice water, clear broths, weak teas and coffee are the common underlying causes.

Intrauterine infection or fetal undernutrition (usually from impaired placental blood flow) may lead to serious curtailment of an infant's potential for physical and mental development. Survivors of severe infantile malnutrition are physically dwarfed and there is evidence that mental capacity may be impaired.

It has been shown experimentally that undernutrition of animals during pregnancy results in a permanently reduced potential for growth. A very brief period of undernutrition in early extrauterine life limits growth permanently; progressively longer periods of deprivation are required for irreversible stunting as life progresses. The learning capacity of animals who have survived severe neonatal malnutrition has been shown to be permanently impaired and chemical maturation of the central nervous system is altered.

Children that survive severe malnutrition are stunted directly in onset. Head size and, almost certainly, brain weight are reduced and in one study, a parallel degree of mental retardation has been documented, although it is not certain to what extent this resulted from environmental deprivation. In the United States, no correlation between height and intelligence is demonstrable since the height of
become irretrievably cachectic (emaciated). (23)

Moreover, "a body weight loss of 20 per cent in a thin person, for example, may produce as much general deterioration as would a 30 per cent weight loss in an obese individual." (24) Weight losses of this magnitude (19 to 28 per cent) were induced in volunteers in the famous World War II Minnesota study on the effects of semi-starvation. (25) Weight losses on this order occurred in the great Russian famine of 1918-1922, and during the 1941-1942 siege of Leningrad. (26)

Here is how the Leningrad famine has been described.

The German blockade of Leningrad in World War II produced a food shortage that rapidly resulted in famine in the winter and spring of 1941-42. There were also other causes of distress — the strain of bombardment, destruction of shelter and community facilities, excessive demands for physical effort, and so on. The available reports deal only with conditions as seen in the hospitals (Tushinskii, Aleshina, and Zeits, 1943; see also Brozek, Wells, and Keys, 1946, and Brozek, Chapman, and Keys, 1948).

Drastic cuts in food rations began in November, and in about 4 weeks emaciation and decreased physical strength became noticeable; numerous cases of people fainting at work came to the attention of the First Aid Service. In general, the signs, symptoms, and complaints conformed to the usual picture of famine. In a sample of 42 patients prominent complaints were polyuria (85 per cent), aches and pains in the extremities (85 per cent), sensitivity to cold (80 per cent), diarrhea (75 per cent), and dryness of the skin and hair (80 per cent); only one patient did not complain of fatigue, and in only one case was there a loss of appetite.

Psychologically, various degrees of deterioration were observed. This was expressed as apathy, dulling of the emotions, lowering of the moral level, narrowing of the intellectual interests, and obliteration of the individual characteristics of the patients (Chernorutskii, 1943, p. 5). Psychotic manifestations, hallucinations, and delirium were rare even in patients who otherwise exhibited the classical signs of pellagra with dermatitis, glossitis, and diarrhea.

The peak of the incidence of pellagra was reached in May and June of 1942, that is, after some 6 months of severe food shortage. Out of 42 pellagrins only 2 showed severe psychopathological symptoms. The other 40 patients did not appear to differ psychologically from the patients with simple semi-starvation, sharing with them a certain inhibition of psychological reactions, depressed mood, and neurasthenia (Khlivitskaya, 1943, p. 89). The absence of the dementia so common in ordinary pellagra was considered to be a result of the more rapid development of the illness as compared with endemic pellagra. (27)
As for the great famine of 1918-1922,

The symptoms of personal and social deterioration were numerous. There was an increase in the incidence of mental illness and of suicide among both the adults and the children. Prostitution, under the pressure of hunger, became common. Children in large numbers were abandoned by their parents. Cannibalism was practiced. Crimes against public and private property, such as theft and robbery, assumed fantastic proportions. As to the behavior of children, Sorokin quotes the following passage from Aronovitch's report: "[In both public homes for children and private homes] there was observed a pathological greed for food. Children exhibited violent irritation, anger and hatred. They would fight to obtain a warmer place near the stove, or a larger ration during the distribution of food ... they stole food from one another and from the administration of the children's homes; the stronger snatch food from the weaker; they lied shamelessly for a chance to obtain food."

The general picture of famine in Russia in the years 1918–22 could be further documented by numerous other reports. Ivanovský (1923) commented on the bent body, the uncertain gait, the skin that lost elasticity and became wrinkled, the general senile appearance, and the weakening or even total disappearance of the sexual impulse. Hassin (1924), describing conditions during the Russian famine of 1922 on the basis of firsthand information, noted severe emaciation with disappearance of subcutaneous fat, accumulation of edema fluid, exhaustion, apathy, indifference to personal appearance and cleanliness, somnolence, loss of sexual desire, resignation, and in the late stages the immobility of the starved. The over-all apathy was strangely combined with heightened irritability; Ogranovitch (1919) reported that women killed other women in quarrels over their place in a queue.

The picture of the horror of starvation, as seen by the American Relief Administration workers in 1921–22, was summarized by Fisher (1927, esp. pp. 85–98). In the starving villages "not a living soul could be seen in the streets ... To find a quarter or even half of the houses closed and boarded up, attesting the flight of their occupants, was common. Already the deaths from starvation were so many, that village clerks no longer kept records ... Of those who remained alive, nearly all were subsisting on food substitutes, the components of which indicated the degree of their want. The more fortunate mixed grain with chaff or ground weeds and acorns. Others, having no grain, made nauseating, poisonous concoctions of weeds, tree bark, and even clay and manure. Such domestic animals as there remained were fast disappearing. They starved and died like
their owners, or were killed for food. Men and women in desperation exhumed dead animals, or killed and hungrily devoured cats and dogs when they could be found. . . . To the peasant crazed with hunger, who had come to eating the flesh of animals dug up from the ground, the practice of eating human flesh was not such a long step” (ibid., p. 98).

In some instances cannibalism was preceded by murder, the flesh being made available for public consumption through somewhat irregular business channels. Fisher records an incident in the city of Orenburg where a head was found in the streets, and the investigation “discovered that the murderer had cut up the body of his victim and sold the flesh to a Persian, who in turn sold it in the bazaar. This case resulted in the issuance of an order by the city authorities forbidding the sale of meatballs, cutlets, and all forms of hashed meats (ibid., p. 109). The report of the medical division of the American Relief Administration quotes the work of Professor Frank of the Department of Mental and Nervous Diseases of Kharkov University, who investigated a number of cases of cannibalism: “He was able to establish the authenticity of twenty-six cases in which humans were killed and eaten by their murderers. He found seven cases in which murder was committed and the bodies sold for pecuniary gain. In these latter the flesh was disguised in sausage form and placed on the open market. The practice of necrophagia he found very common in all districts” (ibid., p. 436; see also Frank, 1923).

The psychopathology of extreme hunger in the years 1921–22 was discussed in detail, with a documentation of the cases of cannibalism, by Rozenstein (1926). With reference to the occurrence of this phenomenon Rozenstein noted that in the district of Samara there were hundreds of thousands of hunger deaths; the cases of cannibalism amounted to only a few hundred, and the instances of murder and cannibalism could be counted only in terms of dozens. In the psychiatric hospital of Samara, Rozenstein examined 35 patients, including 16 children, who had eaten human flesh; 3 of the adults had murdered their victims. The murderer-cannibals were of very low grade intelligence and their personalities were described as “primitive.” Even after 4 to 5 months in the psychiatric hospital all these patients showed symptoms of severe physical exhaustion. The resort to human flesh, often after months of ever-increasing hunger pangs, appeared to be an animal-like reaction without painful emotional overtones. (28)
But there is no need to go so far afield for descriptions of typical famines. In late 1945, thanks to the "stockpiling" of 500,000 tons of rice by the French authorities, the Red River delta suffered a disastrous famine in which from one to two million people died. (29) It is only fitting that we conclude this chapter with some eyewitness accounts of that earlier catastrophe provoked by the French colonial administration.

Old men of 80 to 90 years of age that we have talked with all told us that they had never before seen a famine as terrible as this one. When we passed through areas that once had seen rice and potatoes growing in abundance and had been thriving with activity, now all we could see were dry paddy fields and people who were weak and tired:

Why was there this desolation?
Because no sooner did the population grow the crops than the government took most of it away.
Because the population had been so hungry that their strength had wasted away and they could not continue working.

When we entered market places we seldom saw foods like rice or potatoes. If there was any rice, the rice was full of husks, and if there were any potatoes, the potatoes looked not much bigger than the circumference of a chopstick . . .

When we entered the villages we saw the peasants miserably dressed. Many of them had only a piece of mat to cover their bodies. They wandered about aimlessly in the streets like skeletons with skin, without any strength left, without any thoughts, and totally resigned to the ghosts of starvation and disease. Their rice had all been taken away from them by the government. They did not have any potatoes or corn. They were forced to eat everything, whether poisonous or not, they did not care. They had eaten up all the vegetation around them. They ate even those plants that had been formerly reserved for animals. A family which still had a little bran to eat, considered it a heavenly blessing. When a dog or a rat died, it was the occasion for the whole village to come around to prepare it and parcel it out among themselves . . .

They walk in unending lines together with their whole families. There are old people and there are children; there are men and women, shrunken under the weight of their poverty and suffering. Their bodies are nearly or all naked
and the bones jut out, shaking. Even girls who have already reached puberty and whom one might expect to show some embarrassment are in the same condition. Now and again they stop to close the eyes of those who fall never to rise again, or to strip off any pieces of rag (I do not know what to call it exactly) which are left behind on their bodies. From looking at these bodies, which are more ugly than the ugliest of animals, and at these corpses, which are shriveled up on the roadsides with only a handful of straw for clothes as well as for their burial garment, one feels ashamed of being human. (30)
THE JUDGEMENT IS,” wrote John McNaughton in a memorandum which appears in the Pentagon Papers, “that, because North Vietnam’s economy and organization is predominantly rural and not highly interdependent, attacks on industrial targets are not likely to contribute either to interdiction or to persuasion of the regime. Strikes at population targets (per se) are likely not only to create a counterproductive wave of revulsion abroad and at home, but greatly to increase the risk of enlarging the war with China and the Soviet Union. Destruction of locks and dams, however—if handled right—might (perhaps after the next pause) offer promise. It should be studied. Such destruction does not kill or drown people. By shallow-flooding the rice, it leads after time to widespread starvation (more than a million?) unless food is provided—which we could offer to do “at the conference table.”

“If handled right.” Can one ever handle right the murder of a million people? Thirty years ago, those who thought so were considered war criminals at Nuremberg.

And yet, one must give the clerks their due. As we will see, there are ways and there are ways “to handle it right.” We shall explore some of them in this section, reserving a more speculative discussion of one of them—weather control—for a later chapter.
Bomb Craters

First, some of the basic givens of the situation. A 500-pound bomb—the size most commonly dropped on Indochina—makes a crater about 10 meters wide and 5 meters deep. A 2000-pound bomb makes a crater about 15 meters wide and 7½ meters deep. A 15,000-pound “daisy cutter” or “cheeseburger” bomb makes a crater about 30 meters wide and 15 meters deep.

As for the dikes and dams, though large in an absolute sense, they cannot withstand bombs of this size. The very largest dikes—those at Lam Giu and along a six-kilometer stretch at Hanoi—are 10 meters high, 10 meters wide at their top, 80 meters wide at their base, and about 30 meters wide at a point corresponding to a water level of 8.5 meters at Hanoi. (This is the average level of the Red River at Hanoi in August, and is exceeded at least once at some time almost every summer. See discussion in Chapter Two and Figure 5.) Thus, even the biggest dikes can be breached by a direct hit from three 500-pounders, two 2000-pounders, and one “Daisy cutter.”

Indeed, as we will see presently, this is to understate their vulnerability considerably.

The Smaller Dikes

The rest of the Red River dikes are much smaller. A typical “large dike”—category 1 in Figure 18—is perhaps 5 meters high, 1.5 to 6 meters wide at the top, 32 meters wide at the base, and about 25 meters wide at the 8.5 meters at Hanoi level. Still smaller dikes possess similar proportions, appropriately scaled down. Figure 22 shows the dimensions of dikes of the first and second category.

To the south, in the deltas of Thanh Hoa and Nghe An, the dikes are comparable to those of the Red River delta. The coastal levees which protect the lowlands from the ocean are much lower.

(Nor are North Vietnam’s dams very large when one considers the capacity of the bombs which can be loosed against them. The Bai Thuong dam on the Chu River in Thanh Hoa is one of the country’s biggest. Shaped like a trapezoid, it is 200 meters long but a mere 15 meters thick at its base and 3.50 meters wide at its top.)

81
Figure 22. Typical Dimensions in Meters of Dikes in Primary and Secondary Networks

1. Dikes in Primary Network

2. Dikes in Secondary Network

from Gauthier (1930)
Still, this is not even the half of it. Earthenwork dikes can be breached by much less than a direct hit.

Undermine

For one thing, the ability of a dike to hold up under high water pressure and to withstand being undermined and destroyed by seepage is a simple function of the height of the water level and the width of its base. The long, gently sloping talus behind the top of the dike serves the same function as the flying buttress of a Gothic cathedral. Cratering this part of the dike—which can always be made out to be unintentional—can significantly increase the likelihood of a rupture during periods of high water.

For another, thanks to the extraordinary turbulence of the Red River, "... an earthenwork dike submerged [perhaps following the destruction of a crucial dam or lock upstream] is a dike destroyed." And even a small crack through which a tiny amount of water trickles can rapidly turn into a major breach, as the following account taken from the official report on the great flood of 1915 shows.

The opening of the first breach [at Lien Mac, Ha Dong province] occurred on July 11 around 8 PM. At that time, the inhabitants at work on increasing the height of the small dikes at the entrance to the village of Lien Mac saw a large leak appear in the inner wall of the dike. The leak was followed almost immediately by landslides on the inner and outer walls, and the collapse of a section of the dike. In a few minutes the breach had grown to 100 meters. Frightened, the inhabitants fled in every direction, abandoning the small dikes. Following this, a section of the dike 400 meters upstream was submerged and breached in turn. The two breaches grew rapidly. In twenty-four hours they had reached their definitive width.

At the moment of rupture, a sheet of water 6.5 meters deep smashed through the wall of the dike. Two kilometers "downstream" from the point of collapse, the depth of the waters reached 8 meters.

But even during less extreme conditions of high water,
An earthenwork dike must be constantly maintained. One must be on the lookout to make sure that trees do not sink their roots into it, that animals do not dig their burrows in it, that termites do not build nests in it. One must avoid any seepages which might weaken the dike. This surveillance must be intensified during periods of high water when the increase in hydrostatic pressure inevitably produces various mishaps — weakenings in the wall, leaks or “renards,” that is to say, streams of water under pressure which manage to make their way through the dike. In such cases essential repairs must be carried out immediately ... and the population of the area mobilized. The peasants come running ... They build supplementary dikes in order to prevent the submersion of the main dike, and they repair its damaged walls... The work goes on through the night, under heavy rains, by the light of acetylene lamps, until the necessary repairs have been made.

Or again,

During the flood season, the task of mounting 24-hour-a-day watches along dikes is very important. Our dikes are made of dirt. The quality of dirt is not uniform. Inside the dikes there are large holes that have not been discovered. These weak points are discovered only when the water level rises. That is why guards must be posted along the dikes 24 hours a day. Each one is responsible for a definite section. These guards must be equipped with the necessary equipment. A strict supervision must be exercised over their task. A system of communications and liaison — utilizing all means, rudimentary as well as modern — must function continuously. The guards must have a high sense of responsibility and be constantly vigilant. A minor error may bring about fatal consequences. A termite hole may cause the collapse of a dike section, unless it is discovered and repaired according to the right techniques. A leak may bring about disastrous consequences. If some accidents happen at night in an area where watches are not organized and where no manpower is available to cope with these accidents, major difficulties will be unavoidable. Culverts and other constructions along the dikes must be protected, consolidated, repaired, and controlled on a permanent basis so that when need be, it is possible to make them function immediately.
Moreover, it is not at all necessary that the dikes be breached in many places for major flooding to occur. Most of the flooding in 1913, when nearly half of the delta was inundated, came from a few large ruptures in Vinh Yen, Phuc Yen, and Sontay provinces. (Two large breaches in Vinh Yen, perhaps four or five in Phuc Yen, and two in Sontay). It is estimated that about one-sixth of the total discharge of the Red River (or some 4500 of 25,000 cubic meters a second) disgorged itself onto the delta through these breaches.

The story is much the same for the great flood of 1915, when nearly a third of the delta was inundated. The peak flow of the Red River during this period has been estimated at 35,000 cubic meters a second at Sontay. Of this, half of the river's total volume of water spilled onto the plain through 48 breaches in the dikes. And a third of this, some 6400 cubic meters a second, passed through two adjacent breaches in Lien Mac. It was this twin breach that was responsible for submerging the entire province of Ha Dong beneath a sheet of water from two to four meters deep. Table 7 lists the ruptures and their sizes during the flood of 1915.

Bombing Strategy

It is in this context that the bombing strategy worked out in 1965-1966 by the US Air Force and described by the French geographer Yves Lacoste takes on an ominous significance. According to Lacoste, the area immediately behind the dike rather than the dike itself is attacked. The ensuing shock waves, subterranean cavities and fissures weaken the dike at its base, where the water pressure is highest anyway. Such attacks when carried out before periods of high waters have the "advantage" of appearing to have no connection whatsoever with their real targets. Moreover, it is impossible to gauge fully the extent of such hidden damage until the next period of high water. By then it may be too late. The dike may rupture at its base, allowing most of the water in the river channel to flow onto the plain.

When one keeps in mind the immense destruction caused by the discharge of a sixth of the Red River's total flow in 1913 (half the delta inundated) and 1915 (100,000 hectares of Ha Dong province covered by a sheet of water about two meters deep, 100,000 hectares
TABLE 7.

LOCATION AND SIZE OF BREACHES IN THE DIKES DURING THE FLOOD OF 1916 (IN ORDER OF OCCURRENCE)

<table>
<thead>
<tr>
<th>Location of ruptures</th>
<th>River bordered by dike (L = left bank, R = right bank)</th>
<th>Size of ruptures (meters)</th>
<th>Basin inundated</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 between Luong Phu and Dang De</td>
<td>Black River (R)</td>
<td>600</td>
<td>Son Tay</td>
</tr>
<tr>
<td>1 at Dong Vien</td>
<td>”Canal des Rapides” (R)</td>
<td>80</td>
<td>Bac Ninh</td>
</tr>
<tr>
<td>1 at Da Lam</td>
<td>Red River (L)</td>
<td>200</td>
<td>Basin s. of Bac Ninh</td>
</tr>
<tr>
<td>1 at Gia Quat</td>
<td>”Canal des Rapides” (R)</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>1 at Thuy Mao</td>
<td>Red River (R)</td>
<td>100</td>
<td>Ha Dong</td>
</tr>
<tr>
<td>1 at Dai Lo</td>
<td>”Canal des Rapides” (R)</td>
<td>650</td>
<td>Phu Ly</td>
</tr>
<tr>
<td>1 at Xam Duong</td>
<td>Red River (L)</td>
<td>120</td>
<td>Nam Dinh</td>
</tr>
<tr>
<td>1 at Xam Thi</td>
<td>”Canal des Rapides” (R)</td>
<td>550</td>
<td>Ninh Binh</td>
</tr>
<tr>
<td>1 at Lien Mac</td>
<td>Red River (L)</td>
<td>410</td>
<td>Hung Yen</td>
</tr>
<tr>
<td>2 at Ne Chan</td>
<td>Red River (L)</td>
<td>120</td>
<td>Phuc Yen</td>
</tr>
<tr>
<td>5 between Khe Nga Gi and Luc Canh</td>
<td>Red River (R &amp; L)</td>
<td>720</td>
<td>Phu Tho</td>
</tr>
<tr>
<td>20 between Phu Tho and Vietri</td>
<td>Red River (R &amp; L)</td>
<td>410</td>
<td>Thai Binh</td>
</tr>
<tr>
<td>1 at An De</td>
<td>Tra Ly River (R)</td>
<td>410</td>
<td>Phu Ly</td>
</tr>
<tr>
<td>14 between Phu Ly and Doan Vi</td>
<td>Day River (L)</td>
<td>120</td>
<td>Nam Dinh</td>
</tr>
<tr>
<td>1 at Thi Chan</td>
<td>Nam Dinh canal (L)</td>
<td>4,180</td>
<td></td>
</tr>
</tbody>
</table>

of Binh Lu, Nam Dinh, and Ninh Binh covered by a sheet of water about 2 meters thick), one can begin to grasp the full horror of a technique which may be able to cause the diversion of “the entire river’s flow . . . onto the plain.”20 For good reason Lacoste writes:

If the bombing simultaneously opened a series of breaches in this network . . . during the period of high waters (from June to October) it is extremely likely that this catastrophe would cause more deaths than the explosion of several atomic bombs on the Tonkin plain.
Nor is this all. The B-52 carpet bombing raids have long been used as a substitute for the use of conventionally guided atomic bombs in Indochina. On a typical mission three B-52s drop 756 500-pound bombs onto an area 4.5 kilometers long by .75 kilometers wide (three miles by one-half mile). These are enough bombs to place a fresh 10-meter wide bomb crater every 90 meters in the target area, and to crater about one per cent of its surface. In tonnage, the bombs are equal to a .38 kiloton atomic bomb. But because the explosive force is spread out the area cratered is equal in area to the crater produced by an atom bomb only slightly smaller (12 kilotons) than the bombs which destroyed Hiroshima and Nagasaki.

Laser-Guided Bombs

The introduction of laser-guided bombs represents yet another escalation of the air war equivalent in some ways to the introduction of small tactical atomic bombs. The reason for this new order of magnitude increase in destructiveness lies in the geometry of high explosives. The size of a crater produced by a spherical bomb containing a given charge of explosive is a simple function of its cross sectional diameter. Doubling its cross sectional diameter means doubling the size of the crater which it produces. But the weight of a bomb is a function of its volume. And when the cross sectional diameter of a sphere is doubled, its volume is increased eight times. Thus in order to double the diameter of a crater produced by a bomb of given size one must increase its weight eight times—i.e., $2^3$ times. (These relations still hold fairly well if the bomb is some other shape).  

Now consider a typical 2000-pound laser bomb such as is used in Indochina. Its guidance system brings it on the average to within 4 meters of its target. Since such a bomb usually makes a crater about 15 meters across, a radius of 7.5 meters, the target is usually hit. Now consider a conventionally guided 2000-pound bomb. On the average, such bombs fall within 40 meters of their intended targets. Thus, to insure that on the average the target would be hit each time, one would have to increase the size of their craters about five times—i.e., increasing the radius of the crater from about 7.5 meters to about 40 meters. In order to do this, one would have to
increase their weight $5^3$ times or 125 times. But a bomb with the explosive force of 125 tons of TNT is no longer a conventional bomb. It is a 1/10 kiloton tactical nuclear weapon. Of course, if the target is large, many laser bombs may still be needed to destroy it. But if it is a bridge span, a small generator plant, a dam of modest proportions, or a dike or lock, a single 2000-pound "smart bomb" can be fully as effective as a conventionally guided atomic bomb. Indeed, it can be more effective because no international outcry accompanies its use.

Monster bombs nicknamed the "daisy cutter" and the "cheese-burger," which blast craters 30 meters in diameter, B-52 carpet bombing raids which drop the equivalent of a 12-kiloton atomic bomb over a one and one-half square mile rectangle (four square kilometers), "smart bombs" which possess an undreamed of accuracy which makes them in some respects the equals of conventionally guided 1/10 kiloton atomic bombs—what else, one might ask, could this superpower do which has dropped the tonnage equivalent of one Hiroshima bomb on Indochina every six days for the last seven years?26

The answer is terrifyingly simple. The United States may in fact be tampering with North Vietnam's weather in order to harm her crops and stretch her water control system to the bursting point.
V. WEATHER MODIFICATION IN NORTH VIETNAM

BECause OF THE nature of its subject matter this chapter is necessarily speculative and in this respect must be distinguished from the preceding chapters. The published literature on weather modification is chaotic. Reviewing it, one enters a twilight region of scientific inquiry in which experts are strongly divided, and what at one moment seems most firm and secure turns out in the next to be a methodological nightmare. The field is a battleground of warring scientific paradigms. Scientiflc understanding of the mechanisms of rainmaking is still in its infancy. And relatively few experiments meet the standards for airtight rigor which we expect in a mature science.

Nevertheless, we have decided to raise the question of significant climate modification in North Vietnam for a number of reasons. First, there is strong circumstantial evidence that the United States is indeed engaged in rainmaking attempts. What is less clear is whether any program using existing technology can achieve significant results.

Second, there is ample evidence that much more modest weather modification programs stand a reasonable chance of causing a significant increase in destruction from waterlogging and otherwise moderate flooding.

Finally, the ambiguities surrounding the matter of rainmaking in
North Vietnam are, we believe, typical of the problems which will be raised by a whole new family of covert biological, chemical, and geophysical weapons in the coming decades, weapons which by altering the probabilities of disease and calamity will masquerade as nature itself.2

Crop Destruction

The most likely non-military result of US weather control efforts over North Vietnam is crop destruction due to extensive waterlogging of the spring and fall harvests. Even during peacetime years (1955-1963), a fair amount of the fall crop suffered from waterlogging due to poor drainage (Table 8).3 With proper techniques, the spring harvest could also be affected.4

<table>
<thead>
<tr>
<th>Year</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>25,000</td>
</tr>
<tr>
<td>1956</td>
<td>175,000</td>
</tr>
<tr>
<td>1957</td>
<td>52,000</td>
</tr>
<tr>
<td>1958</td>
<td>85,000</td>
</tr>
<tr>
<td>1959</td>
<td>95,000</td>
</tr>
<tr>
<td>1960</td>
<td>105,000</td>
</tr>
<tr>
<td>1961</td>
<td>55,000</td>
</tr>
<tr>
<td>1962</td>
<td>82,000</td>
</tr>
<tr>
<td>1963</td>
<td>257,000</td>
</tr>
</tbody>
</table>

The key to all this is a method for inducing cloud mergers and massive cloud growth called “dynamic seeding,” pioneered by Dr. Joanne Simpson of the Experimental Meteorology Laboratory at Coral Gables, Florida. When dynamic techniques are applied to single clouds, increases in rainfall on the order of at least 100 per cent occur. These increases have been documented in a series of well-controlled scientific experiments in Florida, one of which led former Under-secretary of Commerce for Science and Technology Myron Tribus to declare in 1970, “In my opinion we now have in hand the knowledge
to proceed to operational weather modification . . [with respect to] the increase of rainfall in some tropical areas. 5

Cloud Mergers

The case for cloud mergers is not as well documented, but it is still quite persuasive. At present, the Florida group has induced seven mergers under satisfactory experimental conditions. On the average, about four times more rain fell in the seven seeded cases than in five unseeded control cases, the average difference in rainfall being about 24.5 million cubic meters, or enough to cover 24,500 hectares with four inches of rain. The odds against this being due to chance are 10 to 1. This is an impressive result. 6

This result is even more significant if one compares rainfall following seeding-induced mergers to rainfall in individual clouds before merger. Increases in one experiment ranged from 10 to 200 times the preseed rainfall from the individual clouds, or from 6 million to 100 million cubic meters of water in the five-hour period immediately following seeding. The size of the merged systems after seeding ranged from 15,000 to 450,000 hectares, with the second most rainfall being produced by the smallest area storm. The rain produced by these storms was sufficient to cover from 6000 to 100,000 hectares of farmland with four inches of rain in five hours. In this experiment, "the magnitude of total target rainfall . . . during the five hour analysis period [was] one to two order of magnitude [10 to 100 times] greater than the maximum amount of rainfall that is observed from intense isolated Florida thunderstorms during their lifetimes." 7

North Vietnam Rain Clouds

The clouds which are seeded in these experiments are supercooled cumulus clouds, the kind which produce most of North Vietnam's rain during the spring, summer, and fall. 8 The simplest of equipment suffices to carry out the seeding: rockets, such as are used by spotter planes for marking targets, a warhead containing about 50 grams of silver iodide (the seeding material), a rack under the wing to hold the projectiles. 9 With one procedure much favored by Defense Department scientists (of which more later), the necessary experience for learning to identify appropriate cloud formations can be picked up
in four hours. In a week's time one can be highly proficient. 10

Seeding

Simpson uses a more formal method. Before take-off, meteorological information is fed into a computer programed with a simple cumulus cloud model. The computer determines the "seedability" of different sizes of clouds on that day. 11 With either approach, almost any aircraft could carry out cloud seeding over North Vietnam in addition to its other missions. The only constraints would be imposed by the North Vietnamese air defense system.

Figure 23 shows the typical progress of a merger. 12 In this particular case 20 times more rain fell after the merger than before it. In total, about 11 million cubic meters of water fell in five hours. One can imagine the effects of a succession of storms of this intensity on the spring and fall harvest, or in a region recovering from serious natural flooding, or in an area like the Ha Dong basin in which water naturally tends to pool in the southern end. At the very least widespread crop damage would ensue. At the most, scenes like the following might be repeated over and over again throughout North Vietnam:

In 1963, 4,270 hectares of . . . 12,000 hectares of cultivated land [in Ly Nhan district, Ninh Binh province] were submerged by rainfalls in July. To fight against water-logging, 7,390 people armed with 600 [manual] waterwheels and 3,600 scoops had to be mobilized. It took them, on the average, 80 man-days to clear a single hectare of land. 13

Time is the great enemy in these desperate battles. If the rice remains under clear water for six to eight days, it is irretrievably lost. If the water is muddy for five days suffices to destroy the whole crop. 14 And even if the rice plants are saved or new ones planted in time after the fields have been cleared of water, yields are considerably lower than in a normal year. 15

But what of still more drastic manipulations of North Vietnam's climate? Is it possible that cloud merger techniques were responsible for the extremely high water levels of 1963 and last year's floods? Interestingly enough, the answer depends on whose results you believe.
Figure 23. Typical Rainfall Increase Following a Cloud Merger

JULY 16, 1970

from Simpson and Dennis (1972)
Those of civilian scientists like Dr. Joanne Simpson are too small by a factor of ten to induce heavy flooding in North Vietnam. Moreover, while hoping that her technique could be used to significantly increase rainfall over a season, Dr. Simpson stresses that only well-controlled scientific experiments will prove that this is the case. One possibility which she cannot rule out but tends to discount is that mergers redistribute rather than increase rainfall.16

In contrast to all this, the results reported by the Defense Department's most eminent weather scientist, Dr. Pierre St-Amand of the Naval Weapons Center at China Lake, California, are large enough to cause massive floods. However, Dr. St-Amand's data are much less convincing than Dr. Simpson's.

### TABLE 9.

NUMBER OF "SIMPSON-MERGERS" NEEDED TO RAISE RIVER LEVELS TO THOSE OCCURRING DURING THE GREAT FLOODS OF 1913, 1915 AND 1926 (ASSUMING THAT HALF THE WATER WHICH FALLS ON THE WATERSHED FINDS ITS WAY INTO THE RIVER).

<table>
<thead>
<tr>
<th>Year and duration of flood</th>
<th>Average height at Hanoi during period (usual height during this period in parentheses)</th>
<th>Excess above daily average for period (cubic meters per day)</th>
<th>Number of Simpson mergers per day needed to generate this much excess water (rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1913</td>
<td>11.1 meters (8.7)</td>
<td>+780 million</td>
</tr>
<tr>
<td></td>
<td>1915</td>
<td>10.7 meters (8.3)</td>
<td>+690 million</td>
</tr>
<tr>
<td></td>
<td>1926</td>
<td>10.5 meters (8.3)</td>
<td>+640 million</td>
</tr>
</tbody>
</table>

a. See note 17.

b. The highest levels recorded during this period were, respectively, 11.38 meters, 11.65 meters, and 11.93 meters. Had the dikes held, it is estimated that the corresponding figures would have been 12.32 meters, 12.92 meters, and 12.00 meters. See note 18.

c. We have subtracted the average amount of water produced in the unseeded control cases (about 8 million cubic meters) from the average amount produced in the seeded cases and from the amount produced in the largest of the seeded cases (about 32 million cubic meters and 109 cubic meters respectively) to arrive at our estimates for "average" and "large" mergers. See note 17 for discussion.
Simpson-Mergers

Table 9 shows how many Simpson mergers a day would be necessary to induce floods on the scale of those in 1913, 1915 and 1926. Column 1 shows the average height of the flood waters during the period and the average height of the Red River during the same period in a normal year. Column 2 gives the average amount of water in excess of the amounts usual for these times of years which was discharged by the Red River. The remaining columns give the number of "large" and "average" Simpson mergers per day needed to generate this much excess water.

Except for the large merger case—which is fairly rare in Simpson’s experiments—the number of mergers needed seems prohibitive. Planes that chase clouds instead of MIGs may be shot down. Moreover, we have no idea how common potential merger situations are in North Vietnam and Laos. Over an area of south Florida about one-fifth as large as the North Vietnamese part of the Red River basin, five out of ten and seven out of thirty days were suitable for seeding in Simpson’s 1970 and 1971 experiments. But Florida was in the grip of a terrible drought in 1971, and in both years seeding missions had to be scheduled around the April-May tomato harvest and hurricane seeding and monitoring experiments carried out in July and August.

In the Philippines there were an average of six seeding opportunities a day, and seeding was carried out on all but 11 of the 51 days of the project. But St-Amand’s two planes ranged over an area about five times that of the Red River’s watershed in North Vietnam. Still, we believe that in the Philippines—and possibly in Florida—more clouds would have been found if more planes had been used.

Dangerous Push

On the other hand, the chances of giving nature a dangerous push in the “right” direction during a period of high waters appear somewhat better. Something like 400 million cubic meters a day suffices to raise the Red River one meter when it is 10 meters or higher at Hanoi, an increase that could spell the difference between no flood and a serious one. Nevertheless, even this requires eight large Simpson mergers a day.

Far more likely is a prolongation of the rainy season into the fall,
an objective which Seymour Hersh's military informants told him was a prime goal in US rainmaking attempts in Laos and North Vietnam. If serious flooding has occurred earlier in the year, this can lead to outright disaster. Following a major flood the dikes are patched together as quickly as possible to allow the work of draining the fields to begin. But these patches are not very strong and can be easily swept away by river crests which would be considered trivial in a normal year. The following example taken from the flood of 1915 in Lien Mac, Ha Dong province is an extreme example of the havoc which these minor crests can cause, but it is precisely such extreme cases which the Simpson cloud merger technique may make possible.

Because of the height of the waters coming through the breach and the force of the currents, no attempt was made to build a dam to close the break in the dike until July 27, after the water level had fallen sufficiently. The dam—which measured some 600 meters in length—was constructed out of a double line of posts faced with wattling on one side to break the force of the current. The space between the posts was filled with sacks of dirt. The resulting bulkhead allowed work to proceed on repairing the gap in the dike . . . 7000 coolies were employed in this task, which presented serious difficulties. Nonetheless, the closing of the breach was completed on the evening of October 12. But then, that very same evening, a modest river crest submerged the dam, causing its destruction. This rupture, stemming from a cause so small, was to have the most disastrous consequences. When it occurred, the flooded basins were rapidly being drained of their water, and the transplantation [of new rice plants to replace those destroyed by the flooding] was moving apace. The inhabitants were already expecting a superb harvest which would make them forget the days of suffering they had endured, when, to their sad surprise, they saw the waters invading their ricefields, yet again, drowning all their crops. This time the misfortune was without remedy, and all hopes for a harvest were lost in the four basins . . . It was therefore this second inundation which represented the true disaster, and not the first one, in spite of its appearance of catastrophe and the inevitable suffering which it caused.

In October, the average height of the Red River at Hanoi is 6.35 meters. In November it is 5 meters. An extra 30 million cubic meters of water a day suffices to raise its level by one meter for a day.
This is the amount of run-off postulated to be produced by two large Simpson mergers and ten average Simpson mergers. Some 3.15 million cubic meters and 2.90 million cubic meters of additional water per day would raise the Red River by two meters in October and November respectively. 27

Further south, in Thanh Hau province, the prospects for inducing flooding during or after periods of high water seem considerably better. The Chu River is especially volatile. During the rainy season its level fluctuates wildly from one storm to the next. 28 Upstream of the dam at Bai Thuong, its average depth during the rainy season is about 12 meters. But it is frequently much higher and can reach more than 20 meters in September. During such a period of high water one or two large Simpson mergers a day would raise its level by 2 meters, enough to create a serious flood danger in the Chu-Ma delta. Inducing moderately high crests after a period of flooding also seems within the bounds of possibility. An increase of 170 million cubic meters of water a day will lift the water level about 5 meters, from 11 to 16 meters. 29 Moreover, the Chu watershed would seem almost ideally located for weather modification activities. As with other rivers in the panhandle, it lies partly in Laos. 30 Still, raising the Chu's water level from its 12 meter average in September to 20 meters is unlikely. It would require a daily increase of about 420 million cubic meters of water, or somewhere between 4 and 9 Simpson mergers a day.

Naval Weapons Center

Turning from the results of the Coral Gables Laboratory to the results of the Naval Weapons Center at China Lake, California is like turning from a mouse to an elephant. Dr. Simpson's work suggests that anything more than crop destruction through waterlogging and potentially serious floods during the fall are only marginally possible. In contrast, the work of Dr. Pierre St. Amand and his co-workers suggests far more. It suggests that the United States may now have the operational capability to induce massive floods on the scale of those in 1913, 1915, and 1926.

The heart of the matter is a Defense Department drought alleviation program called Project Gromet II which was at the beginning of the 1969 rainy season from April 29 to June 18. Using two planes
which seeded clouds up and down the archipelago during daylight hours, St-Amand and his co-workers claim to have caused more than three-quarters of the heavy rainstorms and more than half of the total rainfall which occurred during the 51-day period. In all, they claim to have generated no less than 15 billion cubic meters of rainfall with their seeding operations.

Enough is known about 227 of the 266 raining cloud systems to estimate the amount of rainfall. . . . The aggregate from the 227 cases is 25 million acre-feet or 31 billion metric tons of water. The rainfall estimates are, of course, crude, and at present it cannot be told if they are systematically high or low. It is not claimed that all the rain that fell was the result of seeding; we have no way of assessing this. We do feel that more than 50 per cent was artificially induced . . . .

We make no claim that all the rain that fell was produced by seeding. Our own experience leads us to believe that somewhat less than 25 per cent of the clouds would have developed heavy natural rainfall, but these values cannot be substantiated rigorously. 31

Gromet II Results

The Gromet II results are about half of what would be necessary to induce serious floods in a normal year if operations were restricted to the North Vietnamese part of the Red River watershed. Given the numerous uncertainties in our estimates, this is tantamount to saying that, should the effect not be spurious, St-Amand mergers are indeed capable of flooding North Vietnam. Table 10 gives the average daily amounts of water claimed to be produced by seeding for (1) the most successful five-day stretch; (2) the most successful 20-day stretch; and (3) the entire experimental period. 32

Table 11 lists the largest rainfalls reported to follow seeding. 33 Six of them exceeded one billion cubic meters. This is enough water to cover a million hectares of land with four inches of rain, and up to thirty times more water than recorded in the largest of Simpson’s mergers in Florida. Another twelve storms are estimated to have produced from 400 million to 800 million cubic meters of rain after seeding.

These are vast amounts of water. But did the China Lake Weapons Center scientists actually produce them? At present, there is no way
TABLE 10.

RAINFALL CLAIMED TO BE PRODUCED BY DYNAMIC SEEDING DURING PROJECT GROMET II (APRIL 29-JUNE 18, 1969) SELECTED PERIODS

(Average amount in cubic meters per day)\(^a\)

<table>
<thead>
<tr>
<th>Period</th>
<th>Amount</th>
<th>Period</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>During most productive</td>
<td>770 million</td>
<td>Average for entire 50-day seeding</td>
<td>300 million</td>
</tr>
<tr>
<td>5-day period (April 30-May 4)</td>
<td>cubic meters</td>
<td>period (April 29-June 18)</td>
<td>cubic meters</td>
</tr>
<tr>
<td>20-day period (April 30-May 19)</td>
<td>450 million cubic meters</td>
<td>期间 (April 29-</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) An estimated one-half of the water which falls on the Red River basin becomes run-off.

of telling because there were no scientific controls in the experiment. All promising clouds were seeded. None of the randomization techniques necessary to rule out chance effects were employed. As a result, because of the notorious natural variability of rainfall, it is perfectly possible that all or part of St.-Amand’s results are spurious.\(^{34}\) A single example will show why we cannot take his claims at face value. In 1965 an extremely well-designed experiment in seeding warm clouds in India was concluded.\(^{35}\) Over a period of many years, clouds over Delhi (1957-1961; 1963-1965), Agra (1960-1965), and Jaipur (1960-1963) were seeded during the monsoon months of July, August, and September. The results were very impressive: an increase of 40 per cent in rainfall in areas seeded on seedable days, with a probability of only four chances out of 10,000 that the observed differences were due to chance. Yet it now turns out that increases in rainfall upwind of the seeding stations were at least as great. Thus, the observed increases in rainfall could not have been caused by seeding.\(^{36}\) To be sure, this is an extreme example of how natural variability in rainfall can be mistaken for a man-made effect. But it is for reasons like these that one must be very cautious about St.-Amand’s claims.

And yet, it could be equally dangerous to ignore them. When recently asked about the use of cloud seeding in Indochina, St.-Amand said it was “outside of my ability to answer.”

Like other DOD spokesmen on the subject of weather modifi-
### TABLE 11.

THE EIGHTEEN LARGEST STORMS REPORTED IN
PROJECT GROMET II (APRIL 29-JUNE 18, 1969)

<table>
<thead>
<tr>
<th>Date</th>
<th>Estimated amount of rainfall after seeding (cubic meters)</th>
<th>Estimated rain intensity before seeding</th>
<th>Duration of rain following seeding (in hours)</th>
<th>Estimated rain intensity after seeding (N= no rain, L= light rain, M= moderate rain, H= heavy rain)</th>
<th>Estimated linear dimensions of storm after seeding (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr. 30</td>
<td>2,600,000</td>
<td>N</td>
<td>3+</td>
<td>H</td>
<td>no estimate</td>
</tr>
<tr>
<td>May 3</td>
<td>1,960,000</td>
<td>M</td>
<td>1+</td>
<td>H</td>
<td>330 x 90</td>
</tr>
<tr>
<td>May 4</td>
<td>1,640,000</td>
<td>N</td>
<td>6+</td>
<td>H</td>
<td>70 (diameter)</td>
</tr>
<tr>
<td>May 11</td>
<td>650,000</td>
<td>N</td>
<td>2</td>
<td>H</td>
<td>40 x 70</td>
</tr>
<tr>
<td>May 12</td>
<td>520,000</td>
<td>H</td>
<td>3+</td>
<td>H</td>
<td>40 x 70</td>
</tr>
<tr>
<td>May 12</td>
<td>780,000</td>
<td>L</td>
<td>4+</td>
<td>M</td>
<td>55 x 90</td>
</tr>
<tr>
<td>May 13</td>
<td>780,000</td>
<td>Nⁿ</td>
<td>3+</td>
<td>H</td>
<td>110 x 40</td>
</tr>
<tr>
<td>May 13</td>
<td>665,000</td>
<td>H</td>
<td>3+</td>
<td>M</td>
<td>160 x 40</td>
</tr>
<tr>
<td>May 18</td>
<td>3,250,000</td>
<td>N</td>
<td>3+</td>
<td>H</td>
<td>185 x 90</td>
</tr>
<tr>
<td>May 22</td>
<td>650,000</td>
<td>Nⁿ</td>
<td>2+</td>
<td>H</td>
<td>90 x 65</td>
</tr>
<tr>
<td>May 27</td>
<td>870,000</td>
<td>Nᵇ</td>
<td>5+</td>
<td>H</td>
<td>40 x 70</td>
</tr>
<tr>
<td>May 27</td>
<td>980,000</td>
<td>L</td>
<td>3+</td>
<td>H</td>
<td>20 x 280</td>
</tr>
<tr>
<td>May 30</td>
<td>520,000</td>
<td>L</td>
<td>3+</td>
<td>H</td>
<td>70 x 40</td>
</tr>
<tr>
<td>May 30</td>
<td>1,300,000</td>
<td>L</td>
<td>5</td>
<td>H</td>
<td>90 x 40</td>
</tr>
<tr>
<td>June 9</td>
<td>1,300,000</td>
<td>N</td>
<td>5+</td>
<td>H</td>
<td>110 x 40</td>
</tr>
<tr>
<td>June 17</td>
<td>780,000</td>
<td>N</td>
<td>3+</td>
<td>H</td>
<td>100 x 40</td>
</tr>
<tr>
<td>June 17</td>
<td>545,000</td>
<td>N</td>
<td>3+</td>
<td>M</td>
<td>70 x 65</td>
</tr>
</tbody>
</table>

- a. No rain from target but rain from vicinity of target.
- b. No rain from target but light rain from vicinity of target.

As to the potential of cloud seeding for impeding infiltration routes, St-Amand said, "I don’t think using weather to discourage people from moving is a bad thing to do. If you estimate the amount of damage done impeding someone’s transportation, versus blowing them up or burning them up, I don’t think it is so immoral." In effect, weather is no less humane a weapon than bombing and gunfire.
Is US Doing It?

But questions of effectiveness aside, is there any evidence that the US is engaged in producing St-Amand mergers over North Vietnam? Rhode Island Senator Clayborne Pell, for one, is convinced that rainmaking has been carried out over North Vietnam, and he has been publicly quoted as saying the 1971 floods were caused by it. And the Pentagon Papers provide ample evidence of the war planners' complete indifference to all but pragmatic considerations concerning the conduct of the war. Proposals for further escalation are never rejected because they are inhuman or immoral, but because the Soviet Union or China might retaliate, or because public opinion at home or abroad might find them intolerable. Given this Realpolitik of our leaders, it seems inevitable that a weapon as discreet and cheap as rainmaking (perhaps as little as $25,000 for all the seeding ordnance used in Project Grommet II) will be used. That there is no conclusive proof it is effective may even be a further advantage, given the weapon's negligible cost.

The fuzzing of moral distinctions lies at the very heart of what Hannah Arendt has called the banality of evil: there are some things even a McNaughton, who hid his humanity behind his computer-like prose, might prefer not to be sure about. But we must emphasize once more: if even the war planners themselves may not be sure, we cannot be sure either. (Incidentally, the Philippine government was so pleased with the "results" of the project that they repeated it the following year, and planned to carry out a similar rainmaking program in 1971. One wonders if there is any connection between the present heavy floods in the Philippines—termed the worst natural disaster in its history—and a 1972 repeat of the seeding program.)

Massive waterlogging which destroys substantial amounts of the spring and fall harvests, the possibility of inducing dangerous (but

*The necessary experiments to verify St-Amand's claims may have already been carried out in secret. Such experiments would explain St-Amand's otherwise rather baffling intransigence about the 1969 results—an intransigence which leads him to flatly assert in a recent (1971) paper that "modification of cold cumulus clouds... is considered operationally feasible," and then to cite as his only justification of this claim Project Gromet II. 41
modest) floods in the fall, of weighting the odds against North Vietnam during a year of naturally high water and turning a potentially dangerous situation into a disaster; and if we take the Pentagon's claims at their face value, the induction of floods as massive as any in North Vietnam's history—is the United States engaged in such attempts? Consider this description of a project started by Rand in 1969: 43

The Rand program on climatic dynamics for environmental security starts with the concept that the US might be harmed either inadvertently or maliciously by changes in the climate, so that we must find out how to anticipate change in the climate... What might happen if some of the large ocean currents were diverted? What would result if films were developed to retard the evaporation of water over large ocean areas? Some of these projects might be undertaken with a very definite beneficial end in mind, and result in serious climatic problems. On the other hand, it is not inconceivable that, if a scheme were available which could change the climate, it might be used in a malicious fashion.

So finally, what is our approach to this whole problem of climatic simulation for national security? We want to find out primarily what changes in the face of the earth or in the content of the atmosphere would have an effect on the climate.*

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*There are other rainfall modification techniques besides cloud mergers. A review of the literature suggests that none of them could come close to generating enough water to trigger a flood in an otherwise normal rainy season. But the matter is complex and we cannot go into it here. See Appendix 3 for a brief discussion of this and other aspects of weather control, especially the possibility of steering typhoons toward the North Vietnamese coast and the Yunnan plateau, as well as rainfall in South China being affected by seeding in Laos and North Vietnam.
VI. WILL THE DIKES BE DESTROYED?

NORTH VIETNAM is a nation of villages protected by dikes which tower high above them, huge basins which stand three to ten meters below the peak water levels of the rivers that mark their boundaries; hundreds of thousands or perhaps millions of people who would be in danger of drowning if the dikes and the irrigation dams gave way, and millions more on the coast who depend on levees to protect their crops from rough seas during typhoons. It is a nation barely larger than the state of North Carolina so delicately poised between hunger and plenty that a single season of bad floods could precipitate a famine, a nation which depends for its survival on earthenwork dikes, small irrigation dams, and the ceaseless struggle of its peasantry. Arrayed against this rural world is the mightiest power on earth, with its rich man's nuclear weapons—the B-52 and laser guided bomb—its endless fleets of fighter bombers and ships, its immense wealth and ever-advancing science which even now may possess the power to turn the rain itself into a weapon of death and destruction.

Last Summer's Floods

Nothing better gives the sense of what will happen if President Nixon decides to destroy the dikes and dams than North Vietnamese newspaper accounts of last summer's floods—floods which ranked among the worst of the century. Here are some excerpts from those
During the days when the water was high, more than 2,000 people in assault units of 23 townships were constantly at the dikes. They stayed at the dikes day and night taking turns banking up the earth and strengthening key sections of the dikes and places at the base of the dikes which had crumbled.

Now Dong Anh [Phuc Yen province] has repaired and stopped up 34 breaks, 166 places where there were leaks, and many sections that had caved in. At the D. M. dike work site, almost 300 workers have banked over 2000 cubic meters of earth in order to repair the base of the dike which had crumbled.

While the level of the rivers has temporarily gone down, the Flood Prevention and Control Committee of the Dong Anh District is still keeping over 2,000 assault members on duty at the dikes. They continue to bank key sections of the dikes and to make inspections to find places where there are leaks and termite nests. There is constant inspection of the dikes day and night.

In the Haiphong area] 20 cooperatives having flooded fields have been using buckets and water wheels to quickly drain the fields. Each day, in the districts lying along key dikes, thousands of people protect, inspect, and rebank key sections of the dikes. Townships lying along the edges of rivers, the sea, and salt flats have 500 assault units ready to do flood and typhoon control tasks. On the average, there is one person on watch along every 10 to 15 meters of the dike.

Every day on the Nam Ha ricefields, tens of thousands of cooperative members used baling buckets and oil pumps on field after field to fight against the flood.

At the present time the greatest task is to strengthen the dikes and culverts. Forces must be concentrated at the vital sections of the dikes to perform the urgent work of sealing up spots where there has been crumbling or where water is seeping through. The low sections must be made higher.

The problem of evacuating people must be well resolved. Those families living in riverbank areas must be promptly evacuated and there must be plans for the protection of their lives, property, livestock, domestic fowls, and rice. Proper arrangements must be made for moving them to messing and billeting areas within the city or out in the fields.
In addition to assigning people to flood control projects, it is necessary to concentrate forces to combat inundation and waterlogging in those areas already planted where it is possible to remove the water and protect the secondary crops. It is necessary to find methods to plant additional tenth month rice and guard and care for the seedlings so that there will be enough or even an excess to transplant when the water recedes. We must be resolved to fight thoughts of how transplanting at this late date will not work but rather concentrate on the work of preparing the seedlings. Regardless of the price, the outlying areas must ensure the plans for their farm land. It is better to transplant late and have a smaller harvest than to let the fields lie empty.

As soon as the water began to flood in, the [Me Tri Thuong Cooperative in Tu Liem district] used every available means to bail it out. In addition, 150 members carried out emergency repairs on a section of irrigation embankment which had a breach 4 meters deep and 1.8 meters wide. After 2 days of makeshift repairs, water could no longer rush through this section of embankment. After this section was repaired, a 50 meter section of the road to the north was breached. After working continuously for four days and two nights, they had built up this section of the embankment more securely.

Co Diem B, Van Dien, and Dong A cooperatives of Tu Hiep township in Thanh Tri district [Ha Dong province] were severely flooded: [they] organized bailing shifts night and day to relieve the flooding. Along with nine electric and gasoline pumps, 3000 cooperative members bailed water continuously and tirelessly for 5 days and nights, undaunted by the high water. As a result, they saved 880 hectares of rice. The cooperative will sow more seedlings and retransplant the areas where rice was damaged with the attitude that eating a little is better than eating nothing at all.

The recent heavy floods inundated a quantity of food provisions. Some food soaked in water for scores of days, disintegrated and was spoiled. A number of people held that damage was total and that the food is unfit to eat; [and] therefore [that] it

* Italics added.
should be fed to chickens and pigs, which is highly wasteful.

Methods of preserving food: First of all it is necessary to categorize, select, and separate the types of food into good, bad, dry, damp, wet, decomposed, rancid, spoiled, sprouting, and so forth for appropriate handling. Damp food should be dried and then used for human consumption. As for wet food that is spoiled but the seeds have not yet disintegrated, wash, stir, and rinse it repeatedly with clean water to eliminate the spoilage, and then dry it out.*

Nam Tien Cooperative in Lam Thao district, Vinh Phu Province, had just competed transplanting the tenth-month rice when the floods came. Ninety-seven percent of the rice area was lost; nearly one-half of the families experienced flood waters in their homes.

... The people have reserve grain; but, how will they ever have enough food to last until next May? The party committee and the cooperative management board are determined, regardless of the hardships, that production must be restored and are determined “to squeeze rice and paddy from the soil.” Not relying on help from the state, the cooperative constructed a plan for transplanting supplementary crops and planting secondary crops. [Hopefully this will] average out to 14 kilograms of [paddy equivalent] per person per month.

Upon learning that several families still had some rice of this strain and that some families had not eaten all their potatoes and 3-month corn, the cooperative motivated them to bring them in and exchange them for the collective [so that they could be used for seed]. Those families that had small amounts left, exchanged small amounts; those who had large quantities, exchanged large amounts. Nam Tien encouraged the cooperative members to have others also exchange their holdings. The people went as far as Thanh Sơn and Yen Lap—approximately 60 kilometers—and bartered for more than 1 ton of 3-month corn.*

Dong My cooperative [in Thanh Tri district, Hà Đông province], even though it has recently had to concentrate its manpower in shoring up the dikes, has still organized the cooperative members

* Italics added.
to struggle against time to plow the fields, sow additional seedlings and combat water-logging to finish transplanting 140 hectares, and weed and fertilize the rice area transplanted since the beginning of the season... In the areas of the Vay, Giong and Loc fields, and in Hoa Ca, the people have rushed to lift up plants and wash off leaves wherever the water has receded. In rice fields where the flood waters have remained for a long time, and the paddy rice cannot live, the cooperatives... have mobilized the plowmen and continued to plow and transplant.*9

Vinh Ninh cooperative [Ha Dong province], with many flooded fields, has mobilized its workers daily for more than a week to pump the water out [of its flooded fields]. Wherever the water has receded, the cooperative members have struggled to pull up the weeds and trash from around the rice plants to permit them to recover. In Ich Vinh cooperative, after several heavy rains, the cadres and members waded together through deep water to scrape away the mud covering the banks so that the pumps could work quickly. Thus, today the rice in Doi fields which was flooded will be able to recover.*10

Final Escalation

But will the President take the final escalation? Putting to one side the possibility of covertly inducing large-scale floods, what are the prospects that the dikes and dams will be destroyed before the November election, rather than after it or some time next year?

At first thought, nothing seems less likely. Mr. Nixon would appear to have nothing to gain and everything to lose. Why should he risk harming his reelection chances by such a visible act of violence? To be sure, the President managed the full-scale resumption of bombing over the North and the mining of its harbors. Still, that was done under the screen of the North Vietnamese counter-invasion. Why risk another Cambodia out of the blue? Besides, there would still be time to ruin the November rice harvest after the election, not to mention the June harvest, which depends upon the network of irrigation dams for its success.11

* Italics added.
Of course, even Richard Nixon could not trigger mass drownings in a month when the average water level at Hanoi is 5 meters. But he certainly doesn’t want such flagrant genocide on his hands in an election year either. (Better, perhaps, to wait until 1973 for that.) Why, then, would the President ever dream of destroying the dams and dikes in August or September?

Last, Desperate Gamble

One answer may be that his hand will be forced by events in South Vietnam. A successful September or October offensive by the revolutionaries may leave him no choice but a series of last, desperate military gambles.

Another answer may be that the President will actively seek to create a “sellable” excuse for bombing the dikes. Not an incident, like Tonkin Gulf. But a new set of hostages, like the American POWs. The most obvious way to arrange this would be a South Vietnamese invasion of the panhandle. 12 As with the downed American flyers, their sheer physical presence would be what counts. Once they are in North Vietnam they will have to be defended. Destroying the dikes and irrigation dams could then be presented as a necessary tactical move (see Appendix 1). And indeed it might well be, given the way ARVN has acquitted itself in recent years.

But the best suggestion that the dikes and dams may be bombed before the election comes from the President himself. While still continuing to deny that they are now being targeted, Mr. Nixon has dramatically escalated the language he has used in connection with them. When asked about the possibility in his April 30, 1972 news conference, he answered in the words already quoted:

... the problem that is raised with regard to dams or dikes is that, while it is a strategic target and indirectly a military target,* it would result in an enormous number of civilian casualties. That is something that we want to avoid. It is also something

* Italics added
Deny Reports

Two months later, in his June 29 news conference he first contented himself with denying published reports of dikes being hit. "We have checked those reports. They have proved to be inaccurate." He did nothing to dispel the impression that he considered the dikes and dams "strategic" and "indirectly military" targets. But then he proceeded to invent out of thin air 15,000 French POWs who the North Vietnamese never repatriated in 1954. (Two days later, a New York Times dispatch from Washington quoted a French embassy spokesman as saying "somewhat indignantly" that "we are certain that the North Vietnamese gave us back all the prisoners they had.")

One last point with regard to the POWs. I know that every American is concerned about these men. I have been somewhat concerned about them.

I will only say that I have had some experience, and a great deal of experience as a matter of fact, in this past year in dealing with Communist leaders.

I find that making a bargain with them is not easy, and you get something from them only when you have something they want to get from you.

The only way we're going to get our POWs back is to be doing something to them and that means hitting military targets in North Vietnam, retaining a residual force in South Vietnam and continuing the mining of the harbors of North Vietnam—only by having that kind of activity go forward will they have any incentive to return our POWs rather than not account for them, as was the case when the French got out of Vietnam in 1954 and 15,000 French were never accounted for after that.

In the event, this proved to be only a hint of what was to come. During his July 27, 1972 news conference, the President pulled out all the stops. "A minimum" of half a million peasants died during the 1954-1956 land reform, a figure ten times larger than the standard—and now exploded—atrocities claim made in the past. Half a million people died in slave labor camps during the same period, said the President, quoting a figure supplied to him by the Bishop of Danang in 1956 and kept secret for 15 years by supporters of the Saigon
Push Peasants

As for South Vietnam, we learned that the NLF and North Vietnamese deliberately push peasants in the path of American bombs and artillery shells: since 1966 600,000 civilian casualties have resulted from the "deliberate policies of the North Vietnamese communists, not accidental, but deliberate." Then, showing why a policy of systematically unsystematic bombing is a PR man's dream, the President explained that "when, as a result of what will happen, a bomb is dropped, if it is in an area of injury to civilians, it is not by intent, and there is a very great difference." Nor was that all. Readers of the Pentagon Papers were relieved to learn that the Joint Chiefs of Staff have undergone a complete change of heart since the dark days of the Johnson administration:

Our military doesn't want to do that [bomb Hanoi]. They believe it would be counterproductive, and secondly, they believe it is not necessary. It might shorten the war, but it would leave a legacy of hatred throughout that part of the world from which we might never recover. So our military have not advocated bombing the dikes; they have not advocated bombing civilian centers. They are doing their best in carrying out the policy of hitting military targets only.

And the President once more raised the specter of a bloodbath in South Vietnam following a Communist takeover (conveniently ignoring the

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* Curiously enough, the 1962 edition of the US Army Area Handbook for Vietnam makes no mention of any deaths occurring during the 1954-1956 campaign against landlords. Nor, though it talks about forced labor, does it claim that anyone died in slave labor camps. Five years later, the army issued separate handbooks for the two Vietnams, and—perhaps reflecting another kind of escalation—the handbook on North Vietnam now claims that 50,000 to 100,000 people were killed by the North Vietnamese government in the 1954-56 period. But the Bishop of Danang's slave labor atrocities were still missing. Perhaps they will be in the next edition.
one which has preceded it), and called the North Vietnamese invasion of the south this spring "one of the most barbaric invasions in history."

But all this was mere garnishing to a lengthy comparison which he developed between Hitler Germany—and the "moral" necessity of destroying its cities—and present-day North Vietnam.

I remember one of the first conversations I had with President Eisenhower about war. We were riding back from Quantico.

You may remember it. Charlie Wilson used to have those meetings in Quantico of the defense establishment people. He asked me to ride back with him. It was very early in the administration, the first year.

He was talking a little about the decisions he had to make in World War II. One of the questions I raised with him was: Here on our part, the deliberate bombing of German cities, the tragedy of Dresden, of Essen, of Hamburg, not to mention Berlin. General Eisenhower said it was a terribly difficult decision for us, the strategic bombing of civilians in Germany. But, he said, "On the moral question, we had to answer to ourselves this fundamental problem." He said, "The height of immorality would be to allow Hitler to rule Europe."

Now, in our case we have not gone that far. We are not going to bomb civilian targets in the North. We are not using the great power that could finish off North Vietnam in an afternoon, and we will not. But it would be the height of immorality for the United States at this point to leave Vietnam, and in leaving, to turn over to the North Vietnamese the fate of 17 million South Vietnamese who do not want a Communist government, to turn it over to them.  

Pentagon Papers

Scan the Pentagon Papers carefully and you will find curious outcroppings of words like "family," "feelings," "anxieties," "imaginative," "fear," "play," "sensitivity," and "doctor." But "family" refers to a "family of infiltration related targets," and "feelings" to "American feelings about US casualties," and "anxieties" to "the anxieties and complications on our side of the line." "Imaginative" refers to the need for "great, imaginative efforts on the civilian, political as well as the military side," in South Vietnam and "fear" to North Vietnam's "fear of China." "Play"—the proposal that "if the DRV will not 'play'
the above game, we must be prepared . . . to risk some flashpoints." "Sensitivity"—the claim that the North Vietnamese "will be searching with enormous sensitivity for the answers." And "doctor"—the conclusion that "it is essential—however badly SEA may go over the next 1-3 years—that U.S. emerge as a 'good doctor.'" Where humanity fails, a word comes to take its place.

Dikes in Holland

A generation ago, in the closing stages of World War II, General Eisenhower said this about the destruction of the dikes by the Germans in occupied Holland:

... I propose to send a very strongly worded message to the German Commander ... that the flooding of large areas of Holland with the resulting destitution, starvation and the enormous loss of life to the population will constitute a blot on his military honor ... He must be told to cease opening the dikes and to assist in every way possible the distribution of food ... and that if he fails in this respect to meet his clear obligations and his humanitarian duty, he and each responsible member of his command will be considered by me as violators of the laws of war who must face the certain consequences of their acts. 24

At Nuremberg the German commissioner for occupied Holland was put on the stand:

Dr. Steinbauer [Attorney for the defense]: Now, to another chapter. Floods did occur. Did you have anything to do with them?

Seyss-Inquart: I know about this, and in a certain connection I did have something to do with it.

There were previously prepared floodings by the Armed Forces for defense purposes and there were so-called "battle" floodings, which suddenly became necessary in the course of battle.* The prepared ones were carried out in closest contact between my

* Italics added.
office and the Dutch offices. Through their intervention, about half of the area demanded was spared and saved. The flooding was done mostly with fresh water so that less damage would occur, and the outer dikes were spared... I was not actually informed of the execution of the battle floodings. The commander [of Holland] had decided on it overnight...

Dr. Steinbauer: The report of the Netherlands Government, which the Prosecution also mentioned, states in great detail that the defendant, as Reich Commissioner, is responsible for the famine which began in September of 1944 and lasted until the spring of 1945 and for the great mortality, especially of children... because, on the occasion of the shipping and railroad strike, he prohibited the importing of food. That is one of the most important and serious charges made against him...

Seyss-Inquart: I should like to be allowed to comment on this matter. This is the charge which seems the most serious to me, too...

Dr. Steinbauer: In the Government Report it is asserted that at the time 50,000 Dutch people died of starvation; and, therefore, I should like to ask you what reason you had for establishing this traffic embargo at that time?

Seyss-Inquart: I believe I have already explained that in the main. The traffic situation was such that the Wehrmacht had to make sure of its shipping space. As long as it did that there was no ship traffic as such possible. I wanted to limit this to as short a period of time as possible so that afterwards ship traffic could again be assured and Holland regularly supplied with food. Ship traffic was not interrupted primarily by my embargo, but rather—the witnesses will confirm this—by the fact that all ships that could be found were confiscated. Naturally, I asked myself whether the Dutch food supply would be endangered; and I said to myself that the Dutch people themselves were responsible for this state of emergency, and that the military interests of the Reich were, anyhow, equally important.*

... May I also call your attention to the fact that the Dutch

* Italics added.
Government . . . changed the figure of 50,000 deaths to the correct one of 25,000. 25

“People who fight devils,” wrote the German philosopher Nietzsche, “must be careful they don’t turn into devils themselves.”
Dikes in North Vietnam are extraordinarily vulnerable to attack. Only a few major breaches in the Red River system will lead to widespread flooding of the Red River delta. In the panhandle, the Chu-Ma delta in Thanh Hoa province and the Ba delta in Nghe An province are also especially vulnerable.

- It is not necessary to bomb the dikes themselves in order to cause massive ruptures and serious flooding. Cratering the area next to a dike creates deep cracks and hidden faults. This damage—largely undetectable—may cause the dike to give way many weeks later during a period of high water.

- Significant numbers of dikes can be destroyed without actually targeting them. Many bridges cross them. Many small roads run on top of them. Some dikes run parallel to main railroad lines and highways. Others are the highest ground for miles around and are often used for storage areas.

- There is no evidence that any attempt was made to cause serious floods during the Johnson phase of the air war. But many dikes and dams were hit, one thousand civilians a week were killed or badly wounded, most industrial targets were destroyed, and an enormous tonnage of bombs rained down on the countryside. In the face of this
systematically unsystematic destruction, food production plummeted. Half a million tons of grain was imported in 1967 and nearly three-quarters of a million tons in 1968. Without these imports serious malnutrition—but not outright famine—would have occurred.

● Destruction of the dikes and dams during periods of high water may lead to mass drownings. The areas south of the Red River in Son Tay, Ha Dong and Ha Nam province, and the region just north of the “Canal des Bambous” is likely to be hardest hit. Hanoi and the provinces of Hung yen and Bac Ninh on the north bank of the Red River are also vulnerable. More than two million people live in the first of these regions. Another one and one half million live in the areas north of the Red River. One to two hundred thousand people are still in Hanoi. Except for Thanh Hoa, we can make no estimates for the panhandle provinces. But in Thanh Hoa the two hundred thousand people on the wedge of land between the Chu and Ma Rivers and the half million people in the irrigated areas south of the Chu, would be in some danger of drowning.

● Destruction of the dikes and dams at other times in the summer and fall will ruin as much as half of the November rice crop. North Vietnam cannot sustain a loss of this magnitude. Unless it is somehow made good, the result will be outright famine.

● There is compelling evidence that weather modification techniques (“Simpson mergers”) may play a significant role in crop destruction by causing widespread waterlogging of the June and November crops, and by impeding efforts to reclaim and replant damaged areas after major floods. There is anecdotal evidence that other techniques (i.e., “St-Amand mergers”) may be able to cause serious flooding in the rainy season when none would otherwise occur.
During the final months of the Second World War the Nazis exposed the Dutch civilian population to a form of war crime the United States and English Governments especially designated as crimes against humanity. To prevent the advance of Anglo-American troops, the German High Commissioner in Holland, Seyss-Inquart, opened the dikes and by the end of 1944 flooded approximately 500,000 acres of land. The result was a major disorganization of the Dutch economy and the most precipitous decline in food consumption any West European country suffered during the war. By 1945 the caloric intake in occupied Holland, or the large bulk of the country, was less than 900 a day, and in certain areas 500 calories. As the Allied armies advanced, the Germans threatened to extend the destruction of the remaining dikes to block Allied supply lines and movements.

The misery of the Dutch people, the Prime Minister-in Exile, P.S. Gerbrandy, warned SHAEF Commander Eisenhower, threatened "... a calamity as has not been seen in Europe for centuries." The Red Cross issued the same warning, and during April 1945 both Eisenhower and Churchill moved to confront the enormous tragedy resulting from the impact of the destruction of the dikes. On April 10th Churchill wrote Roosevelt that "I fear we may soon be in the presence of a tragedy." To prevent it he proposed the Allies make available necessary food and medical supplies for Red Cross distribution. A warning was to be given to Seyss-Inquart and his

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subordinates "...That by resisting our attempt to bring relief to the civilian population in this area they will brand themselves as murderers before the world, and we shall hold them responsible with their lives for the fate which overtakes the people of Holland." 3 Several weeks later Eisenhower made an additional proposal along the same lines: "...I propose to send a very strongly worded message to the German Commander ... that the flooding of large areas of Holland with the resulting destitution, starvation and the enormous loss of life to the population will constitute a blot on his military honor ... He must be told to cease opening the dikes and to take immediate steps to assist in every way possible the distribution of food ... and that if he fails in this respect to meet his clear obligations and his humanitarian duty, he and each responsible member of his command will be considered by me as violators of the laws of war who must face the certain consequences of their acts." 4 Confronted by such grave warnings, Seyss-Inquart agreed to stop the destruction of the dikes and cooperate in relief measures.

Nevertheless, the barbarism of Seyss-Inquart in destroying dikes and starving civilians made him appear in the eyes of the Western officers as "one of the worst war criminals," and when General Walter B. Smith met with him on April 30, 1945 to arrange for Dutch relief he also warned the German "... you are going to be shot." 5 Of the 185 Nazis indicted at Nuremberg only 24 were sentenced to death. Seyss-Inquart was one of the 24. His crime was considered to be one of the most monstrous of the Second World War, and prominent among the charges against him at Nuremberg. 6

On May 13, 1953, while armistice negotiations in Korea were bogged down, 20 U.S. Air Force F-4's attacked and destroyed the Toksan irrigation dam in North Korea. The Americans also bombed the Chasan, Kuwonga, and Toksang dams and scheduled the bulk of the remainder for attack — only the signing of the armistice prevented their destruction. The flash flood resulting from the destruction of the Toksan dam resulted in a deluge of 27 miles of valley farmlands. In May 1953, "The production of food in North Korea was the only major element of North Korea's economy still functioning efficiently after three years of war," states the official U.S. account. The Americans were now prepared to destroy it, and quite properly the Air Force concluded that "These strikes, largely passed over by the press, the military observers and news commen-

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3Ibid., 402
4Coles and Weinberg; Soldiers Become Governors, 831
5Ibid., 832

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tators in favor of attention-arresting but less meaningful operations events, constituted one of the most significant air operations of the Korean War." "To the Communists the smashing of the dams meant primarily the destruction of their chief sustenance — rice. The Westerner can little conceive the awesome meaning which the loss of this staple food commodity has for the Asian — starvation and slow death. . . Hence the show of rage, the flare of violent tempers, and the avowed threats of reprisals when bombs fell on five irrigation dams. . . ." "

Briefly, despite an earlier correct definition of the nature of the war crime inherent in flooding of farm land via destruction of dikes and dams, the U.S. Government within a decade followed the precedent of the Nazis, fully aware of the human and political consequences of their action. The United States has already begun the destruction of the dams of Vietnam, but it has also clearly defined the nature of the action for what it is — a war crime of the first magnitude.

1Quarterly Review Staff, "The Attack on the Irrigation Dams in North Korea," Air University Quarterly, VI (Winter 1953-54), 40-41
On 13 May 1953 twenty USAF F-84 fighter-bombers swooped down in three successive waves over Toksan irrigation dam in North Korea. From an altitude of 300 feet they skip-bombed their loads of high explosives into the hard-packed earthen walls of the dam. The subsequent flash flood scooped clean 27 miles of valley below, and the plunging flood waters wiped out large segments of a main north-south communication and supply route to the front lines. The Toksan strike and similar attacks on the Chasan, Kuwonga, Kusong, and Toksang dams accounted for five of the more than twenty irrigation dams targeted for possible attack—dams upstream from all the important enemy supply routes and furnishing 75 per cent of the controlled water supply for North Korea's rice production. These strikes, largely passed over by the press, the military observers, and news commentators in favor of attention-arresting but less meaningful operations events, constituted one of the most significant air operations of the Korean war. They sent the Communist military leaders and political commissars scurrying to their press and radio centers to blare to the world the most severe, hate-filled harangues to come from the Communist propaganda mill in the three years of warfare.

In striking one target system, the USAF had hit, hard at two sensitive links in the enemy's armor—his capability to supply his front-line troops and his capability to produce food for his armies. To the U.N. Command the breaking of the irrigation dams meant disruption of the enemy's lines of communication and supply. But to the Communists the smashing of the dams meant primarily the destruction of their chief sustenance—rice. The Westerner can little conceive the awesome meaning which the loss of this staple food commodity has for the Asian—starvation and slow death. "Rice famine," for centuries the chronic scourge of the Orient, is more feared than the deadliest plague. Hence the show of rage, the flare of violent tempers, and the avowed threats of reprisals when bombs fell on five irrigation dams. Despite these reactions this same enemy agreed to sign an armistice less than one month later, and on terms which for two years he had adamantly proclaimed he would never accept—terms containing two provisions directly contrary to the announced Communist position: (1) a line north of the 38th parallel, and (2) voluntary repatriation of prisoners of war.

The Toksan-Chasan air strikes were an object lesson in air power to all the Communist world and especially to the Communists in North Korea. These strikes significantly pointed up their complete vulnerability to destruction from the air. More important, they indicated U.N. determination to increase pressure through air attack—a kind of war the enemy knew he could not survive. To the Communists the strikes may well have appeared to be the opening gun in a campaign to destroy the vital elements of his whole national economy—all basic elements required for continued military and political resistance.

The production of food in North Korea was the only major element of
ATTACK ON IRRIGATION DAMS IN NORTH KOREA

North Korea's economy still functioning efficiently after three years of war. Despite the decisive military importance of the food supply and the irreplaceable loss it would have been to the enemy, it had not been attacked by U.N. air during these years. The air campaign in the early days of the war had concentrated on paving the way for the Pusan break-out. Later it made possible the rapid drive to the Yalu, and shortly thereafter was the principal force responsible for stopping the auspicious Chinese Communist ground offensive south of the 38th parallel. The story of these phases of the air action in Korea is forcefully pointed out by the FEAF Commander, General Otto P. Weyland, in "The Air Campaign in Korea," Air University Quarterly Review, VI, 3 (Fall 1953), 3-28.

After the battle line stabilized and truce talks were begun in July 1951, FEAF's mission was to maintain military pressure from the air on the enemy in order to force an armistice. This FEAF did by providing round-the-clock offensive air action against the enemy's deployed military forces for over two years. Targets for air attack during this period ranged from front-line close support for U.N. ground forces to interdiction operations extending north to the border of the enemy's Manchurian sanctuary. Targets included every moving or stationary object of tactical value, the destruction of which would assist in attaining FEAF's objective of reducing the threat to U.N. ground forces and at the same time pressuring the enemy through the air. FEAF was always mindful of the theater political objectives and aware that sensitive targets did exist within North Korea—to attack which might disrupt the armistice or expand the war. The limited U.N. air forces were allocated to continuous pounding of only those targets directly related to the immediate military situation on the ground.

In June 1952, after 11 months of fruitless armistice negotiations, authority was granted to air forces in Korea to attack and destroy one of the so-called sensitive targets—North Korea's vast electric power industry. This was considered a test of whether destruction of sensitive enemy targets would goad the enemy into major reprisals. Electric power was attacked and destroyed in a series of simultaneous air strikes, and it became apparent the enemy was in no position for reprisals, nor did he wish to expand the war.

As the armistice negotiations dragged on and were finally suspended by the United Nations in October 1952, FEAF began targeting a second sensitive target system—a system so vital that its simultaneous destruction (like that of the electric power complex) might well produce sufficient military pressure to bring about immediate armistice agreement or even capitulation of the enemy armies. This target system was formed by the more than

The U.N. air attacks on the North Korean hydro-electric complex and on the irrigation dams have been cited among the important air actions of the Korean War. Each of the two target systems was of significant military value, but each was so intertwined with political considerations that much deliberation preceded the final order to attack. Having studied the strikes on the hydro-electric system ("The Attack on Electric Power in North Korea," Air University Quarterly Review, VI, 2 (Summer 1953), 13-50), the Editors of the Quarterly Review, in conjunction with the Director of Targets and the Director of Reconnaissance, Hq FEAF, examine the irrigation dam target complex and review the air attacks on parts of the system.
twenty earthen and stone irrigation dams that furnished 75 per cent of the controlled water supply for the growing of North Korea's most important food, rice.

The immediate objective of breaking the dams was the wholesale disruption which a series of flash floods would bring to the entire west coast transportation system. This sudden and prolonged cut-off of the small amount of supplies getting through to the front could be fatal for the enemy. The destruction of the dams and flooding of the valleys would also turn North Korea from an exporter of rice (North Korea's only export surplus to be exchanged for war materiel) to a heavy importer of rice. But imported from where? Intelligence reports indicated serious rice famine in South China, the big rice-producing area of Asian Communism, which made it seem that little Chinese rice would be available for shipment to Communist armed forces in Korea. Soviet logistical support of the Communist armies in Korea included only "hardware." Even if rice should be imported from some source, it would have to pass over a transportation system already seriously overloaded and at the point of complete breakdown as a result of USAF day-and-night interdiction strikes. If 10 per cent of the imported rice got through—the percentage of other supplies successfully running the interdiction gauntlet—this small quantity would be insufficient to feed armies. Hungry soldiers are poor fighters.

In the last part of April 1953, armistice negotiations were again resumed at the request of the Communists, only to fall into the familiar pattern of delay, stall, and stalemate. On 5 May 1953 a new impasse was reached at the conference table, and the U.N. Command warned the Communists, "Time in these talks is running out." Almost simultaneously FEAF attacked Toksan Dam—first in a series of strikes on five dams in the system.

Irrigation Dams: The Target System

Throughout the fertile valleys and broad lowlands of North Korea's Haeju peninsula many large earthen and stone dams impound the waters of small streams into reservoirs for the controlled irrigation of the "rice basket" of Communist North Korea. In a traditional war strategy these dams represent a target system of limited value. They constitute a certain unit of enemy resources, yet their destruction, in a static battle situation, could have only limited effect on the relative strength or disposition of the enemy forces.

But a theater air commander, responsible for planning and conducting air operations within the framework of an air strategy, could not consider these targets solely in relation to the front lines. Scanning the whole theater of war for all targets available to his air weapons, he must select for attack those whose destruction will effectively and economically accomplish the theater objectives. From this perspective certain of the irrigation dams appeared as targets of great significance—primarily of tactical and secondarily of strategic value.

Twenty dams in the Haeju area were selected for study to determine their value as tactical targets. With many it was found that floods resulting from breaching the dams would probably wash out whole sections of tracks and roadbed, undermine highways, destroy or weaken bridges, and inundate supply areas and military installations. It was determined that maximum
tactical results could be obtained at any time of the year, provided that the impounded water represented more than 80 per cent of the capacity of the reservoir. The resulting flash flood would constitute a critical, though temporary, blow to the west-coast main and secondary railroad and highway lines to the front.

The strategic value of these targets stemmed from the vital relationship of the irrigation dam system to the enemy’s whole national economy and the staple food supply of North Korea. Most of the rice produced in enemy-held areas of North Korea is grown in the valleys and low flatlands of the Haeju peninsula. In the south Pyongyang-Hwanghae region alone approximately 500,000 acres are planted in rice each year. Over 75 per cent of these important rice lands receive their water supply from controlled irrigation made possible by reservoirs. Less than 290,000 acres have a natural water supply sufficient for optimum crop growth. Thus a rigidly controlled water supply is the key to rice production. In North Korea rice was one of the most important elements in the war economy. The one crop of which North Korea grew a surplus, this rice fed the Communist army. If the local supply could be drastically reduced, the army would have to import its food from China. This would tremendously complicate the enemy’s logistic problem. Not only was China already seriously short on rice, but the food would have to be moved over the supply routes already bottlenecked and collapsing from the relentless air interdiction attacks.

To obtain maximum strategic results from attacks on the reservoir dams, the strikes should take place during one or both of the periods critical to rice production. The first comes early in May, at the end of the transplanting season but before the roots are firmly embedded. During the first period excessive water would uproot numerous plants, cover others with silt, and in general cause the planting to be repeated. The second period arrives in August, when floods would permanently destroy a very large percentage of the rice plants. Flood conditions at any time would cause silting, wash away valuable topsoil, and increase the need for fertilizer to reinvigorate the flooded areas. Successful attacks on the reservoir system during either critical period would produce serious damage to the rice crop. Attacks in August would be more damaging, but attacks in May would be most effective psychologically, since the government and the farmers would have all summer to contemplate a probable repetition of the strikes in August.

For maximum strategic results all dams would need to be broken in one concerted attack on the whole system. Any attempt at progressive destruction by staggered air strikes would tip off the enemy and give time to drain the remaining reservoirs. Since the primary objective in destroying the dam would be to loose the destructive force of the impounded waters, lowering the water in the reservoirs would neutralize the target system.

It was realized that Communist propaganda would immediately scream that food had been snatched from the mouths of old folks, women, children, and babies. But if the sole objective of the attacks had been to destroy rice lands, it could have been accomplished by the relatively simple process of breaching the coastal dykes and flooding vast areas of agricultural lands in a region where no tactical targets existed. Attacks on the irrigation dams, it was believed, would produce useful psychological reactions, since farmers would tend to blame the war, and thus the Communists, for exposing their crops to attack and destruction. Moreover studies of North Korean popula-
tions trends indicated that less than 50 per cent of the 1950 civilian population still inhabited the land. Intelligence reports confirmed that "undesir- able" farm personnel had been removed and their lands assigned to "loyal" farmers. Since all lucrative farm areas were under close control of Communist officials and government quotas were placed on rice production, most farmers in North Korea provided direct support to the Communist armed forces. Government rice quotas took the major portion of the crop, leaving the old folks, women, children, and babies to find what food they could. Ultimately, as has always been true, military decision must weigh the values of a proposed action in terms of its immediate military significance as opposed to its long-range effect on the public. The justification for over-

(figures omitted)

whelming pressure is that the enemy is quickly forced to terms rather than slowly and painfully whittled down to where he can no longer resist.

If the overall theater objectives included war against the nation or forcing the enemy to meet terms, the strategic intent of breaking the dams would serve that objective as perhaps no other target could. And in striking the dams at one of the two times in the year when the target had strategic value, the tactical benefits would still occur. If attacked at any time other than spring or fall, only the tactical benefits would be gained.

If the theater objective was to attrite the enemy or a limited offensive to push him back for geographic advantages, attack any time of the year would be extremely helpful. It would not only cut off the flow of logistic support to the front by interdicting the vital lines of supply but would also destroy the rat-holed supplies dispersed throughout the valleys and rural villages and would destroy farm buildings and haystacks used to camouflage military stockpiles. The repair effort the enemy would have to throw into the flooded area would curtail the support activities of his armies and diminish his front-line capability for defense.
ATTACK ON IRRIGATION DAMS IN NORTH KOREA

The Enemy Reaction

Immediate enemy reaction to the bombings took the form of the most vindictive, vitriolic propaganda indictments made against the United States in the three years of the Korean war. Attacks on the precious water supply had struck where it hurt the most. The enemy could sustain steady attrition of war materials inflicted by the USAF day-and-night interdiction program, so long as at least a minimum quantity arrived at the static battle front. He could stand the loss of industry; so long as the loss was offset by procurement from Manchuria and Soviet Russia. He could sustain great loss of human life; for life is plentiful and apparently cheap in the Orient. But the extensive destruction and flood damage to his two main rail lines into Pyongyang was a critical blow to his transport capabilities. Not only was he faced with a tremendous reconstruction problem involving replacement of miles of track, road-bed and bridges, but the impact was further compounded by the coincidental flood damage to large areas of agricultural lands, which seriously threatened his basic source of military food supply.

The strikes were followed by immediate and extensive radio and newspaper blasts labeling the United States "imperialist aggressors attempting to destroy the rice crop by denying the farmers the life water necessary to grow rice." A concerted propaganda campaign attempted to make the world believe that the whole irrigation system lay desolate and the entire Korean rice crop destroyed. In vengeful broadcasts to all Asia and the West the Red propagandists gave the impression that dozens of irrigation dams were destroyed. Each dam was referred to by seven or eight different names—alternating between its Japanese name, two or three Korean equivalents, the province name, a nearby village name, or a fictitious name. The goal—to marshal world opinion against this type of warfare, to bring censure on the United States Air Force, and to generate international pressure in the hope of forcing U.N. air forces to spare the irrigation dams from future air attack. Fully realizing what air attacks on the other dams would mean, Communist propagandists used every devious trick in their trade to forestall them.

Reactions at the destroyed dam sites were equally strenuous. A study of post-strike aerial reconnaissance of Toksan Dam reveals repair activity unequalled during the Korean War. Only the efforts to repair the damaged bridges across the Yalu approached the Toksan effort. Some indication of the enemy's desperate straits is shown in the vigor of restoring the vital dams and washed-out rail and highway lines: over 4000 laborers were immediately dispatched to Toksan to repair the dam and the flood-damaged rail line, highways, and bridges. A special railroad was constructed to bring in the heavy equipment and the repair materials. The work was carried out round-the-clock, with complete disregard to the delayed-action bombs strewn over the target area. Had this level of activity been simultaneously required at 20 irrigation dams, the magnitude of the repair job would have severely strained the military support resources of the Communists in North Korea. The diversion of 20 times this amount of personnel and equipment would have materially affected military operations along the battle line.
ATTACK ON IRRIGATION DAMS IN NORTH KOREA

That the enemy immediately threw the greatest repair effort of the Korean War into the irrigation strike areas leads to interesting speculations in regard to his pre-armistice military position in Korea and his future intentions.

The two main rail and highway lines washed out by the Tsokan and Chunchon floods provided logistic support to Communist military forces on the western half of the front. Both lines were repaired and serviceable in less than 11 days—only two thirds of the minimum time estimated by FEAF intelligence. It is quite possible that their incredible repair efforts were spurred by a lack of reserve stockpiles of food and ammunition on the front, so that a cut-off of the main supply pipeline for more than 14 days would have been critical.

The order of priority of the enemy’s repair efforts was (1) rail and highway lines—to resume logistics support for front line armed forces; (2) irrigation channels and canal networks—to control water for rice growth; and (3) main dams—to provide surplus water and to ensure flood control.

The first and second jobs were accomplished within 14 days after the strike, indicating their repair was essential to the military position and to the success of the rice crop. The dams were repaired several weeks before the armistice was signed. This might indicate the Communists always intended to sign an armistice despite threats to break off the talks, insistence on recapture of the liberated prisoners as an “absolute prerequisite to an armistice,” and the slow-down technique of negotiation. Otherwise, why throw tremendous effort into repairing the dams if a single air strike could negate the huge outlay of expense, labor, and resources?

If the irrigation dams were vital to the Communist military position in North Korea, there was really no acceptable way of defending them short of signing an armistice. The only military means of parrying another air attack would have been by a counter air attack on the United Nations air forces. But the Communists had no air power in North Korea. Had this counter air attack been mounted from bases in Manchuria, the enemy would have risked losing his sanctuary behind the Yalu. It would be hard to say whether anything in North Korea would be worth the risk of the security of Manchuria. The U.N. high command had made it clear to the enemy, that if U.N. forces were attacked by aircraft based in Manchuria, the U.N. would no longer be bound to stop its retaliation at the Yalu. The enemy obviously had no desire to bring on any such expansion of the war. To place his Manchurian-based air force on North Korean airfields was impossible so long as the USAF maintained air superiority in North Korea—a fact the enemy had already learned the hard way. Only an armistice would give him the opportunity to move his airpower into North Korea.

Also interesting is the relation of the dam strikes to the enemy’s behavior at the truce table. On 30 April 1953 the armistice negotiations were resumed at the request of the Communists in conformance to the new world-wide peace offensive and “soft talk from the Kremlin” initiated after the death of Joseph Stalin. By 5 May it had become apparent that the Communists were again resorting to “stall tactics.” It was on this date that the U.N. informed the Communists their time for discussion was running out. On 7 May the Communists introduced their version of the prisoner exchange plan as “absolutely the last concession” on the plan for voluntary repatriation of prisoners of war—the big issue blocking the armistice proceedings. This plan, actually only a restatement of the previous Communist stand, was rejected by the United Nations.

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On 15, 16, and 22 May FEAF launched the attacks on the irrigation dams, Toksan, Chasan, and Kuwonga, respectively. This military action was followed on 25 May by the U.N.'s "now or never" counterproposals, embodying the Western world's firm stand on voluntary repatriation of prisoners of war. Within the Communists immediately denounced the proposal as unacceptable, but requested a week for study and formalizing an official reply. On 4 June the Communists called for a resumption of the truce talks, and six days later, on 8 June, the prisoner exchange agreement was signed, ending the deadlock in the 23 month-long armistice negotiations. The U.N. had won its victory on voluntary repatriation. Thus three weeks after the initial attacks disrupted the west-coast transport network and revealed the air capability to make serious inroads on food supply, the Communists had an agreement on terms he had proclaimed for over two years he would accept, and which but a few days before the attack on the irrigation dams he termed "absolutely unacceptable."

It would of course be extremely presumptuous to claim that the Communists signed the armistice solely as a result of the pressure put upon them by strikes against the irrigation dams and the threat of further attacks. But for three years U.N. air and ground action had combined to make the Korean war far more costly to the enemy than he had ever bargained for. During two years of truce talks the air campaign had relentlessly wrecked his supply and transportation system. To an enemy in such a plight, the strikes against the irrigation dams may well have been the final pressure needed to end his stalling. Viewing these strikes against the stiff warning he had recently received in the truce sessions, the enemy may have concluded that U.N. patience was finally exhausted—that the U.N. would now commit its air power to all-out war in Korea.

The Lesson

The irrigation dam attacks, though small in scale and relatively unimportant strategically in comparison to what could have been exerted against 20 dams instead of 5, gave the enemy a sample of the totality of war that an air strategy makes possible—a totality embracing the whole of a nation's economy and its people, the whole of a nation's deployed military forces in being. Modern war mobilizes total national resources. Only warfare that cuts sharply across the entire depth of the enemy's effort can bring the war to an end short of exhaustion and economic collapse for both sides. The strikes demonstrated that by means of its air forces the U.N. possessed the capability to attack this totality in Korea. Further, and more important, they surely led the enemy to believe that a command decision had been made to employ U.N. air forces in the Far East against it—a decision which for three years of the Korean war was held in abeyance.

Toksan-Chasan was military strategy employing air forces as a decisive means to accomplish an objective of war—peace terms acceptable to the U.N. It is the same kind of military-political pressure through air power which our long-range strategic air forces have maintained on Soviet Russia since 1945, and which the world's leading military and civilian chiefs agree has maintained the peace and deterred a third world war. Should a third world war