future, without giving precedence any longer to the European social and esthetic practices that accompanied the rise of industry. The varied styles of industrial society emerging today in China, Japan, Yugoslavia, the U.S.S.R., India, and Sweden only hint at the cultural variety that the future can bring forth as the character of cultural evolution is more generally understood. For almost a century, the intellectual atmosphere of the world has been poisoned by a false Darwinism that judged human social development as the survival of the fittest—that is, of the most successfully aggressive individuals and societies. This view can now be corrected.

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11. I thank Columbia University for sponsorship and the National Institute of Mental Health, National Endowment for the Humanities, The Wenner Gren Foundation, and the Rockefeller and Ford foundations for support of this research. I also thank Victor Grauer, co-inventor of Cantometrics, and Roswell Rudd, musicologist, for the musical ratings; Edwin Erickson for his statistical guidance; Irmgaard Bartinieff and Forrestine Paulay, coinventors with me of choreometrics for the movement data; and especially Conrad Arensberg, close collaborator, mentor, and codirector of the research. This article may be identified as reprint article A-661 of the Bureau of Applied Social Research, Columbia University.

NEWS AND COMMENT

Technology in Vietnam: Fire Storm Project Fizzled Out

The Advanced Research Projects Agency (ARPA), which is attached to the Department of Defense (DOD) made at least three attempts, in 1965, 1966, and 1967, to light what defense planners termed "fire storms"—the name used to describe the World War II holocausts at Hamburg, Dresden, and elsewhere—in some of South Vietnam's most valuable timber country. All three attempts, however, fizzled out. One may have even caused rainfall instead of a big forest fire.

The attempts were known by such euphemistic names as Sherwood Forest, Hot Tip, and Operation Pink Rose. They took place in the Mekong Terrace section of South Vietnam—a central plains area which contains several luxury timbers, such as mahogany and rosewood, and half of South Vietnam's sawmills. Timbering is said to be one of the few industries that could develop into prime importance for the South Vietnamese economy. Nonetheless, experts from the U.S. Department of Agriculture (USDA) were called in by ARPA to advise on how to effectively burn the forests. The project's budget was on the order of $1 million.

Military sources say that the attempted jungle fires took place in areas where there were no "permanent type villages," although they allow that Viet Cong supply depots and base camps were in the woods. But Senator Gaylord Nelson (D–Wis.) views the fire projects as part of the U.S.'s "callous" and "unprecedented environmental warfare" which has involved "an outrageous use of technology."

The USDA fire service role in the project was led by Craig Chandler, a fire storm expert who is now director of fire research for the Forest Service. The fire storm project is also discussed in a classified paper, obtained by *Science*, written by Arthur F. McConnell, Jr., a lieutenant colonel in the Air Force who was involved with the Ranch Hand defoliation missions.

Two reasons were given for the project. One was that, by creating a fire which would "crown," that is, burn out defoliated tops of trees, the fire would remove layers of jungle canopy and make reconnaissance from the air more effective. A second reason was that a large-scale jungle fire which reached the tree tops would also destroy the ground cover and make concealment and camouflage by the enemy from U.S. bombing strikes or ground attack impossible.

Fire storms can be many times more dangerous than regular fires; they have occurred accidentally in forests in the American West, as well as in Australia and southern France; they also occurred in urban areas, including Dresden and Hamburg, and on at least two occasions in Tokyo during a 1923 earthquake and during bombing raids in 1944–1945.

In a fire storm, the area of intense burning sucks in oxygen at such a rate that high-speed, cyclone-like ground winds are created, blowing into the fire at speeds which may exceed 100 miles an hour. The Hamburg fire chief, for example, reporting on the fire storm of July 1943, said that many people died from the intense heat even though they were located 150 meters from the nearest burning building.*

Both McConnell's classified paper (which was later sanitized and published in the *Air University Review*†) and ARPA officials used the term fire storm to describe the burning projects in Vietnam. Chandler says he was asked on a number of occasions during the operation of the project whether a fire storm could be ignited in the humid, tropical jungle. Although lighting a fire storm might be feasible under certain conditions in temperate areas, such as the western United States, Chandler said he told the military it was not feasible to do so in the jungle.

Nonetheless, the fire storm project, as it came to be known, was started under ARPA authorizing order 818. Its final reports are all classified, although some press reports appeared at the time of the attempts. Chandler said he was

* "Field notes on World War II German fire experience," title of contract No. N228(62479)-65419 to Carl F. Miller and James W. Kerr, October 1965, Stanford Research Institute, Menlo Park, Calif.

† The sanitized version was published as: A. F. McConnell, Jr., "Mission: Ranch Hand," *Air Univ. Rev.* **21**, 89 (1970).

willing to be interviewed only about those aspects of the project which he had already seen appear in unclassified publications.

The project began at the request of CINCPAC, the office of the Commander in Chief of the Pacific which runs operations in Vietnam. Chemical defoliants were then coming into use in the war. However, the jungle canopy, which can extend upward in tiers to a height of 100 feet from the ground, was not transparent enough after defoliating missions. An ARPA spokesman said, "The question posed by CINCPAC was: couldn't we burn the jungle area in the so-called 'hot zones' of infiltration?"

ARPA hired the fire research section of the USDA Forest Service to carry out the order, and offered the support of its 25-member field unit which had been stationed in Vietnam since 1961. The USDA did some preliminary research, then participated in the first "field test"—as ARPA calls it—in the Boi Loi woods near the Iron triangle near Tay Ninh city. The area is due west of Saigon, close to the Cambodian border. As in all the fire storm attempts, at the beginning of the dry season Ranch Hand crews defoliated the area, the dead leaves were permitted to dry out for a period, thus preparing the fuel supply. Then ignition was attempted. Hence, in April or May of 1965, a section of the Boi Loi woods was ignited. According to McConnell's paper, the project, "Operation Sherwood Forest," was "a massive attempt to burn out a defoliated section of the Boi Loi woods in the hope of denying the enemy an extremely vital base camp area."

Unfortunately, it was raining on the day the field units tried to light the fire. The lighting attempt went ahead, but nothing happened because of the rain. The failure to ignite the woods under the right weather conditions was the reason a second attempt was made a year later.

Chandler recalls two subsequent major attempts, but McConnell's paper implies that there may have been more. "It is interesting to note," McConnell wrote before the Air Force censor deleted the passage, "that during this period and for the next year, several 'fire storm' projects similar to the Boi Loi woods effort were made in conjunction with the Vietnamese Air Force." Asked about this, ARPA officials noted that one of the jobs of the ARPA field unit was to transfer technical skills to the Vietnamese; however, the officials doubted that the incendiary technology was ever successful enough to be passed along to U.S. allies.

The second major burning attempt, code named Hot Tip, was made much farther north, in the Chu Pong Mountains, about halfway between the South Vietnamese cities of Pleiku and Kontum. Ranch Hand crews again defoliated a forest tract probably less than 30 square miles in area. Chandler recalls that the fire was lit sometime in either January, February, or early March of 1966.

"This one wasn't done in the rain," says Chandler. "It was more successful than the first attempt. We recommended some changes afterward, which is why there was a third attempt." Later, an Associated Press account termed this attempt an "incendiary raid" made by "tactical bombers." According to other sources, the fire burned parts of the forest and ground cover, but failed to continue burning, or to spread. One reason, of course, was the high humidity of the jungle. The other was apparently the temperature and wind conditions.

The third and biggest attempt, code named Operation Pink Rose, took place in a Viet Cong stronghold northeast of Saigon near Xuan Loc, in February or early March of 1967. The area staked out for burning was probably 30 square miles. In this case, although weather conditions were perfect, the fire was followed by a rainstorm which put it out. Some accounts say that the fire may have even caused the rainstorm. Thus, all three of the attempts were considered failures.

According to McConnell's original paper, in a passage that was later slightly altered: "One of the highlights of this period [early 1967] was Operation 'Pink Rose,' the third jungle-burning project carried out by Ranch Hand crews. In support of this project, the squadron flew approximately 225 sorties and delivered over a quarter-million gallons of herbicide on selected target areas in War Zones C and D." One military observer, L. L. Herzog, a lieutenant commander, who saw the Pink Rose incendiaries dropping from the sky, was later quoted as saying, "It looked just like the Fourth of July."

Chandler says, "The rain came the evening afterwards. The country doesn't burn well. This is why there was never any expectation on our part that fires were going to spread." Chandler would say only that the incendiaries used for Operation Pink Rose were "of a World War II type" and that after the third attempt, the Forest Service experts who had worked on the project wrote a report to ARPA advising that no further "field tests" or research be carried out.

Much of ARPA's field research in South Vietnam, including the trail sensor network and the foliage penetration radar, has come into wide use in the war. Other projects, such as Pink Rose, which don't work out, are allowed to quietly die. "This was clearly one of those ideas that should have been given the very quietest funeral," an ARPA official said. ARPA briefed the relevant officials in the Air Force and the Office of the Secretary of Defense on USDA's conclusions, and that was that. "It really was a nutty idea to begin with," said an ARPA official.

Despite the unanimous "nyet" of the USDA and ARPA to the feasibility of starting fire storms, or self-propagating fires, in the damp Vietnamese jungle, two questions about the project remain. One is why the term fire storm came to be applied in the first place to the project. McConnell, the former Ranch Hand chief who mentioned fire storms in the course of his paper, said he recalled picking up the term from military sources.

Jay Bentley, a forester, now retired, who was with the fire research service, and headed up the fieldwork for Hot Tip, the second attempt, said he did not recall even hearing the term fire storm in connection with the project until he read it in the newspapers. As to who raised the expectation that a Dresden- or Hamburg-like holocaust would be created in the jungles, Bentley says, "I didn't expect very much to result or think the expectation was very high as far as ARPA was concerned." This statement, as well as ARPA's skeptical attitude toward the project, would seem to imply that the enthusiastic—and horrific—term fire storm emanated from military command sources, over the expert technical advice of the civilians and ARPA.

Another question is what would have happened if the experts had indeed found a way to spark big fires. ARPA sources said unhesitatingly that if Pink Rose had succeeded, the military commanders would have doubtless gone on to use fire-lighting in other situations.

Incendiary technology would have been added, along with herbicides, weather modification, and other environmental weapons, to the DOD arsenal.

Yet, discussing their own role, both the ARPA spokesmen and the Forest Service experts merely claim that they were giving neutral, technical advice.

Chandler obviously likes trees, yet he also supports the jungle-burning project because, in his words, "it was part of a military operation" and no villages "friendly or unfriendly" were involved. "This was definitely not a burn-up-people project," he says. And a high ARPA official defends the agency's role thus: "Here was a situation which came up which clearly no one knew what the facts were. . . . We were, as research people, asked to look into the technical possibilities and to tell people who make political decisions what the facts were." These statements rivet the issue back to the historic claim by scientists that their technical advice is morally neutral and, by implication, divorced from the uses to which the technology they develop is ultimately applied. Perhaps there were no villages involved in what ARPA blandly called the "field tests" of the incendiary projects. Yet clearly there was no insurance that villages would not someday be included in the target area.

The fire storm project is now a mere historical event which its perpetrators would prefer to forget. But another issue may loom very much in the present and future and relates to the matter of ecocide. According to Forest Service experts who have surveyed and inventoried the forest resources of South Vietnam and their alteration due to the war, at least 1 million hectares were defoliated, as of 1967, and that total may have reached 3.5 million by 1969.‡ Defoliation has taken place, not just a few times in a few strategic patches of jungle; some areas have been sprayed for almost 10 years. The tropical hardwood forests of the Mekong Terrace are drier now that they were in 1965–1967 when humidity dampened Pink Rose projects. It is still possible that fires might recur as a mode of warfare in the collective memory of CINCPAC and the military commanders. As one ARPA official said, "If the system has any institutional memory whatever, if this suggestion is ever made again, they'll look into the files and find out it doesn't work."—DEBORAH SHAPLEY

‡ Barry R. Flamm and Jay H. Cravens, "Effects of war damage on the forest resources of South Vietnam," *J. Forest.* **69**, 784 (1971).

Spain (III): Education Reform Drawn on Outside Ideas, Support

The university city on the fringe of Madrid formed the front lines for some of the most sustained and savage fighting of the Spanish civil war. Now, 35 years after the war ended in a victory for the Nationalist forces under Generalissimo Francisco Franco, the embattled university remains a convenient symbol, for it is at Madrid and other Spanish universities that the lines are most clearly drawn between the Franco government and its opposition.

Student unrest is not, of course, peculiar to Spain. As a matter of fact, at no point during the 1960's did the Spanish government seem in danger of losing control of student protests, as seemed possible in France, Italy, Germany, and the United States. What has been remarkable in Spain is that the universities, particularly in Madrid and Barcelona, despite tough countermeasures devised by an authoritarian regime, have for two decades been centers of opposition influencing a generation of university students.

Other Europeans and Americans tend to regard the contest as being between the liberal university and a repressive regime. True, by Western democratic standards; but, as is often the case in Spain, the whole truth is more complicated. The university has been the source of liberal and radical ideas in Spain for more than a century and for much of that time a reservoir of antigovernment sentiment as well. In the 1920's, for example, the universities figured centrally in the events that brought about the downfall of the dictator Diego Primo de Rivera, the abdication of Alfonso XIII, and the rise of the unready Second Republic.

If the universities are incubators of change, they are also themselves institutions in need of reform. The pathology of Spanish universities is much the same as that of French and Italian universities, but in Spain the contradictions seem richer and more perplexing.

The Spanish government has launched what is probably the most ambitious program of education reform attempted in Western Europe. Not surprisingly, the reforms, which affect education at every level, have caused controversy and confusion in Spain, but what puzzles the outsider is that, on so many issues, those who would appear to be natural allies work at cross-purposes. In Madrid, for example, the phenomenon of radical students and reactionary professors joining forces to oppose reforms now causes little surprise. Indeed, many professors identified as liberals are cool to the reforms, not on political grounds, but because they view them as ill-designed and ill-managed.

The education reform has attracted remarkably little notice outside Spain, considering its scale and the fact that it is a textbook example of modern, international educational theory. A pivotal figure in the reform has been the undersecretary of the Ministry of Education and Science, Ricardo Díez Hochleitner. An educational planner with considerable experience with UNESCO and other international organizations, Díez Hochleitner got more than a little help from his friends in the form of money, technical assistance, and moral support. Such organizations as the World Bank, the Ford Foundation, and UNESCO have rallied to the aid of the reform.

The abrupt replacement of Díez Hochleitner last month perhaps indicated some of the limits of reform in Spain. His policies and personality had become a subject of controversy in Spain, but the diagnosis by people in Washington who are in touch with the situation in Madrid is that the pace of reform had grown too swift, its administration too off-handed. But the reform, it appeared, is to continue.

About the necessity for education reform there is actually little disagreement in Spain. The educational system was formed to serve an agricultural economy and a preindustrial social structure. The church dominated elementary and secondary education, and the national universities persisted rigidly in their historic task of transmitting the culture and providing training in the traditional professions.

Social and economic disparities are clearly reflected in statistics on education in Spain. Of 100 students who began primary education in 1951, 27