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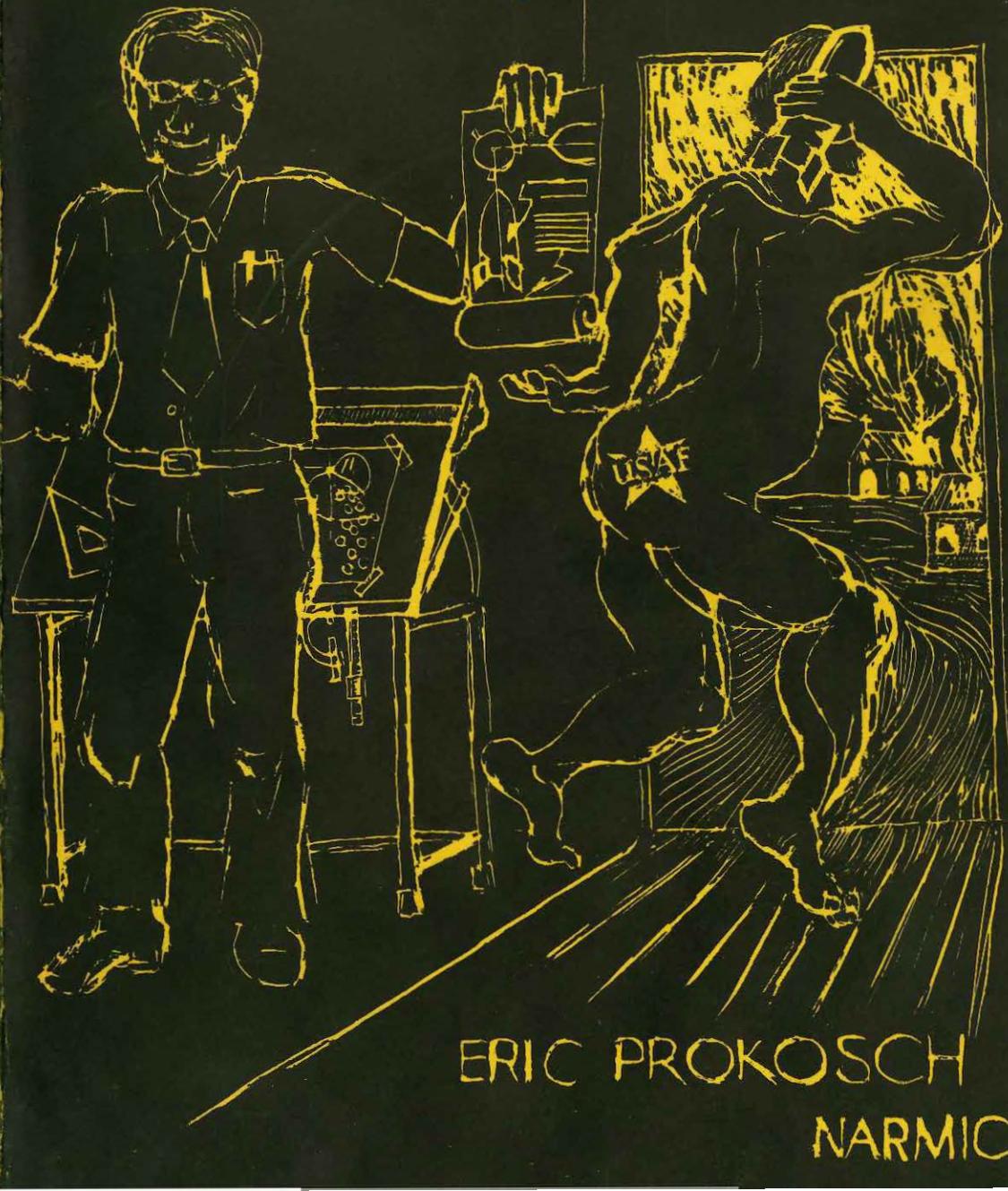
THE SIMPLE ART OF MURDER

ANTIPERSONNEL WEAPONS AND THEIR DEVELOPERS



ERIC PROKOSCH

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THE SIMPLE ART OF MURDER

Antipersonnel Weapons and Their Developers

"Antipersonnel:...Designed to destroy or obstruct personnel"--The United States Air Force Dictionary, 1956

Eric Prokosch

NARMIC 1972

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INTRODUCTION: THE SIMPLE ART OF MURDER

What does a munitions designer do when he comes home at night? Hug the children, settle down for a quiet evening of television, comfortable in the thought that he has done a good day's work?

The work involves many people, many skills. Someone must conceive of a weapon that will accomplish the desired "objective." Someone draws up the plans, designing the weapon so that it will work efficiently and reliably. Someone builds prototypes and someone tests them to see if they are easy and safe to use. Alternative designs and materials are tried out. Finally a design is selected, manufacturing methods are perfected, production tools are designed and built, and then if the "objective" still exists, production contracts are awarded and the weapons are manufactured--and used.

There are many objectives, many "targets" to be "defeated." A target may be a bridge, a building, a concrete shelter, a tank--or a person. Certain weapons work best against certain targets. An antitank shell can blow a hole in a tank. An armor piercing warhead punches through armor. "Antipersonnel" weapons work best against people. And behind the armor, inside the tanks and buildings, the enemy consists of people.

"Antipersonnel" is a technical term, a piece of military jargon. The United States Air Force Dictionary in 1956 defined it as "designed to destroy or obstruct personnel." "Personnel" is also a

military term: The Joint Chiefs of Staff define it as "Those individuals required in either a military or civilian capacity to accomplish the assigned mission." How can "those individuals" best be "destroyed or obstructed"? The most efficient way in most cases is through fragmentation.

A bullet, in a sense, is a fragment: a small piece of something hard. A rifle will do the job, but it only kills one person at a time. A machine gun will kill several people in seconds, but its range is limited and it cannot shoot behind obstacles. Where modern munitions designers have really taken off is with the explosive deployment of fragments. A metal case contains an explosive filler, as in a hand grenade or bomb. The explosive goes off, breaking the case into fragments which shoot off at high velocities. By refinement of the fragmenting mechanism and by proper combination and arrangement of munitions, whole areas (and the "personnel" therein) can be inundated with fast-moving fragments.

The first fragmentation weapon, the hand grenade, dates back to the seventeenth century. The first bomb drop in history involved a fragmentation weapon: An Italian lieutenant tossed a grenade out of his airplane on to a group of Arabs in Tripoli in 1911. Between the two world wars, British armament experts saw the importance of fragmentation and coined the term "general purpose" for ordinary bombs in recognition of the fact that they served two "purposes": blowing up structures (by blast from the explosion) and destroying personnel and light materiel (by fragmentation of the case).

In the meantime, American munitions designers came up with the idea of wrapping heavy steel bar stock around a bomb body so as to produce a more regular and effective pattern of fragments upon explosion. A 20-lb. bomb based on this design was standardized in 1940 and is properly known as a fragmentation bomb since its main effect is derived from the fragments produced upon explosion. "Wicked little weapons" in the words of one officer, the 20-lb. and similar 23-lb. bombs were used in the battle for New Guinea and "became increasingly popular" thereafter, according to the official U.S. Army history of World War II: "If accurately placed, they could harass front-line infantry and disrupt lines of communication far more completely than could machine gun fire."* Fragmentation bombs added a dimension to machine gun strafing because the fragments went off in all directions and covered whole areas at once.

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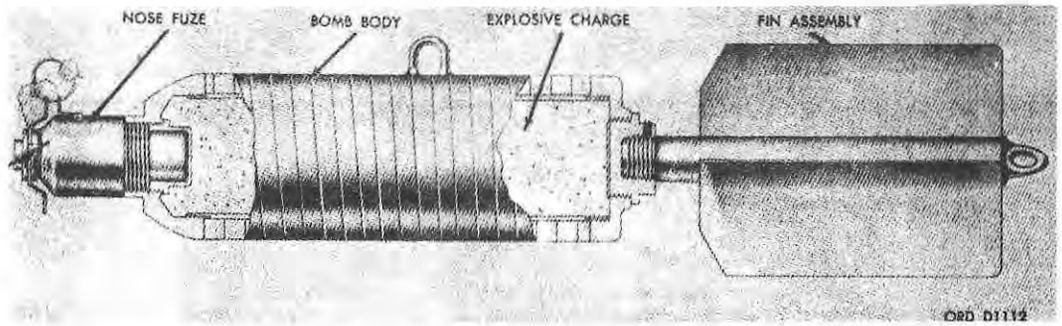
* C.McL. Green, H.C. Thomson, and P.C. Roots, United States Army in World War II; The Technical Services; The Ordnance Department: Planning Munitions For War. Washington, Department of the Army, 1955

A 260-lb. fragmentation bomb, similar in design, was developed shortly thereafter in response to an "urgent" demand from the southwest Pacific. Comparison tests showed the 260-lb. bomb to be more effective against armored vehicles and other "highly resistant and concentrated targets"; the 20-lb. bombs (joined in clusters of six) were more effective against "unprotected troops and lightly armored vehicles and aircraft." This was a lesson the military never forgot. Modern munitions designers have continued in the same direction, creating increasingly small and numerous bombs that produce increasingly small and numerous fragments.

The other main line of development, canister projectiles, also goes back to World War II; it is based on the principle of shotgun ammunition, which of course is considerably older. In World War II projectiles, small steel shot was embedded in a matrix of resin inside a canister. The canister was fired from an artillery piece; the shock of discharge ruptured the canister, scattering the shot forward. Canister ammunition "proved surprisingly effective for stopping massed Japanese attacks and for clearing jungle undergrowth," according to the Army history.

Modern canister projectiles are loaded with flechettes--small steel darts that have been under development since the mid-1950's. Flechettes do surprising things when they hit; they "shred" flesh, they tear "gaping" wounds, they nail people to trees, according to various reports; all effective ways to "destroy or obstruct personnel."

A few modern antipersonnel weapons are based on blast rather than fragmentation. A small explosive charge contained in certain land mines is enough to blow a person's foot off without producing fragments. Fragmentation, though, is the basis for most modern antipersonnel weapons.



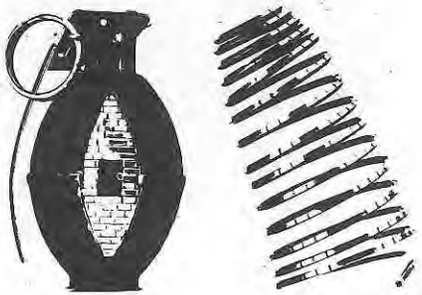
Army drawing of a World War II 20-lb. fragmentation bomb. The body consists of heavy steel bar stock wrapped around a high explosive. (U.S.

An area is to be inundated with fragments: What is the best way of producing them? The cast iron case of the World War II grenade was grooved so as to break into a few large fragments. The body of today's M26 grenade is made of notched steel wire that breaks into more than a thousand fragments having a velocity of over 4,000 feet per second upon explosion. The many small fragments are more likely to hit someone, and a person may be hit in more than one place.

Another way of producing fragments is to manufacture them beforehand. Ball bearings are embedded in "guava" bomblet cases; when the explosive filler goes off, the balls are shot in all directions. Still another way is to make the case out of a material that will give the best fragmentation pattern. Ordnance magazine in 1961 reported on a "revolutionary" new method of casting artillery shells from malleable iron, thereby obtaining "more effective fragmentation." 81mm. mortar shells and 2.75-inch rocket warheads are now made of this material.

The fragments can be "delivered" to their targets in various ways. An Air Force bomber, naval guns, or Army artillery can all deliver ammunition far inside enemy territory. The bomber can go farther, but it is more expensive to run and it may be shot down. Modern armed helicopters use both rockets and machine gun fire against people on the ground: Machine gun ammunition is cheaper and lighter to carry, but the rockets have a greater range and can therefore be used at a safer "stand-off" distance from the "target." Some munitions are also "delivered" by the individual soldier.

Sometimes ammunition is designed to fit existing weapons; sometimes weapons are developed to accomodate a promising new line of ammunition. Beehive projectiles (canisters containing flechettes) have been developed in more than ten types to fit different artillery pieces. On the other hand the 40mm. antipersonnel grenade and launcher, introduced in 1960, were such a success in Vietnam that the Army went on to develop two automatic 40mm. guns for helicopters, a low velocity automatic launcher for ground use, and a grenade launcher attachment for the M16 rifle. Other types of 40mm. ammunition were also developed to go with the guns: sig-



Cutaway view of a modern M26 grenade showing the notched steel wire that breaks into fragments upon explosion. (Photo from U.S. Army Materiel Command Pamphlet AMCP 706-107, Elements of Armament Engineering; Part Two; Ballistics; Sept. 1963)

nal flares, a chemical riot-control grenade, and a rocket-propelled grenade to penetrate jungles.

Sometimes existing weapons can be adapted for new purposes. The 2.75-inch "Mighty Mouse" rocket, the first U.S. air-to-air rocket, was developed in the early 1950's for shooting down enemy planes; it "can knock any plane out of the air," Ordnance commented in 1953. In the early 1960's the Army, looking around for something more to shoot at "personnel" on the ground, designed a new fragmentation warhead for the rocket and made other necessary changes. The new rocket was a tremendous "success" in Vietnam and the military ordered more than a billion dollars' worth. Another air-to-air weapon of the 1950's, the 20mm. Vulcan gun, was described in Ordnance in 1956 as "a giant killer of the sky"; its revolving barrels gave it an unusually high rate of fire. In Vietnam it proved effective against personnel and other ground targets and another, newer revolving-barrel gun, the 7.62mm. Minigun, was also installed on planes and used against "ground targets."*

Fuzes have a lot to do with the effects of a munition. If a general purpose bomb goes off just when it hits the ground, the fragments will be effective against nearby "personnel"; if it penetrates a structure before going off (with the aid of a delayed-action fuze), it will be more effective in blowing up the structure.

Fragmentation munitions are most effective against people on the ground if they explode above the ground so that the fragments go down and outward, instead of being partly buried in the ground. This is mainly possible thanks to a World War II invention, the proximity fuze. The proximity fuze incorporates a radar device (another World War II invention) that senses approach to the ground and detonates the munition at a certain distance above the ground. Development of the proximity fuze "occupied some of the best scientific brains of America and Britain," according to the official Army history; the War Department described the fuzes as "second in importance to the atomic bomb" in bringing about victory, and the Army history notes that "their widest and most deadly application was against ground troops."

In modern times, proximity fuzes have been developed for antipersonnel cluster bombs, and for the 2.75-inch rocket ("in response to an urgent RVN /Republic of Vietnam/ requirement," according to an Army witness at a 1967 Congressional hearing). A new jungle penetration proximity fuze allows general purpose and fragmentation bombs to drop through jungle foliage and then explode above

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* "Target": "A place to be reached and struck at" (The United States Air Force Dictionary, 1956)

the ground; no longer can "personnel targets" hide in lush Vietnamese jungles. Advances in microcircuitry have made possible the development of a miniature proximity fuze for 40mm. helicopter-launched grenades that costs as little as $5 per fuze; dozens of airbursts can be produced in a matter of seconds. Delay fuzes have been developed for antipersonnel bomblets so that some bomblets will go off hours after the attack, when personnel targets who are still alive have emerged from their shelters thinking the coast is clear. Thus from one-dimensional rifle fire to two-dimensional machine gun fire to three-dimensional fragmentation munitions and canister projectiles, munitions designers have gone on to add the fourth dimension--time--to antipersonnel weapons.

What is all this technology for? Why the millions of fragments? Is it to save America from the menace of Communism? Or is it to wipe out anyone who gets in our way?

An anthropologist once used the term "technological hypertrophy" to refer to the process by which a type of object, say a stone axe, is developed and refined over time to the point where it becomes useless for its original purpose. Antipersonnel weapons have been developed and refined over the last 20 years; unfortunately they are not yet useless. All the same the process is a peculiar one; it suggests a kind of cultural madness where an idea is carried to extremes and ordinary, everyday matters become distorted. But what was the original idea that got carried to extremes? Was it murder? Was it an urge to dominate? Or was it simply--technology?

Even in World War II, observers noted that the United States was relying on technology--massive firepower--far more than other countries. In the Korean war, towns were destroyed by U.S. bombs and artillery so that they could be saved--a familiar occurrence in Indochina--and a British observer reported a memorable incident in which withering firepower and tons of ammunition were used to silence a few snipers that a platoon of soldiers could have dealt with much more quickly. Technology, a theme that is widespread in other areas of American culture, has permeated the field of warfare so that for most Americans, this is simply the way war is fought.

Along with technology goes a disregard for human beings. Americans are surrounded by machines, dwarfed by tall buildings, driven by production schedules. All sorts of privations are justified in the name of progress, which is conceived as a more or less automatic unfolding of technology. Officially and in accordance with

our Christian ethic, human life is important: Outrages in war are justified in the name of "protecting American boys," and rescue missions and "civic action programs" are emphasized. Underneath this is indifference, even hatred toward fellow human beings; it emerges in its full dimensions in our relationships with "other types" of people; and Indochina is inundated with fragments.

Who are the "personnel" that are to be "destroyed or obstructed"? How many Americans care? It is a technological accomplishment to hit a bridge with "pinpoint accuracy." Who cares if other bombs somehow accidentally miss their targets and land elsewhere and "destroy or obstruct personnel"? A helicopter armed with air-to-ground rockets and grenades is a fancy piece of machinery. Who cares if the pilot cannot distinguish between "friendlies," "VC suspects," and other "gooks"? Artillery officers are proud that their guns are capable of inflicting "terrible punishment" on the enemy. Who cares if no one has designed a device that would make the guns ask first, shoot later?

Senator Jack Miller of Iowa asked at a 1967 Senate hearing, "Have we on any occasion in connection with any of the targets that have been struck in North Vietnam given any advance warning that civilians would be endangered and they should therefore evacuate if they want to protect themselves?" Admiral Sharp of the Navy replied, "I do not believe so." (By then more than 200,000 tons of bombs had been dropped on North Vietnam, according to the Cornell air war study.) Some of the ensuing discussion was censored from the record and Admiral Sharp then remarked, "I think that is a good idea and we will work on that thought." Why hadn't he thought of it before?

At another hearing in 1967, following censored testimony that was probably on new aerial mining systems, Congressman Sikes (D., Fla.) asked an Air Force general, "Are you making the battlefield too dangerous for our own people to fight in? Or are you making the waters so dangerous that friendly forces cannot use them when the fighting is over?" Congressman Lipscomb (R., Calif.) snapped back: "That is not the Air Force problem." Whose problem is it?

American society is constructed in such a way that the greatest problems become no one's problems. It stems from what the French sociologist Durkheim called "organic solidarity": The society sticks together as a whole because its parts are differentiated. A weapons designer is not, first and foremost, a murderer; he is a statistician, a metallurgist, or an engineer. He is trained for his profession and he thinks in its terms. When presented with a problem, he seeks solutions which are "elegant" and "rigorous" (as a mathematician would say). A neat solution satisfies his scientific bent and earns praise from his colleagues; a successful solution brings rewards from management, and for engineers in mili-

tary laboratories, prizes and recognition from above.

Enter the world of the munitions designer. It is filled with "lethal area estimates" and "kill probabilities," "effective casualty radius" and "expected damage to a circular target area." There is interior ballistics (what happens to a projectile inside a gun), exterior ballistics (what happens to it in the air), and terminal ballistics (what happens when it hits the "target"), and then as a subfield of the last, there is "wound ballistics"--what it does to people. There are "sensitivity studies" and there are "compatability tests"--not a form of marriage counselling, but a procedure for making sure that a given bomb can be used with a given airplane. It is not the language of a murderer, but it belongs to the art of murder.

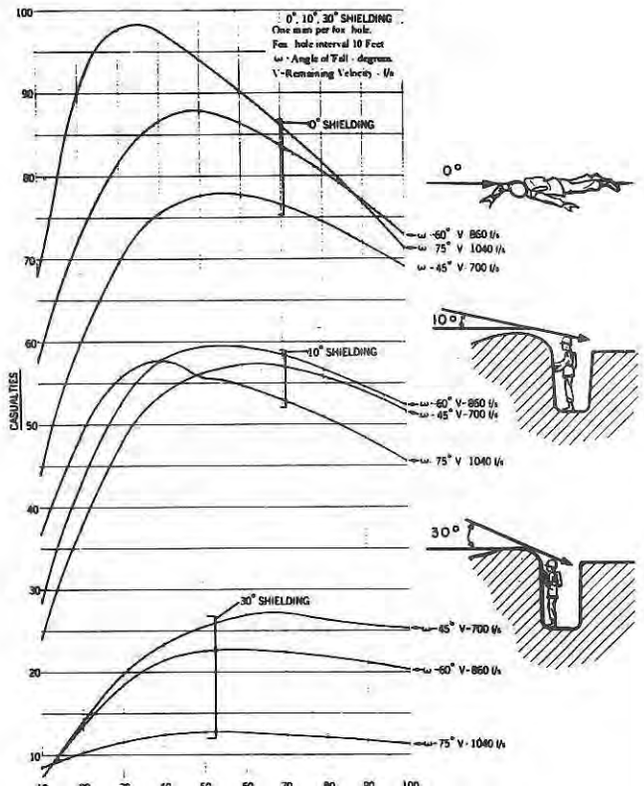
An Army contractor relates in the abstract of a report on "A computerized stochastic mathematical model of MBD-1 B-47 antipersonnel grenade dispenser lethality" that "After consideration of system objectives, target parameters, and system peculiarities and constraints, system lethality criteria are synthesized and operational parameters are assessed..." An Army study encompasses "experiments in which an expedient antipersonnel weapon employing the linear shaped charge principle was devised and proof-fired against silhouette targets at ranges of 15 to 110 yards to determine the effectiveness of the weapon against massed infantry attack." The study shows that it "is a highly lethal device at ranges up to 55 yards" and that "filling the linear shaped charge cavity with steel washers or nails, or using two steel fence posts nested together as the cavity liner, can significantly increase both the casualty effect and range of the expedient antipersonnel weapon." Army engineers find in another study that "Incapacitation, resulting from swelling and pain approximately 30 minutes after injury, makes caltrops /multi-pointed spikes/ highly effective for impeding travel," and they suggest that "sufficient evidence exists to warrant a field test of caltrops in a combat environment." "System lethality criteria" and "silhouette targets," "steel washers or nails" and "field tests": scientific notions and essential equipment in a munitions designer's laboratory.

The language applies to one world; the reality, to another. The same holds true for military jargon and those who use it. Most antipersonnel weapons were probably first intended for use against enemy soldiers. Most if not all of them have also been used against civilians. Does this mean that the weapons are destined to wipe out all human life or that civilians are now included among "personnel targets" to be "destroyed or obstructed"? Either conclusion would make the military seem unacceptably cruel; and after all, we are a peace-loving people who are taught, "Thou shalt not kill," "Love thy neighbor," and "Turn the other cheek." So the military take refuge behind their jargon.

"Flak suppression weapon" and "fire suppression weapon," for instance, are favorite terms for air-to-ground weapons. Translated, they mean: "Shooting back at someone who is shooting at your plane." Missiles and Rockets magazine reported in 1966 that GE's Minigun on slow airplanes had proved to be "a great equalizer against small-arms ground fire." But what kind of an "equalizer" is an antipersonnel cluster bomb that delivers fast-moving fragments over a wide area? The idea behind it is not so much to knock out antiaircraft guns as to destroy the people who are using them. What happens to other people who are within the area the bomb is designed to cover?

Carry it a step further and send a plane over the air space of another country: If someone shoots at it, shoot back. Carry it a step further and bomb North Vietnam because there are so many antiaircraft emplacements there. Why not carry it one more step and drop antipersonnel bombs just in case there is someone down below who might some day shoot at one of your planes?

This last step was hinted at during an Air Force general's testimony on the new antipersonnel CBU-24 "guava" bomb at a 1967 Con-



Army diagram illustrating some of the computations that go into studies of the effectiveness of a fragmentation bomb. The graph shows that an airburst 30 to 70 feet above the ground is ideal for producing casualties among personnel protected by a mixture of 0°, 10°, and 30° shielding. (From Army Materiel Command

gressional hearing (military jargon underlined):

> Major General EVANS... Although this was developed as a flak suppression weapon, its area target applications will become obvious from the next film clip.
>
> This is a film clip of the operational tests that were run in Southeast Asia in April of last year.
>
> This is an F-105 carrying /censored/ these CBU-24 bombs...
>
> Here is a target about 130 miles north of the DMZ, an actual North Vietnamese target, a communications center. This shows what /censored/ these CBU-24's are doing to that target area. The picture, of course, is taken by a follow-on F-105 aircraft to record the initial operational test and evaluation.
>
> Here you can see the secondary fires and explosions that resulted from that one attack. Because of the extreme success of this weapon in Southeast Asia, we have now received approval from the Defense Department to produce these at the rate of /censored/ per month.

It started out as a "flak suppression weapon" and pretty soon it was found to have "area target applications." "Area target" is another bland military phrase that conceals some tricky assumptions. The Joint Chiefs of Staff define it as "A target consisting of an area rather than a single point"; what the area may contain is not specified. Then there are "area denial munitions," which are supposed to "deny" the enemy the use of an "area." Which area, and who is the "enemy"? Is it an army that acts against the wishes of most of the population? (That is what North Vietnamese say about the United States.) If the people support the army, are the people "enemy" as well?

Military jargon is confusing at times, but the motives behind military reasoning can be translated into familiar American themes: power, success, progress, a love of gadgetry. Each year generals and admirals appear at closed sessions of Congressional committees to explain why they should be given so-and-so many billions of dollars for the next year. The Congressmen give them a hard time on minor misexpenditures: In 1967, for instance, Congressman George H. Mahon, chairman of the House Appropriations Committee, was irked when he found out that the government was supplying production equipment for the steel balls that are the source of fragments in "guava" bombs. "Industry has been making ball bearings for years," he complained. "Do you have to do this to encourage them to accomplish the objective?"

Protectors of the overtaxed citizen, the Congressmen and Senators are basically in sympathy with the military. One Congressman at a 1966 hearing could hardly contain his enthusiasm when the Army unveiled its new flechette-filled 105mm. Beehive ammunition.

> General CHESAREK (U.S. Army). We mentioned on Tuesday, Mr. Chairman, our new /censored/. I would like to have Mr. Matt describe these rounds to you. They use a very interesting concept.
>
> Mr. MATT (Picatinny Arsenal). I have two models here, one the 105mm. Howitzer round.
>
> Mr. FLOOD (D., Pa.). How big is a /censored/?
>
> Mr. MATT. They are /censored/.
>
> Mr. FLOOD. Different sizes?
>
> Mr. MATT. No.
>
> Mr. ANDREWS (D., Ala.). You say the shell has /censored/?
>
> Mr. MATT. Yes.
>
> Mr. FLOOD. What kind of wound does this make? Will this kill?
>
> Mr. MATT. Yes, sir.
>
> General CHESAREK. It is a nasty thing.
>
> Mr. FLOOD. A guy will pick up /censored/.
>
> General CHESAREK. It depends on how close he is to the burst.
>
> Mr. MATT. /Censored/
>
> Mr. FLOOD. Is it disabling without any question?
>
> Mr. ANDREWS. Do the Vietcong troops have any of this type of weapon?
>
> Mr. MATT. No, sir.
>
> Mr. FLOOD. That is what we have been talking about for years. (Emphases added)

Some people think that technology unfolds automatically, that "progress" is inevitable. Weapons development, in fact, is a long, drawn out process--unless there is an "urgent requirement" from the "field." Every step in the process requires attention, effort, and money. None of it would happen unless someone decided to make it happen. It is possible to stop at any time.

This booklet documents for the first time the enormous amount of brain work that U.S. companies, research institutes, and universities have devoted to the development of antipersonnel weapons. And even this is only one side of the story: Military laboratories are also heavily involved. The Army's Harry Diamond Laboratories in Washington develop fuzes; the Ballistic Research Laboratories at Aberdeen Proving Ground, Maryland, devise mathematical models of fragment distributions and kill probabilities; Edgewood Arsenal specializes in "wound ballistics." Bombs and rockets are tested at the huge Eglin Air Force Base in northern Florida. These and other such activities will be covered in a later publication.

Most of the information in this booklet comes courtesy of the U.S. government in the form of the Technical Abstract Bulletin, a Defense Department publication whose blue-and-white covers bear ominous warnings that it is not to be left in open-stack areas of libraries or shown to unauthorized persons. (On the other hand, it is also to be disseminated as widely as possible among those having "legitimate need-to-know"; another case of organic solidarity: Everyone will be better off if the concerned parties "know" as much as possible and everyone else is kept ignorant.) The Technical Abstract Bulletin is issued twice a month and lists reports by military agencies and defense contractors in fields such as ordnance, nuclear weaponry, "military science," and basic research in physics and chemistry. Often there are abstracts of classified reports along with contract numbers, dates of work, and names of report authors.

In 1966 certain underhanded individuals with what might be called a "need not to know" began publishing extracts from Technical Abstract Bulletin on chemical and biological warfare, and in 1967 the Defense Department slapped a security classification on all subsequent issues--thereby greatly inconveniencing scientists who would now have to use it in security areas of their laboratories instead of putting it in their briefcases and taking it home to read at night. In 1971 the abstract indexes (issued separately) were also put under classification. The leak has been plugged,

but for background information on fifteen years of munitions development, Technical Abstract Bulletin and its predecessors, Technical Information Pilot and Title Announcement Bulletin, are invaluable sources.

For the most recent years and for additional information on earlier years, there are lists of military contracts in Commerce Business Daily, Research & Development Directory, and McGraw-Hill's DMS Defense/Aerospace Contract Quarterly, all of which are sold to people interested in doing business with the military. Congressional hearings, military manuals, and reports in defense industry magazines such as Ordnance are excellent sources for descriptions of weapons.

Much ingenuity and a touch of guesswork are needed in piecing together the information. What was the "pop-up barrier device" that RAYTHEON worked on in 1965? Their report was listed in Technical Abstract Bulletin under the index headings "Free Fall Missiles," "Minefields," and "Antitank Ammunition," so it must have been a device to be dropped from airplanes and somehow pop up and stop enemy tanks from going where they mustn't. GENERAL ELECTRIC developed a 20mm. proximity fuze under "Project Eyeball"; the word "eyeball" suggests that it sensed heights by optical means rather than radar. What were "Project Heat Wave," "Project Destruct," and "Project Wooden Shoe" (1962)? What about "Project Cheops" (1966): was it a device for sealing Vietcong in pyramidal tombs, or a plot to annihilate them by releasing the curse of King Tutankhamen?

There is method in the madness. The sooner we understand the method, the sooner we can find a treatment for the madness. The sooner we know the art of murder, the sooner we can try to stop the murderer.

ANTIPERSONNEL WEAPONS AND THEIR DEVELOPERS

1 Infantry Weapons

In the 1950's most of the military was keen on nuclear weapons and ballistic missiles. The Army, though, managed to develop three small but important new antipersonnel weapons for infantry: the M26 hand grenade, the M79 40mm. grenade launcher system, and the Claymore mine. All three weapons entered the Army inventory in 1960 or thereabouts; all three have been widely used in Indochina and each, in its way, paved the way for subsequent developments.

Hand grenades

The origins of the new hand grenades probably go back to the U.S. Army Ballistic Research Laboratories' "Hand Grenade Study" of 1951-52. At the time of the Korean war (1950-53), U.S. forces were still using the World War II Mk II grenade and although this proved "superior in every way to the Russian hand grenade" according to an infantryman quoted in Ordnance magazine in 1953, the Army went ahead with its plans. The new M26 grenade probably made its first appearance in the mid-1950's and a later version, modified "to improve its fragmentation characteristics" according to an Army manual, was designated the M26A1 and probably entered the Army inventory around 1960.

The familiar Mk II "pineapple" grenade had been made of cast iron, grooved so as to break into a few large chunks of metal upon explosion. The M26, in contrast, is made of notched steel wire wrapped around an explosive. The wire breaks into more than 1,000 fragments upon explosion, giving the grenade an "effective casualty radius" of 15 meters or approximately twice the area coverage of the Mk II. ("Effective casualty radius" is a useful bit of military jargon; the Army defines it as "the radius of a circle about the point of detonation in which it may normally be expected that 50 percent of the exposed personnel will become casualties.")

Since 1960, the M26A1 has been redesigned again to weigh less and accomodate a larger amount of explosive filler; the new grenade is designated the M56/M57. There is also a new grenade, the M33/M59, which is shaped something like an apple; it weighs less than the M26 and thus has a slightly greater throwing distance. The Army has also come up with what Ordnance called "a real fancy fuze" for hand grenades, the M217; it is a combination impact and time delay fuze which makes it more likely that the grenade will explode as soon as it lands and thus makes it more difficult for "enemy personnel" to toss it back.

> NATIONAL PRESTO INDUSTRIES under Army contract DA11-022-ORD-1229 did developmental work in 1954 that involved the T46 and T46E1 high explosive grenades. ("T- " designations are used for test items; the T46 and T46E1 may have been the same grenades that were later given the designations M26 and M26A1.) MILLER RESEARCH CORP. in 1956-57 made production engineering studies of fuzes for the M26A1 and other hand grenades under contract DAI28-017-501-ORD-2178.*

40mm. grenades

The M79 40mm. grenade launcher system is a new weapon in its own right. Its origin is in the grenade launcher attachments of World War II which were used to project hand grenades from ordinary rifles. The difference is that the M79 is not simply an attach-

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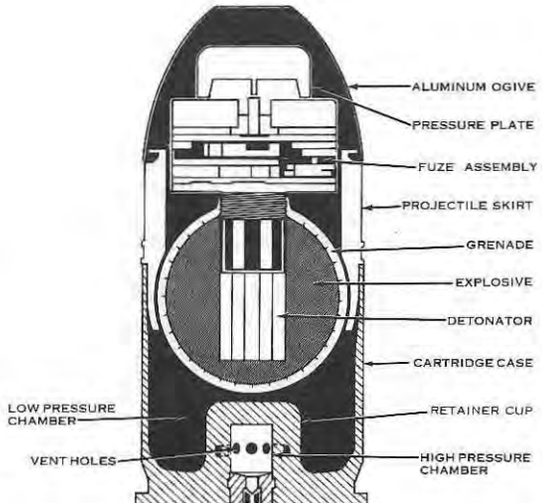
* All contracts beginning with "DA" are Army contracts. Navy contracts start with "N", Air Force contracts with "AF" or "F."

ment; it is a launcher, shaped like a sawed-off shotgun, that is designed specifically to shoot 40mm. projectiles containing high explosive grenades. The infantryman braces it against his body and fires up to four shots a minute. Each shot explodes producing a ball of fast-moving fragments. Because of its high trajectory, the infantryman can use it to shoot into bunkers and behind fortifications that would be barriers to ordinary rifle or machine gun fire. Its range, approximately a quarter of a mile, is intermediate between the ranges of the hand grenade and the 81mm. mortar and according to Ordnance, it was developed to fill the "firepower gap" between these two weapons.

A 40mm. high explosive round weighs about half a pound and looks like an oversized bullet. It contains a spherical grenade which, like the M26 hand grenade, is made of notched steel wire wrapped around a high explosive. The whole round is often referred to as a "40mm. grenade." Its effective casualty radius is less than that of the M26 grenade--five meters, covering the area of a medium-sized room.

The M79 system entered the Army inventory around 1960 and quickly became a standard piece of equipment in Vietnam. It is familiar to virtually every Vietnam veteran. Typically a grenadier armed with an M79 would accompany several riflemen on patrols. The grenadier would use his M79 to knock out "targets" that the riflemen could not reach. "Our people....love the M79 grenade launcher," G. Baxter reported in his 13/13; Vietnam: Search and Destroy (1967). "It's like brass knuckles in a barroom brawl."

With the widespread use of the M79 in Vietnam, efforts were made to find new ways in which the same idea could be put to use. The



Army diagram of a 40mm. high explosive round used with the M79 launcher. The part labelled "grenade" is made of notched steel wire and breaks into fragments upon explosion. (U.S. Army Field Manual FM 23-31, 40mm. Grenade Launcher, M79; May 1965)

most important developments were high-speed automatic guns for firing 40mm. grenades from helicopters and slow-flying airplanes. Efforts were made to improve the ammunition and low-speed automatic launchers were developed to shoot 40mm. grenades from the ground and from river patrol craft.

Many companies worked on the development of new 40mm. ammunition and launchers in the 1960's. AAI CORP. commenced work in 1960 on the development of a "40mm. grenade cartridge" under Army contract DA36-034-ORD-3234. In 1962 AAI commenced work on a 40mm. smokeless flashless cartridge and in 1966 the company commenced the production engineering of the new XM170 40mm. smokeless flashless cartridge case; this would make it harder for "enemy" to spot soldiers firing 40mm. grenades. (REMINGTON ARMS CO. also began development of a 40mm. smokeless flashless cartridge in 1962 under Army contract DA19-020-AMC-5757.) In 1961-62 AAI worked on the development of "40mm. scatter ammunition" under Army contract DA36-034-501-ORD-3387; the company's reports were indexed under "Antipersonnel Ammunition" and "Canister Projectiles," so perhaps they dealt with the flechette-filled 40mm. round that some veterans say the United States has. According to McGraw-Hill's DMS Market Intelligence Report (May 1971), AAI has also worked on the advanced development of "40mm. disposable barrel cartridge area target ammunition/signal cartridge."

AVCO CORP. has been working on a special new rocket-

And here is the man who shoots them. A soldier in "modified kneeling position" holding an M79 launcher. (Army manual FM 23-31)

propelled 40mm. round that would get past one of America's most vexing obstacles in Vietnam: jungle foliage. Ordnance reported in Jan.-Feb. 1968 that Avco had received three military contracts for work on its "Avroc" line of ammunition, and noted that most of its work up to then had been on the 40mm. size. The new ammunition, Ordnance noted, was rocket-propelled and had "greater range and accuracy than conventional ammunition of the same size." Another advantage was that "Present grenade weapons are handicapped when used in dense foliage similar to that found in the rain forests of Vietnam, because of the need to use a high trajectory. With the new ammunition the flat trajectory makes it possible for a man to fire under foliage of this type to reach the target." (Two years earlier, Missiles and Rockets magazine noted that Avco had been working on Avroc ammunition for several years "with a minimum of help from government sources." Apparently the company was so convinced of the usefulness of its new ammunition that it was willing to invest its own money in it until such time as the military might really get interested in it.)

AEROJET-GENERAL CORP. worked on the development of a 40mm. low velocity automatic launcher from about 1964 to 1967, and in 1968 the company was awarded an Army contract (number DA11-199-66-AMC-719W) for "magazines and modifications of magazines" for the XM174 launcher. All this work was probably on the same launcher, the XM174, which weighs 13 pounds and fires 40mm. grenades at the rate of 350 shots per minute. It uses the same ammunition as the M79 and has about the same range.

REMINGTON ARMS CO. in 1963 submitted a final summary report on the development of a 12-gage insert

Aerojet-General's XM174 low velocity, automatic 40mm. grenade launcher (company photo)

for the M79 launcher under Army contract DA19-020-AMC-0071A. Such an insert would have enabled an infantryman to fire 12-gage shotgun shells from the M79.

Mines

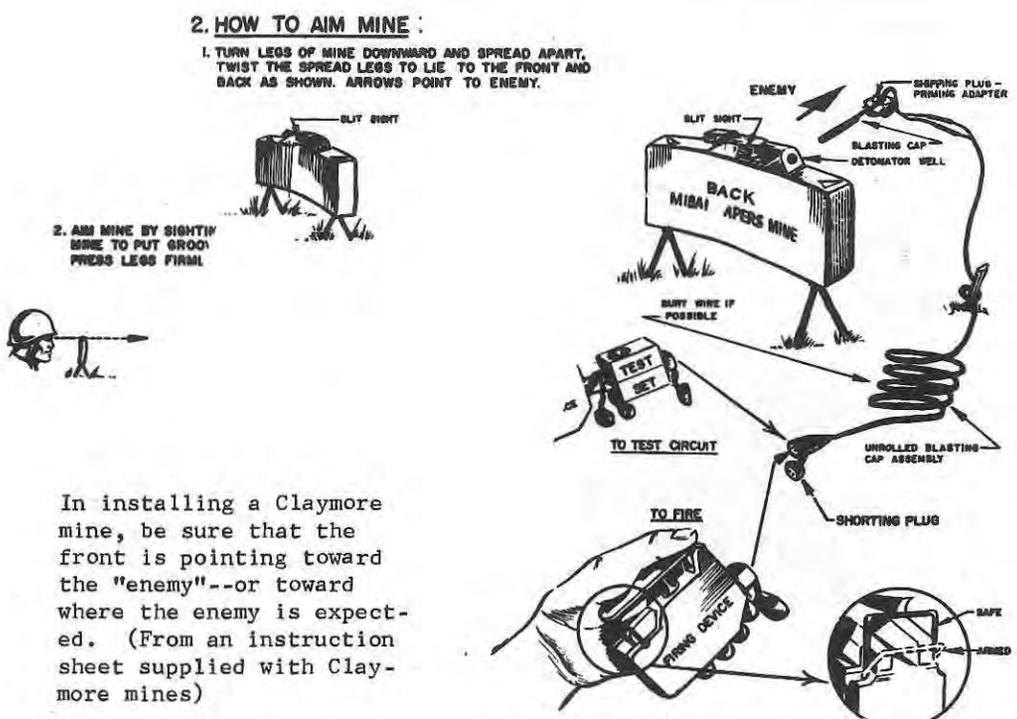
The Claymore mine was described in the Secretary of the Army's annual report for 1959 as "a new concept in defensive munitions." It is a curved box, mounted on folding legs, with a fragmentation face on the outside and an explosive charge inside. A series of mines is set up on the outskirts of "friendly" bases with wires running to where a sentry sits. If he sees something moving, he fires a mine, shooting fragments outwards in a fan-shaped pattern. According to J.S. Tompkins (The Weapons of World War III, p. 116), the Claymore mine "was designed specifically to kill the Chinese human-sea charge"; if this is correct, then the Army's "need" for such a weapon goes back to the Korean war. In Tompkins' colorful words, "A well-placed line of them can reduce a human-sea charge to mincemeat at the touch of a button." (The concept of the "human-sea charge" is one more way of depersonalizing individual "enemy" and turning them into just another "target.")

The original M18(T48) Claymore mine was standardized in fiscal year 1959 and had a fragmentation face that produced rectangular fragments. The improved M18A1 Claymore mine was standardized in 1960; in this mine, steel balls are embedded in the outer face (made of plastic) and behind this is the explosive charge. One advantage of the improved Claymore mine is that it is safer to use than the original version; another advantage as shown in an Army manual is that it has a "50-meter killing zone" as compared to the 30-meter killing zone of the original mine. The improved Claymore mine is of particular historical interest because it was the first U.S. high explosive antipersonnel munition in which steel balls were used as the source of fragments. Steel balls were later used in "pineapple" and "guava" bomblets (see section 4).

The New York Times reported May 1, 1966 that the Claymore mine had received its "first test of war" in Vietnam. "It forms some of the principal defenses of every U.S. camp or position in Vietnam," the Times said. The M18A1 Claymore mine has been used extensively in Vietnam and is familiar to almost all G.I.'s who have been there.

AEROJET-GENERAL CORP. designed and developed the T48E1 Claymore mine in 1956-58 under Army contract DA04-495-501-ORD-840; in all likelihood the T48E1 was the same thing as the M18A1 improved Claymore mine. Two other companies also worked on Claymore mines: OLIN CORP. conducted "process engineering studies" of the T48E1 mine in 1958-60 under Army contract DA28-017-ORD-3082 and TECHNICAL OPERATIONS, INC. submitted a 1958 report on "Claymore employment techniques side experiment" under contract DA04-351-AVI-1228.

The Claymore mine, with its folding legs and pushbutton control, is in a class by itself among antipersonnel mines for infantry. The commoner sort of mine is that which is buried and goes off when someone steps on it. Developmental work was done on various mines of this sort in the 1950's and 1960's. The M16, for example, is one of the older U.S. antipersonnel mines; it shoots a projectile two to four feet in the air and the projectile then explodes, producing fragments. It is modelled on the German "Bouncing Betty" mine of World War II. The M14E1 is a plastic antipersonnel mine that weighs only four ounces; its light weight makes it a predecessor of some of the aerial mines that were developed later (see section 5), and the fact that it is nonmetallic means that it cannot be discovered with an ordinary mine detector. Still other mines have been developed, but details are hard to come by.



In installing a Claymore mine, be sure that the front is pointing toward the "enemy"--or toward where the enemy is expected. (From an instruction sheet supplied with Claymore mines)

DALTON FOUNDRIES in 1954-55 worked on the improvement of components of the M16 mine under Army contract DAI-11-022-ORD(P)-17. PERRY PLASTICS claimed credit in an ad in Ordnance July-Aug. 1963 for the development of the M14E1 mine; this work was probably done in the 1950's. ERIE RESISTOR CORP. in 1956-57 under Army contract DAI28-017-501-ORD(P)-1885 conducted "Design and development of the T37E4 nonmetallic antipersonnel mine," which was intended to replace the M14E1. MILLER RESEARCH LABORATORIES in 1957 submitted a report by R. Siegmeister under Army contract DA36-034-501-ORD-57 on "Functioning loads of antipersonnel mines."

HAMILTON WATCH CO. commenced work in 1960 on the development of the "T52 SSS antipersonnel mine" under Army contract DA28-017-501-ORD-3911; UNITED STATES TIME CORP. worked from about 1960 to 1963 on "Design and fabrication of SSS antipersonnel mine" under Army contract DA19-020-AMC-0163A. AVCO CORP. made a feasibility study of a "repeating antipersonnel mine" in 1967 or thereabouts (Technical Abstract Bulletin, 1967, no. 18), and according to DMS Market Intelligence Report (Jan. 1972), Avco was the developer of the XM60 repeating antipersonnel mine. DMS also states that AEROJET-GENERAL and BREED CORP. have worked on the development of the XM43 chemical/mechanical antipersonnel mine. AAI CORP. made a "Design study of a wide area antipersonnel sensor for use with standard antipersonnel fragmentation mines" in 1963, and in 1966 the company submitted a final summary report on the design and development of the XM617 antipersonnel mine fuze in collaboration with UNITED AEROTEST LABORATORIES; both projects were conducted under Army contract DA36-034-ORD-3750. AEROJET-GENERAL submitted a final report in 1966 on the design and development of a delay fuze for the XM29 antipersonnel mine under Army contract DA04-495-AMC-209A. THIOKOL CHEMICAL CORP. was awarded a $537,730 Army contract (number DAAA21-68-C-0755) in 1968 for "Development of a reliable chemical fuze for antipersonnel mine."

Many other developments have been made in the field of aerial mines--land mines that are sown from airplanes. They will be discussed in section 5.

2 Artillery Ammunition

In the late 1950's and early 1960's the Army redesigned its high explosive ammunition for artillery pieces of various sizes. The Army developed a new 81mm. projectile made of malleable iron, a material that had recently been found to have desirable fragmentation characteristics upon explosion. A new 105mm. projectile had a new shape for increased range and a different case, explosive, and fuzes, making it "three times as deadly" as the World War II projectile, according to Tompkins (The Weapons of World War III, p. 104).* Developments continued as the war in Vietnam got under way: An Army witness at a 1966 Congressional hearing described the new XM591 90mm. projectile as "A high explosive round for the 90mm. recoilless rifle designed for use against personnel targets," and included it in a list of about 120 items that "are being placed into the inventory as a result of the lessons learned in Vietnam" (emphases added). (One of the "lessons" of Vietnam, he implied, was that personnel were now an important "target.")

High explosive ammunition is used more than any other type of

* New guns of various sizes were also being developed. The Secretary of the Army in his annual report for 1960 described four new artillery pieces that were lighter, cheaper, and more reliable than earlier models, and in his 1962 annual report he described four new 105mm. and 155mm. Howitzers, stating that "Using new ammunition, these new weapons will be more lethal, and they will have greatly increased range." Earlier developments had led to a new series of artillery pieces that became available at the end of the Korean war (he noted in his 1960 report) but these did not satisfy either the "requirements" of the Army or the "technological possibilities"; hence the subsequent developments.

artillery ammunition. Many people are aware of the massive bombing that has gone on in Indochina; fewer realize that up to the limits of its range, artillery fire is cheaper and more accurate than bombing from planes. High explosive projectiles, like general purpose bombs, are effective by both fragmentation and blast: Fragments from the explosion rip up people and light vehicles and structures and the blast shakes foundations, tunnels, and bunkers.

High explosive artillery ammunition has been used in Vietnam against "suspected enemy troop concentrations" (to borrow a phrase from the military) and against villages. An ex-Marine artilleryman told me that when he was in Vietnam in 1966-67, a forward unit that had been fired on from a village would sometimes radio back for artillery fire. The artillerymen would fire successive volleys of six rounds each for ten minutes or more, demolishing the village--but in his view "There's nothing to rebuilding a house, they'd just bang it together out of cardboard or whatever they had around." He noted that "They never told us if we were firing at a vill /village/ or something else but you could usually tell by the type of firing. One time I was positive we were firing on a vill, you could see the rounds landing there... The grunts /infantry/ would go out with a map, there'd be a vill marked on it, a few houses--it wasn't there, it had been levelled... We were supposed to fire the first round from one gun with a white phosphorus /target marker/ round, then correct for it. Usually we just used HE /high explosive/ for the first round. That's how the villagers knew they were going to be bombarded, when the shells started falling on their heads." Under such conditions the fragments from high explosive projectiles would obviously "destroy or obstruct" villagers who weren't fortunate enough to be inside their family shelters.

If high explosive projectiles are the most widely used of recent developments in artillery ammunition, Beehive projectiles are the most imaginative, to say the least. A Beehive projectile is a canister containing upwards of 2,000 little "flechettes" or metal darts. It is used with a dual purpose fuze so that it can be either muzzle fired as from a shotgun, producing a barrage of flechettes, or shot in the air and then burst open to release the flechettes which fly off in all directions. An Army manual of 1967 lists two 90mm. Beehive projectiles, the XM590 (containing 2,276 flechettes) and the M377 (5,600 flechettes). There are at least nine other Beehive projectiles ranging in size from 90mm. to 155mm., and according to some veterans, there is a 40mm. Beehive round for the M79 grenade launcher. (Flechettes are also used in a 2.75-inch rocket warhead and possibly in certain cluster bombs.)

Two newspaper reports in late 1967 and early 1968 described the new Beehive projectiles that were being used in Vietnam. An Asso-

ciated Press dispatch (Palo Alto, Calif., Times, December 14, 1967) reported:

> New artillery rounds fired in regular 105mm. Howitzer pieces spray thousands of dart-shaped steel shafts over broad areas of jungle or open territory.
>
> One well-aimed round can kill hundreds of enemy troops massing for an attack.
>
> Military men report the weapon has been used with lethal effectiveness in such actions as Communist charges against American artillery positions below the Demilitarized Zone.
>
> "I've seen reports of enemy soldiers actually being nailed to trees by these things," one officer reported.
>
> Information on the antipersonnel cartridge has been cleared for publication by the Defense Department's security review office but defense officials decided not to announce its development through the Pentagon. A possible reason was the ugly nature of the weapon.
>
> The new artillery round was first sent to the war zone on a test basis but is expected to become a standard ammunition item. (Emphases added)

A United Press International dispatch (San Francisco Examiner, January 2, 1968) reported:

> U.S. troops killed 344 attacking Communists with almost point-blank barrages of tiny steel darts today in a Cambodian border battle that closed out the bloodiest truce of the Vietnam war...
>
> Fighting against being overrun, the 500 Americans lowered their artillery barrels and boomed round after round of "beehive" shells into the human waves of guerrillas.
>
> Each "beehive" shell exploded into hundreds of half-inch darts that shredded the Vietcong, /UPI correspondent/ Kaylor said.
>
> The guerrillas killed 26 Americans and wounded 111, U.S. officers said.
>
> But American commanders said the bodies of 344 enemy soldiers were found on the field at daybreak today. (Emphases added)

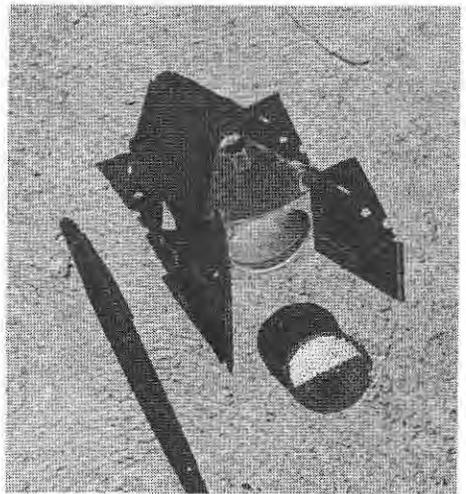
Besides nailing people to trees, flechettes can be used against targets such as the human spine. (North Vietnamese photo)

After the initial enthusiasm and an initial series of production contracts on the order of a few million dollars each, the production of Beehive projectiles abruptly and mysteriously ceased. Perhaps they had proved too dangerous to American gunners, or perhaps the flechettes were scratching gun barrels and the Army decided that tried-and-true high explosive ammunition was, after all, the best thing for "destroying or obstructing personnel." But the designers must have been gratified to know that on a "test basis" at least, their new gadgets were handy for shredding Vietcong and nailing Communists to trees.

> Antipersonnel canister projectiles for artillery are derived from the shot-filled canisters that were used against Japanese troops in World War II. Flechettes are derived from the "aerial darts" that were dropped on Zeppelins and similar targets in World War I, and from the "Lazy Dog" missiles--small pieces of iron shaped like miniature bombs--that the French (according to Bernard Fall) used in Indochina. The development of Beehive projectiles--artillery canisters filled with flechettes--began in the 1950's, and the first company to work on them was probably INTERNATIONAL HARVESTER CO., which held Army contract DA33-008-ORD-1257 for the development of 90mm. canister ammunition sometime before 1957. International Harvester's work was taken over by WHIRLPOOL CORP. in 1957, and in 1957 Whirlpool was also awarded Army contracts for the "Design of canister fillers" and for the "Investigation and design of long-range antipersonnel 155mm. artillery ammunition," including "Beehive ammunition" specifically. Between 1957 and 1966 Whirlpool held at least nine Army contracts for the development of at least five different types of Beehive projectile, as well as contracts for the "De-

sign and development of "Sting Ray" (apparently a combined chemical and flechette projectile) and the development of a packaging technique for the 7.2-grain dart for the Navy. GENERAL TIME CORP. designed and developed fuzes for 90mm., 105mm., and 106mm. Beehive projectiles under a series of Army contracts in 1964-66. Both Whirlpool and General Time were later awarded millions of dollars in production contracts for the Beehive projectiles and fuzes that they had helped develop.

Other companies did miscellaneous projects of a similar sort. In 1965 or 1966 the Air Force gave NORTHROP CORP. $429,600 to conduct "Design, development, and evaluation testing of a flechette area neutralization gun 'Fang'" under contract AF08(635)-4977. In 1968 the Army gave MILLER RESEARCH CORP. a $288,308 contract (number DA-OAD-05-68-C-0345X) for research and development on a "Counter ambush barrage weapon system," possibly an artillery piece firing flechettes.



Another interesting new development in artillery ammunition: a pop-up cluster shell for naval guns. According to North Vietnamese, each shell contains more than 100 winged bomblets (shown here). The shell releases the bomblets in the air and they fall to the ground, bounce back up, and burst into hundreds of fragments, causing multiple wounds on the upper part of the body. (Photo by John Sullivan)

3 Aircraft Armament

The modern emphasis on shooting people from planes is a fairly recent one. Machine guns were the only weapon short of bombs that World War II flyers had for this purpose. Interest in the early 1950's was focussed on weapons for shooting down other planes. Two weapons that emerged from this period, the 20mm. Vulcan gun and the 2.75-inch rocket, were later adapted for use against "ground targets."

The growth of interest in ground targets probably dates from the mid-1950's when the Army began looking into the possibility of arming helicopters for use in combat. Helicopters themselves had not become practical until after World War II; they were used in the Korean war mainly for transporting cargo and troops and for medical evacuation missions, and the first extensive use of armed helicopters in combat was by the French in the Algerian war (1955-62). In 1956 or thereabouts an Army staff at Fort Rucker, Alabama, began trying out a "wide range" of weapons on a variety of helicopters to determine the feasibility of using the transport helicopter as a "weapons platform," and in 1961 an Army committee formulated a doctrine on who should have armed helicopters and what weapons should be used. (These and other details are contained in an historical review of armed helicopters, prepared by Army major D.J. Haid and published in the Army magazine Military Review, Sept. 1965.)

As of 1957 the Army was apparently still thinking mainly in terms of machine guns: An article by an Army general in Ordnance (Jan.-Feb. 1968) mentioned the possibility of arming cargo helicopters with a single machine gun "to permit them, when moving into a dangerous area, to at least spray the ground as a sort of sanitizing measure." He also suggested using machine guns on light reconnaissance helicopters to execute the "battle-tested device of recon-

naissance by fire": shooting into a "suspected area" to see if a "reply" was "forthcoming." The discovery, not the destruction, of the "enemy" would be the function in this case. Another possibility was to have a small number of "shooting helicopters" armed with machine guns and possibly rockets to "back up" air-transported riflemen and reconnaissance helicopters. This last possibility has been carried out with a vengeance in Vietnam.

By 1961, as shown by the Army Research Office task summary for that year, the Army was working on high velocity 40mm. grenade launchers and was studying possible warheads for the 2.75-inch rocket for use in "arming Army aircraft in the air-to-ground role"; both of these weapons would certainly be useful for "destroying" people as well as "discovering" them.* In his 1962 annual report the Secretary of the Army stated that the adaptation of machine guns and rockets for light helicopters was continuing with "success." Around 1962 a company of UH-1A helicopters armed with machine guns was sent to Vietnam; they were an "immediate success" according to Major Haid, and other weapons soon followed.

The three main types of weapon that have been used in helicopters and slow-speed airplanes against people on the ground are Gatling-type guns, 40mm. grenade launchers, and the 2.75-inch rocket.

Gatling-type guns

The original Gatling gun was a Civil War machine gun that achieved its high rate of fire by the use of several rotating barrels. The idea was abandoned for a long time but in 1945 the Army began experimenting on old Gatling guns from an Army museum, and in 1946 GENERAL ELECTRIC CO. began its developmental work on a new Gatling-type machine gun.

* The familiar notion of the "area target" crops up again here: The work on the 2.75-inch rocket warhead was done under an Army project entitled "Aerial Delivery of Improved Area Weapon." Another interesting term in this connection is "suppressive fire." According to Major Haid, "suppressive fire" was originally conceived as "a large volume of essentially unaimed fire" designed to force the "enemy" to keep their heads down until troops could be landed. He did not say what would happen to people who were unable to lower their heads far enough but presumably they would be "suppressed" permanently.

The first of the new Gatling guns, the 20mm. Vulcan gun, has six revolving barrels which give the gun the outstandingly high rate of fire of about 6,000 shots per minute, or more than 100 shots a second. Each shell is several inches long and explodes when it hits something. Characterized by Ordnance in 1956 as "a giant killer of the sky," the Vulcan gun was intended for shooting down enemy planes but with the situation in Vietnam, it began to be used against people on the ground. The second new Gatling gun, the 7.62mm. Minigun, was also developed by General Electric and has also been widely used in Vietnam against "ground targets."

> When GENERAL ELECTRIC first worked on the Vulcan gun, the gun was conceived of as an antiaircraft weapon. But General Electric was quick to develop an interest in "ground targets": An Ordnance article in 1957 (only a year after the start of the Army's program at Fort Rucker) reported that GE engineers had designed two "ground fire suppression kits" consisting of machine guns and 3.5-inch rockets, to give helicopters "defensive protection" in battle. In 1964 under "Project Eyeball" GE submitted a report to the Air Force on a "feasibility study of a proximity fuze for the 20mm. projectile"; such a fuze would have made 20mm. ammunition more effective against people by causing it to explode in the air before hitting the ground. GE developed the 7.62mm. Minigun and has also done developmental work on a 5.56mm. Minigun which is lighter than the 7.62mm. gun and has an even higher rate of fire. Most recently, GE has been developing the 30mm. Close Air Support Gun (see section 8).

"SAIGON (7AF)--Minigun Blast--Miniguns mounted aboard an AC-47 Dragonship, often called 'Puff, the Magic Dragon,' send their 7.62mm. ammunition into enemy positions. The guns, each capable of firing 6,000 rounds per minute, are triggered by the pilot, through a side-window sight." (Air Force photo and caption)

GENERAL AMERICAN TRANSPORTATION CORP. was another developer of Gatling-type guns. In 1966 the company's MRD Division submitted a final report under Air Force contract AF08(635)-4037 on the development of a high rate of fire 7.62mm. Gatling gun that featured a continuous-flow ammunition feeder, a boltless action, and a "unique radial motion of the barrels" that permitted "a simplicity of mechanism."

40mm. grenade launchers

The Army has developed two high velocity 40mm. grenade launchers for use on helicopters, the M75(XM75) and the XM129. Both launchers fire high explosive fragmentation ammunition that is similar to the 40mm. grenades used with the M79 infantryman's launcher.

The development of the M75 goes back at least as far as 1961. The potentialities of an automatic 40mm. launcher were appreciated in the early years of the war in Vietnam, as shown in a report in Ordnance (Jan.-Feb. 1963):

> Vulnerability of helicopters recently used in operations in Vietnam emphasized the need for a new weapon, and the Army has assigned the FORD MOTOR COMPANY to develop a 40mm. grenade launcher to be mounted on U.S. Army choppers. Helicopter pilots expect to use the launcher in situations where enemy ground fire has harassed their operations.
>
> The XM75 grenade launcher was designed by the Springfield Armory, a facility of the Army Weapons Command, and has been undergoing development and refinement by Ford's Special Military Vehicles Operations at Dearborn, Michigan, for the past two years. It is capable of firing long, sustained bursts of 40mm. grenades with accuracy. It is regarded as highly effective when used as an antipersonnel weapon or against trucks and other light military vehicles. (Emphases added)

The M75 launcher fires 40mm. grenades at the rate of 250 rounds per minute at ranges up to 1,000 meters (about two-thirds of a mile). The newer, XM129 launcher is lighter than the M75 and has

a higher rate of fire and a greater range. The M75 launcher was produced for a number of years and has been widely used in Vietnam; the XM129 completed development in fiscal year 1970 but has apparently not yet been produced on a large scale.

> FORD MOTOR CO. developed both the M75 and the XM129 launchers. Ford worked on the M75 launcher from 1961 to 1964. In 1966 Ford submitted a report on the XM129 launcher under Army contract DA19-058-AMC-1522W. Ford also submitted a 1966 report under Army contract DA19-058-AMC-1425W on mounting the XM129 launcher on an M3 tripod so that it could be used for target practice on the ground.

Another contribution to the art of murder was the development of the XM596 proximity fuze for helicopter-launched grenades. A proximity fuze makes it possible to produce dozens of airburst explosions in a matter of seconds. The radar devices used in the older proximity fuzes would have made such a fuze too bulky and too expensive to be used in a 40mm. projectile but recent advances in microcircuitry and automated production techniques have made it possible to produce XM596 fuzes for as little as $5 apiece.

> MOTOROLA, INC. developed the XM596 fuze in 1966-67 under Army contract DAAG39-67-C-0029 and was awarded a contract in fiscal 1968 to develop production equipment for the fuze. The Army paid Motorola more than a million dollars for its work. GLOBE-UNION INC. developed the power supply for the fuze under Army contract DAAG39-67-C-0025 and worked on production equipment for the power supply.
>
> HONEYWELL INC. in 1966 worked on the product improvement of another 40mm. fuze, the XM218 mechanical impact fuze, under Army contract DA28-017-AMC-2571A; available descriptions do not indicate whether this fuze is used with helicopter-launched or with M79 40mm. ammunition.

The 2.75-inch rocket

The 2.75-inch Folding Fin Aircraft Rocket (FFAR), one of the most widely used munitions in Vietnam, is derived from the Navy's

Mighty Mouse air-to-air rocket of the 1950's. Interest in using 2.75-inch rockets against "ground targets" goes back at least as far as 1961, as shown by the Army Research Office task summary. Army general F.J. Chesarek at a 1966 Congressional hearing traced the development of the rocket back to 1963 and said that at that time the Army experimented with a number of Air Force rockets.

> We found that these rockets were not suitable for our purposes /he continued/. We were looking for an extremely quick fuze reaction, rather than a delay type, and a high degree of warhead fragmentation, rather than blast. In order to achieve stability in flight when launched from a relatively slow-speed platform, greater rotational spin of the rocket had to be built in. We proceeded to modify the Air Force rockets, and by November 1964 we were ready for limited production of the Army-type rockets. As the troops in the field began to utilize these rockets with ever-growing success, their demand increased rapidly. (Emphases added)

The reason for the quick fuze was to make the warhead explode as soon as it hit something, instead of penetrating first (which would be better against an airplane, but would cause many of the fragments to get buried in the ground if used against "ground targets"). Mr. Matt of Picatinny Arsenal explained at the 1966 hearing that "The new fuze has a graze-sensitive feature, so that upon contact the rocket will immediately detonate and spew fragments" (emphasis added). The reason for a "high degree of warhead fragmentation" was, of course, to make the rocket more effective as an antipersonnel weapon. This was accomplished by designing a warhead made of pearlitic malleable iron, a material that had recently been found to have optimal fragmentation characteristics upon explosion.

Helicopter firing a 2.75-inch rocket (Army photo in Ordnance, May-June 1972)

The "ever-growing success" of the rocket in Vietnam spurred Army munitions designers to seek even more effective versions. By 1972, Ordnance was able to report (in its May-June issue): "There are at least eight different warheads that can be used with the same rocket motor." One of the new warheads is the WDU-4, 14 inches long, three inches in diameter and filled with flechettes. "They're excellent against troops in the open," a 31-year-old Air Force major told a New York Times reporter (May 10, 1972). "Nails 'em right to the ground." If production contracts are any indication, the WDU-4 warhead has been used more widely in Vietnam than any other flechette weapon. Another widely used development is a white phosphorus warhead, used mainly to mark "targets" so that high-speed jet fighters can bomb them. A proximity fuze was developed, providing "an outstanding example of quick reaction in response to an urgent RVN /Republic of Vietnam/ requirement," an Army witness stated at a 1967 hearing. The proximity fuze produced an airburst explosion and was "much more effective than the impact fuze, depending upon the type of target," he said (emphasis added). Army engineers in 1967 were also working on a "jungle canopy penetration fuze," presumably in response to another "urgent RVN requirement," and a new launching pod was developed in the mid-1960's to speed up the reloading of airplanes when they return from combat missions.

The latest development is an improved rocket motor that increases the range of the rocket and thereby allows attacking airplanes to keep further away from "targets" that might shoot back at them. An Air Force witness explained at a 1972 Congressional hearing:

> Another significant way to improve our survivability is to stand off further when we deliver our weapons. There is a model over there of a 2-3/4-inch rocket and our rocket engineers took this old 2-3/4-inch rocket and replaced the motor with a modern, composite rocket engine. This permitted the burnout velocity to increase by 25

Air Force photo demonstrating how 2.75-inch rockets are loaded in 19-rocket pods (Ordnance, Nov.-Dec. 1970)

percent, and for the same rocket it let us put a larger warhead on it. It let us stand off twice as far as with the conventional rocket and give the same accuracy. And this, then, contributes greatly to the survivability of our attacking airplanes in the ground support role. (Emphases added)

Hoping that it may some day seize the Vietcong (an unintentional pun?) and dispatch them permamently to the underworld, the Army is toying with the idea of a replacement for the 2.75-inch rocket called "SEAS." DMS Market Intelligence Report (July 1971) notes that "The new weapon, designated SEAS for Selective Effects Armament Subsystem, will feature a high-power propulsion system. SEAS will have a wide variety of fuzes and warheads not now available for more effective results against massed personnel. It will also have a limited anti-armored-vehicle capability. Among the items the U.S. Army is looking at are superquick, delayed, time, and proximity fuzes, as well as high explosive, flechette, smoke, tear gas, and incendiary warheads" (emphases added).

GENERAL TIME CORP. developed the fuzes for the Army's 2.75-inch rocket. In 1963-64 the company

BANG! BANG! You're *alive!*

Little boys will always play guns. Rules will change only when the world grows up...in a peace for all time, all people. To bring that peace closer, General Time's Ordnance Group works to keep today's peacemakers stronger. And tomorrow, our complete capability will work to make the good life even better. A better time with *The Big Time.*

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War toys may be bad for children, but Peacemaker GENERAL TIME CORP. has an excellent line of Beehive fuzes for adults who want to play guns and cut the enemy to shreds. (From an ad in Ordnance, May-June 1970)

worked on the development of the M423 and M427 fuzes under Army contract DA28-017-AMC-583A. (The M423 is for use on helicopters and the M427 is for use on planes; both are impact fuzes.) ELGIN NATIONAL WATCH CO. also worked on the development of the M423 fuze under contract DA28-017-AMC-63-N304.

ZENITH RADIO CORP. worked on the design and engineering of the XM429 proximity fuze for the 2.75-inch rocket under Army contract DA49-186-AMC-372A, awarded in 1966 or 1967, and may have been the principal developer of the fuze. MICROCOM CORP. also worked on the fuze; in 1968 it was awarded a $92,818 Army contract (number DAAG39-68-C-0065) for developmental work on a "Telemetry system for the XM429 fuze."

NORTHROP CORP. has been the main producer of the WDU-4 flechette warhead, and may have had a hand in its development.

Helicopter armament subsystems

Once the individual weapons have been developed, they must be fitted to a helicopter or airplane. There are now several different Helicopter Armament Subsystems (HAS) that involve various combinations of machine guns, grenade launchers, and rocket launchers and are used with various helicopters.*

EMERSON ELECTRIC CO., GENERAL ELECTRIC, and HUGHES TOOL CO. have all helped develop helicopter armament subsystems. EMERSON's work goes back the farthest: In 1961 the company submitted a one-volume report on "Research and development of fire suppression kit for HU-1A, H-21, and H-34 helicopters" un-

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* Airplanes have also been equipped as "gunships." Old DC-3's and AC-47's armed with three 7.62mm. Miniguns made their debuts in Vietnam and were soon nicknamed "Puff, the Magic Dragon" by imaginative American soldiers. More recently the Lockheed C-130 has been modified to carry various combinations of 20mm. Vulcan guns, 7.62mm. Miniguns, and 40mm. cannon.

der Army contract DA23-072-504-ORD-9. In 1963 or 1964 Emerson was awarded a $175,802 Army contract (number DA23-072-AMC-165W) for research and development work on the XM6 helicopter armament subsystem; it consists of quad-mounted M60 machine guns and is used on the UH-1B/C helicopter. According to DMS Market Intelligence Report (March 1969), Emerson developed the Tactical Armament Turret TAT-102, consisting of a single 7.62mm. Minigun, and the XM28 helicopter armament subsystem, which consisted of two Miniguns and two XM129 40mm. grenade launchers and was intended for the AH-1G helicopter. Emerson has also produced the XM21 armament system, consisting of two seven-round 2.75-inch rocket pods and a 7.62mm. Minigun, and the XM156 multi-armament helicopter mount.

GENERAL ELECTRIC CO. developed the M5 helicopter armament subsystem which is used for mounting the M75 40mm. launcher in the nose of the UH-1B helicopter. HUGHES TOOL CO. was awarded more than $130,000 on Army contract DA04-495-AMC-1541W between 1966 and 1968 to "Design and fabricate installation system" of the XM27 armament system (using a 7.62mm. Minigun) on the OH-6A light observation helicopter, and in 1968 Hughes was awarded $639,608 on an Army contract (number DAAF01-67-C-0811) to "Engineer, develop, design, fabricate and test the XM8 helicopter armament subsystem based upon the XM129 40mm. grenade launcher with the MX70E1 reflex sight," also for the OH-6A helicopter.

Other rockets and missiles

Missiles and Rockets noted March 28, 1966 that the Zuni 5-inch air-to-surface rocket "has been used more extensively than anticipated in Vietnam operations. The rocket has been equipped with a proximity fuze that makes it a more versatile weapon against such targets as trucks, bunkers, and personnel concentrations" (emphases added). (The Zuni rocket has been used in Vietnam, but on a much smaller scale than the 2.75-inch rocket and other key aircraft armaments.)

In an earlier issue October 25, 1965, Missiles and Rockets reported on the development of the small, spin-stabilized Wasp antipersonnel rocket for use on helicopters. "Army officers consider the development of this one-pound, unguided missile and its zero-length launcher concept as an important potential breakthrough in helicopter armament," the magazine said. (Its light weight would have made it especially attractive for helicopters, most of which cannot carry heavy loads. However, the Wasp has apparently never gone into production.)

EMERSON was awarded a $250,000 Army contract (number DA23-072-AMC-118Z) in 1963 or 1964 for "Wasp helicopter weapon system feasibility demonstration to implement technical requirements," and in 1965 the company submitted a technical review of the "Wasp advanced development program" under Army contract DA01-021-AMC-11835Z.

Another new weapon with the fanciful acronym "ZAP" was described in a 1968 Associated Press dispatch:

The Navy is moving swiftly toward production of a new weapon nicknamed the ZAP missile to beat down North Vietnamese antiaircraft guns.

ZAP is an acronym for "Zero Antiaircraft Potential"...

The ZAP, sources said, will be a solid-fueled "hypervelocity" rocket that will fly at speeds around 2,000 miles per hour and detonate with shattering effect over enemy antiaircraft sites.

"We will be able to just plaster the ground with this thing," one officer said.

The ZAP will have a conventional explosive warhead of unspecified size designed to go off just before it hits the ground with a special high-fragmentation effect.

The weapon's fantastic speed is vital to its success.

With the ZAP, the pilot of a 1,400-m.p.h. Phantom jet, for example, will be able to launch his weapon almost point-blank at any enemy target while zooming at supersonic speed...

At the same time, with the ZAP's new dispersing warhead the pilot won't have to be too concerned with precise hits on his target (San Francisco Chronicle, April 18, 1968; emphases added).

The idea of "plastering" the "target" with "point-blank" fire that need not be "precise" is a far cry from the "pin-point bombing" that the military so often boasts of. The Navy, apparently, is "not too concerned" about people ("non-targets"?) who might be working in their fields near the "target." The report refers to a conventional (non-nuclear), explosive fragmentation warhead but it also mentions a "new dispersing warhead" which suggests the possibility of a warhead containing bomblets, as in the Lance missile (see section 8).

The Bullpup air-to-surface missile was developed in the 1950's and was originally intended to be launched from outside the range of ground fire against small targets such as pillboxes and tanks; the idea for it came from the Korean war when American pilots were being harassed by ground fire (Ordnance, July-Aug. 1957). The Bullpup B, weighing in at 1,785 pounds and with a range of about eight miles, was the first air-to-surface missile used in Vietnam. Missiles and Rockets reported June 7, 1965 that it had been a "good weapon" against radar sites, "Vietcong ferries," large boats and ships, and certain bridges, though not against steel-reinforced bridges. "Bonus effect: Bullpup has turned out to be a good antipersonnel weapon because of high fragmentation, although cost would rule out its use solely for this purpose" (emphases added).

> Ordnance announced in its September-October 1966 issue: "A program has been initiated by the Air Force to develop an antipersonnel version of the Bullpup B air-to-surface missile for the war in Vietnam. A $900,000 contract has been awarded to MARTIN-ORLANDO to develop a version of the missile for fragmentation use against ground troops" (emphases added).
>
> Another MARTIN project was the Standoff Delivery System (SODS II). In 1964-65 under Air Force contract AF08(635)-3733 Martin studied the feasibility of ejecting canister munitions simultaneously in opposite directions from a "non-rolling missile airframe." (The source does not specify whether the canisters were to be filled with flechettes, or with noxious gases or some other material.)

The Shrike air-to-surface missile, according to North Vietnamese, has a warhead that produces 3/16-inch cubical fragments and has caused many casualties. The Shrike is officially known as an "antiradiation" missile; it homes in on enemy radar and is intended to destroy radar sites (and their operators presumably), or SAM sites where radar is used. The Shrike weighs 390 pounds and has a range of eight to ten miles; it is one of two current U.S. antiradiation missiles (the other is the Standard antiradiation missile).

4 Cluster Bombs

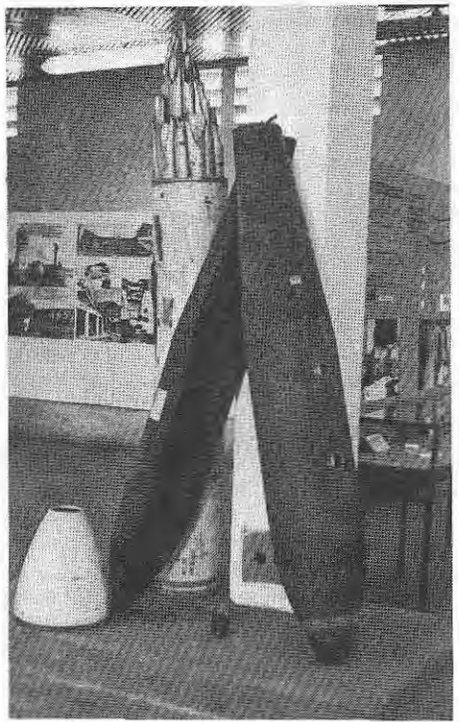
In World War II the military found that many small bombs were often more effective than a few large ones. Several small bombs were joined in a "cluster" weighing, say, a hundred pounds. The cluster could then be dropped from an airplane that was equipped to handle ordinary 100-lb. bombs and the cluster would open in the air, releasing the individual bombs. Clusters of 20-lb. fragmentation bombs were used against "enemy personnel" and clusters of 6-lb. incendiary bombs were dropped in great numbers on inflammable Japanese cities where most buildings were of wood or paper. The smallest constituent bombs were four pounds, though, and the most of them ever joined in a cluster was 182.

In modern cluster bombs there are many more constituent bombs, and they are much smaller--so small that they are usually called "bomblets." A modern cluster bomb consists of a "dispenser" loaded with "bomblets" which are then released in various ways. They have Air Force designations, "CBU- " for the complete cluster bomb, "SUU- " for the dispenser, and "BLU- " for the bomblets, so that the "guava" cluster bomb for instance is a "CBU-24" and consists of an "SUU-30" dispenser loaded with 665 "BLU-26" bomblets. By using many small bomblets the military is able to inundate an "area target" with fragments or other noxious materials such as tear gas or white phosphorus.

There are five principal types of dispenser: the SUU-30, SUU-7, SUU-14, SUU-13, and Tactical Fighter Dispenser (TFD). The SUU-30 is like an empty 750-lb. bomb case and is slit down the middle so that it can be made to open in the air, releasing the bomblets inside. The SUU-7 and SUU-14 consist of long horizontal tubes and are slung under an airplane; bomblets are ejected from the tubes as the plane flies along. The SUU-13 and Tactical Fighter Dispenser consist of vertical tubes or bays from which bomblets are

dropped. Dispensers and bomblets are designed so that they can be used interchangeably as far as possible; the SUU-13, for instance, can be loaded with BLU-18 antipersonnel bomblets, "Dragontooth" mines, or bomblets containing the incapacitating agent BZ, depending on the occasion.

It was AEROJET-GENERAL CORP. in all likelihood that developed the SUU-30 dispenser. Aerojet held Navy contract N124(60530)-26833A in 1962 or 1963 for development of the "Sadeye missile" (the Sadeye is a Navy dispenser which is practically identical to the SUU-30) and it was Aerojet in 1966 that announced details of the SUU-30 dispenser which it was then producing. Aerojet was probably also the principal developer of the SUU-14: In 1963 the company submitted a summary report on the design of the SUU-14/A (the first version of the SUU-14) under Air Force contract AF08(635)-3006. HONEYWELL INC. was probably the developer of the SUU-13: In 1965 it submitted a final summary report (author: M.J. Slepica) on production engineering of the SUU-13/A dispenser under Army contract DA28-017-AMC-1218A. Honeywell may also have developed the



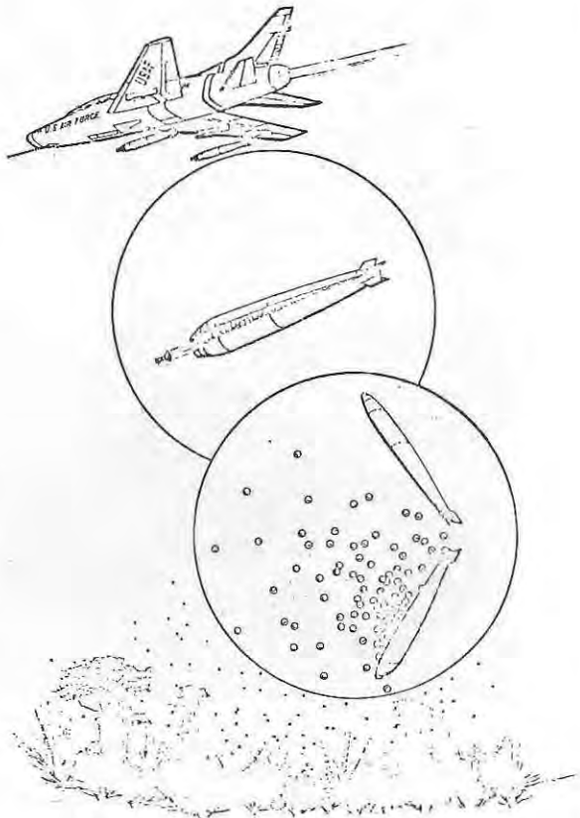
Cluster bomb dispensers on display at the war museum in Hanoi. In front, an SUU-30 dispenser, used with "guava" bomblets; behind it, a 19-tube SUU-7 dispenser, used with "pineapple" bomblets. (Photo by John Sullivan)

Tactical Fighter Dispenser, which it later manufactured.

Three main types of antipersonnel bomblet have been used in Indochina. Vietnamese have nicknamed them "pineapple," "guava," and "orange" bomblets because of their appearance.

The "pineapple" bomblet, from North Vietnamese descriptions, is used with the SUU-7 dispenser. The 19 tubes of the dispenser can contain some 360 bomblets. Each bomblet is cylindrical and has several fins that unfold upon release, stabilizing the bomblet in flight and causing it to land nose first. 1/4-inch steel balls are embedded in the side of the case and when the bomblet hits the ground, the balls are shot out on all sides.

The "guava" bomblet, from U.S. Air Force descriptions, weighs about a pound and is the size of a baseball. Steel balls are embedded in the case. 665 bomblets are released from an SUU-30 dispenser. Flanges on each bomblet cause the bomblets to spin,



Air Force diagram showing dispensing sequence for "guava" bomblets. Step one, an Air Force fighter drops an SUU-30 dispenser which opens in the air (step two), releasing "guava" bomblets (step three) which disperse and fall to the ground. According to the Air Force, the "guava" bomb was originally developed as a "flak suppression" weapon.

stabilizing them in flight and dispersing them in a pattern so that an area will be uniformly covered with bomblets. When they hit the ground they explode, shooting the balls in all directions. The original version of the "guava" bomblet is the BLU-26; another version, the BLU-36, consists of a BLU-26 equipped with a delay fuze so that it will go off hours after the attack.

The BLU-24, "orange" bomblet is a jungle penetration bomblet used with the SUU-14 dispenser; a similar bomblet, the BLU-66, is used with the SUU-7. The bomblet has a spherical metal case containing a high explosive. Curved plastic vanes are attached at one end of the case. Fragmentation of the case makes the BLU-24 effective against "personnel."*

HONEYWELL was awarded a $95,643 Army contract (number DAAA21-67-C-1105) in January 1968 for "Development of a three piece delay assembly for BLU-3/B

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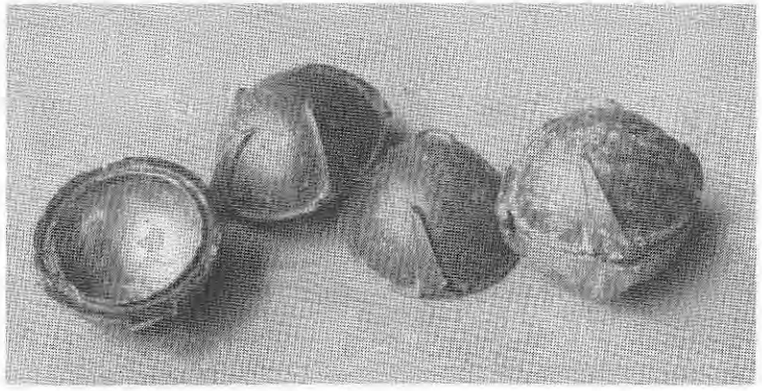
* According to the Technical Abstract Bulletin (1967, no. 18), "The BLU-24/B /original version of the BLU-24/ was designed to penetrate jungle canopy. The curved vanes in the bomb cause the bomb to rotate rapidly, arming the fuze... The bomb fuze fires only when the bomb's rotational rate decreases below 2,000 r.p.m. (caused by friction between bomb and target)." What this means is that whereas a bomblet with an ordinary impact fuze would go off as soon as it hit jungle canopy, the BLU-24 will not go off until it has penetrated the canopy and slowed down. The lush forests of Vietnam are just one more challenge to the ingenious munitions designer.



North Vietnamese photo of "guava" bomblets showing steel balls embedded in the cases. The two halves of a bomblet are manufactured separately and then

fragmentation bomb," which in all likelihood was the "pineapple" bomblet. Honeywell may have been the original developer of the "pineapple" bomblet and may also have developed the "guava" bomblet, which it later produced in great quantities. AVCO CORP. in 1966 or 1967 was awarded a $237,511 Air Force contract (number AF08(635)-5708) for development of a "BLU-26/B bomblet proximity fuze"; such a fuze would have made "guava" bomblets even more effective against "personnel targets" by exploding the bomblets in the air. AEROJET-GENERAL may have had a hand in the development of the "orange" bomblet, which it later produced.

Rockeye

The Rockeye is a cluster bomb containing 247 bomblets. Each bomblet has a shaped charge warhead designed to perforate armor. The bomblet contains a high explosive in the shape of an inverted cone. When it goes off, the explosive because of its shape produces a long, thin jet which will bore through the side of a tank. The metal liner inside the cone is converted into tiny, hot particles which follow in the path of the jet, damaging "personnel" and setting fire to explosives and fuel inside the tank. An Army manual of 1959 indicates that a shaped charge would also be effective against "objects" /or people, of course/ inside a concrete shelter. Even if it did not penetrate the concrete completely, it could still cause pieces of concrete of "considerable size and velocity" to be thrown off the inner face of the concrete wall.

In the face of heavy U.S. bombardment, the North Vietnamese undertook a program to distribute mass-produced one-man concrete shelters to cities, towns, villages, and even farms throughout the country. The shelters have concrete lids that protect a person inside from antipersonnel bombs and from any but a direct hit with a general purpose or incendiary bomb. U.S. fliers are now dropping Rockeyes on North Vietnam and according to the North Vietnamese, they are being used against shelters. North Vietnamese press releases state that "perforating" bombs have been used on dikes and in populated areas of Haiphong. A North Vietnamese doctor told a French journalist that his hospital in Thanhhoa province had been hit by 12 2,000-lb. general purpose bombs and 24 "antitank bombs that penetrated the concrete roofs of the hos-

pital as well as the air-raid shelters" (New York Times, May 9, 1972). A correspondent of the French newspaper Le Monde visited the damaged dikes of Phu-Ly and reported: "Even an old bunker dating from the time of Lattre and Tassigny had been perforated by a projectile" (Le Monde, July 4, 1972).*

> The Navy stated at a 1966 Congressional hearing: "HONEYWELL INC., Minneapolis, Minn., developed the dispenser, shipping containers, bomblets, and bomblet fuze for Rockeye; MELPAR INC., Fairfax, Va., developed the dispenser fuze." Honeywell went on

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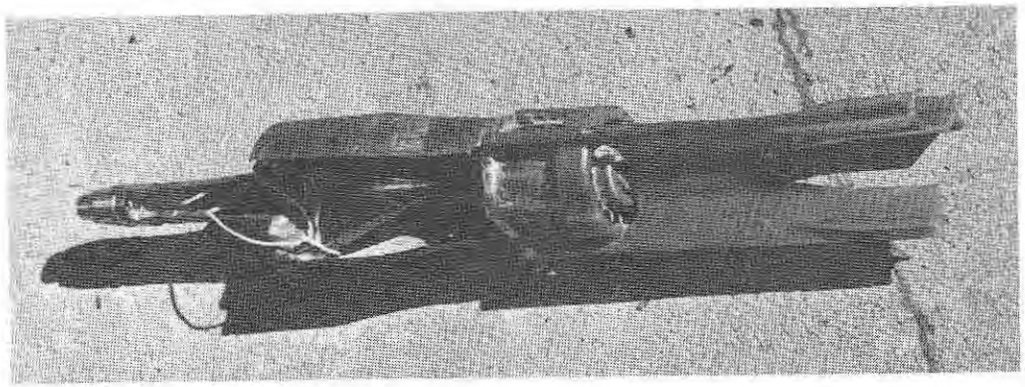
*All of these reports almost certainly refer to the Rockeye, which is the only "antitank" cluster bomb that the U.S. military has been buying over the last few years. The Navy usually refers to the Rockeye as an "antitank" bomb and this is consistent with military usage in general: Shaped charge weapons are ordinarily called "antitank." At a 1966 hearing, though, the Navy said that the Rockeye contained "antitank and antipersonnel bomblets." When a Congressman asked whether this meant that there were two different kinds of bomblet, an admiral replied, "They are the same, sir. They spread and if you have a concentration of personnel, would be damaging to the personnel" (emphasis added).

Like other cluster bombs, the Rockeye is an antipersonnel weapon by virtue of the wide area that it covers. If one-man shelters are scattered throughout the "target area," a Rockeye with its wide dispersion of more than 200 bomblets stands a good chance of hitting more than one of them at once.



Cutaway view of a Rockeye bomblet. The cone-shaped piece inside the front of the case is the metal liner of the shaped charge. (Photo by John Sullivan)

> to become the main producer of the Rockeye, and has had more than $100-million in production contracts to date. The Navy has recently developed an "antipersonnel/antimateriel" (APAM) cluster bomb, the CBU-59; an admiral stated at a 1970 hearing, "The APAM weapon utilized /sic/ the Rockeye dispenser and fuzing concept. It has a different bomblet which is designed for use against personnel and materiel targets" (emphases added). Honeywell was awarded a $3,153,600 Navy contract (number N00123-71-C-0575) for pilot production of "APAM bombs" and may also have helped develop this new version of the Rockeye.

Other bombs

An Air Force witness stated at a 1972 Congressional hearing that the development of "a 'pop-up' bomblet, the BLU-62, primarily developed for the flak-suppression role," would be completed in fiscal year 1972 (emphasis added). An Air Force list provides the additional information that the BLU-62 is a fragmentation bomblet, weighs 0.9-lb., and is filled with the explosive cycloto1.

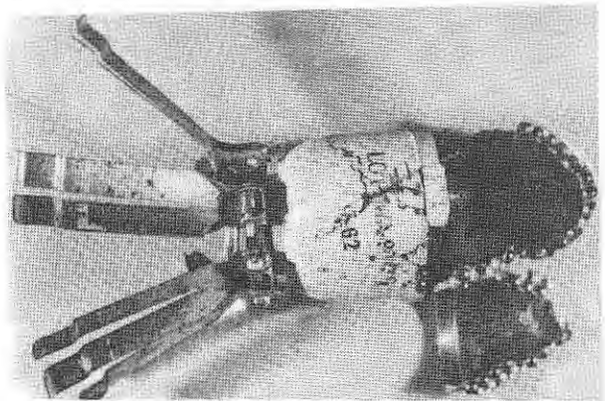
The BLU-63 is a 0.9-lb. spherical bomblet and is "made of steel that is scored to break into shrapnel fragments when it explodes," according to a Business Week article April 15, 1972 (emphasis added). It is intended to replace the BLU-26 "guava" bomblet; the Air Force claims on the basis of preliminary tests that "the BLU-63, packing more explosive and with shrapnel that is heavier than the BLU-26 steel balls, is proving to be the superior weapon," according to Business Week. It is also supposed to be cheaper. Manufacturers have had difficulty gluing the two halves of the bomblet together, though, and the North Vietnamese offensive of spring 1972 has led the Air Force to use up "guava" bomblets at a higher rate than expected. But stockpiles of "guava" bomblets should last until early 1973, and by then the BLU-63 will, hopefully, be ready.

Many other contracts have been awarded for the development of bombs. It is often hard to find out exactly what was involved.

AEROJET-GENERAL was awarded a $3,808,000 Air Force contract in 1965 or 1966 for "Engineering development of aircraft ordnance dispensers." This could have been for the SUU-30 dispenser or it could have been for something else. HAYES INTERNATIONAL CORP. in 1965 submitted a final report by C.K. Taylor on "A computerized stochastic mathematical model of MBD-1 B-47 antipersonnel grenade dispenser lethality" under Air Force contract AF08(635)-2936. The MBD-1 may have been a predecessor of the dispensers described above. MOTOROLA and HONEYWELL were awarded Air Force contracts (numbers F08635-72-C-0198 and F08635-72-C-0197 respectively) in May and June, 1972, for research and development on a "Guided cluster munition active optical fuze"; this is probably a proximity fuze, and may be for the Rockeye or for something else.

AVCO CORP. was awarded an $804,490 Air Force contract (number AF08(635)-5858) in 1965 or 1966 for development of the CBU-18/B cluster bomb. According to an Air Force list, the CBU-18/A (which is probably very similar) consists of the SUU-13/A dispenser loaded with BLU-25/B "cylindrical antipersonnel" bomblets. The use of the term "antipersonnel" (rather than "fragmentation," the term ordinarily used for "guava" and "orange" bomblets) suggests that the BLU-25/B may be a flechette-filled, canister-type bomblet.

CORNELL AERONAUTICAL LABORATORY in 1968 was awarded a $99,760 Army contract (number DA21-69-C-0040) for "Development of a popcorn bomblet"; the name is suggestive, but it may or may not have been an antipersonnel bomblet.



"Pineapple" bomblet. Note steel balls (embedded in case) and unfolded fins that stabilize the bomblet in flight. (North Vietnamese photo)

Some of the earliest work on cluster bombs was done by GLOBE AMERICAN CORP. In 1953-57 the company worked on "Fragmentation bomb cluster T28E2 and T28E3" under Army contract DA33-008-ORD-618, and in 1959 the company submitted a final summary report under contract DA28-017-501-ORD-2359 on a production engineering study for the T28E2 bomb.

Two other developments, described by Air Force witnesses at a 1972 Congressional hearing, are worth noting. The first involved getting bomblets to disperse in a better pattern. In a prepared statement highlighting "a few recent accomplishments," an Air

"This is my house, built of lumber 26 years ago. It was struck by the airplanes which dropped antipersonnel bombs /"pineapple" bombs, center/, causing everything to burn...

"This is my 19-year-old sister. She had stopped to pick some vegetables but just then the airplanes came and she had nowhere near to run to. So she ran for the jungle, but was hit by a bomb first. She lost a limb and thereafter was unable to work...

"One antipersonnel bomb canister released not less than 300 bombi, which fell all over, killing and wounding many animals...

"During that time I thought of my house and my belongings, and everyone in the house had to wash away their tears." (Drawing and narrative by a 49-year-old Laotian farmer. F. Branfman, Voices from the Plain of Jars, 1972)

THE SIMPLE ART OF MURDER

Force witness said:

> Our cluster bomblets, developed a few years ago, have proven to be a highly effective munition against personnel, radar installations, and other targets. One serious problem has been that because of their aerodynamic properties these bomblets have spread out to form a doughnut-shaped pattern when they strike the ground. But the target is at the center of the hole of the doughnut if our delivery is accurate. Our Armament Laboratory added a small nylon tuff (sic) about the size of your thumbnail to the bomblet which changed the aerodynamics and eliminated the hole in the doughnut pattern. (Emphases added)

The other development involved adding an incendiary component to the BLU-61 2.2-lb. fragmentation bomblet. This was supposed to make the bomblet more effective against trucks: It would puncture fuel tanks and then set the fuel on fire. An Air Force witness testified that

> ...the BLU-61 bomblet, which the gentleman is holding up here, we put lots of these* in dispensers, drop them on light materiel targets. They do fine from the standpoint of explosives and shrapnel. But in order again to set on fire the fuel, we added a liner in the thing to help make it burn. This liner is zirconium. It was a fairly high cost item. Our engineers felt that perhaps by using particles in the explosive itself it would work just as well and it would be cheaper. This did work just as well. The liner has been replaced by zirconium particles in the explosive, and this year it is going to save us about $2 per little bomblet, which means for the inventory for 1972, the buy, about $8-million cost savings.**

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* 254 to be exact, according to an Air Force list. The BLU-61 is used with the SUU-30 dispenser, the same dispenser that is used for "guava" bomblets and for the new BLU-63 antipersonnel bomblet.

** In other words the Air Force was planning to buy about 4,000,000 bomblets--quite a mammoth way of shooting down a few trucks. Drop 254 bomblets on a truck and if they disperse properly, the fragments from them should be effective against nearby personnel. The incendiary particles give an added punch--people burn too--and with a saving of $2 a bomblet, the munitions designers can be congratulated for their "accomplishment."

5 Aerial Mines

The U.S. military began to appreciate the importance of mines in World War II when allied forces ran into German antitank mines in North Africa and German antipersonnel mines in Europe. Several American mines were developed during the war, but they were cumbersome and had to be emplaced by hand.

The development of modern cluster bomb dispensers (see section 4) opened the way to a radically new form of mine warfare: laying land mines by plane. Munitions designers were also coming up with smaller mines and with the smallest of them--weighing only seven-tenths of an ounce--thousands can be carried in a single dispenser. The new mines are "aerial mines" since they are laid from airplanes and they are often referred to as "area denial" munitions because they can be used to "deny" an area to the enemy. The strategy of "area denial" marks another change in mine warfare. Earlier mines, like the Claymore mine, were used mainly to defend one's own positions or to impede a pursuing enemy during a retreat. The new mines could be sown far inside "enemy" territory and used as offensive weapons in conjunction with attacks on the enemy.

Project Doan Brook

The origins of aerial land mines go back to 1951 when the CASE INSTITUTE OF TECHNOLOGY under Project Doan Brook began looking into the possibility of laying land mines from airplanes. Over

an eight-year period the project expanded and came to include the actual design of mines and the development of the military doctrine that would govern their use. In view of the fact that aerial land mines were unknown in World War II, CASE INSTITUTE's work emerges as a major contribution to modern weapons development.

> A 1960 report submitted by CASE INSTITUTE under Air Force contract AF08(616)-77 shows the scope of the project. According to the abstract as published in Technical Abstract Bulletin, the report summarized "all the work conducted under Project Doan Brook during its eight-year history from May 1951 through October 1959. The original task of the Project was to establish the technical and tactical feasibility of an air-laid land mine. Subsequently, the main effort was concentrated on (1) the design and development of aerial mines to be employed against various targets and (2) the study of the tactical applications of these weapons." (Doubtless "personnel" were among the "various targets.")
>
> In 1958 under the same contract CASE INSTITUTE submitted a report by Robert J. Denington on "terminal ballistic tests" aimed at "determining how the ricochet and penetration characteristics of a missile are affected by such factors as the impact velocity, impact angle, soil type, and physical and geometrical properties of the missile." This was probably aimed at finding out how to make the mines ("missiles" in this context) penetrate the ground after being released from the airplane. In 1959 Case Institute submitted "a handbook of operational and service instructions on the air-laid land mine hardware, as well as the aerial mining doctrine, which have been developed by Project Doan Brook. Included are sections dealing with the background of mine warfare, description of hardware, assembly and delivery instructions, applications of aerial mines, target vulnerability and criteria for target selection, foree (sic) requirements, and countermeasures." The handbook was written by Michael Layzorek and Samuel E. Salem.

Modern aerial mines

Three main types of aerial antipersonnel mines were developed in the 1960's and used in Vietnam: the Wide Area Antipersonnel Mine (WAAPM) or "spider" mine, the Gravel (or "leaf" mine), and the Dragontooth mine. All three mines are fairly small and all are delivered to the "target" by cluster bomb dispensers.

The Wide Area Antipersonnel Mine (WAAPM) looks something like a "guava" bomblet; it has a spherical metal case containing an explosive filler. When the mine comes to rest on the ground, springs cause some eight tripwires to be deployed (hence the Vietnamese nickname "spider") and when the tripwires are disturbed, the mine explodes. There are two versions of the WAAPM, the BLU-42 and the BLU-54. According to an Air Force document, the BLU-54 is a "bounding type, long life WAAPM"; this may mean that the mine remains active longer than the BLU-42, and that it is thrown up in the air before exploding--which would make it more effective.*

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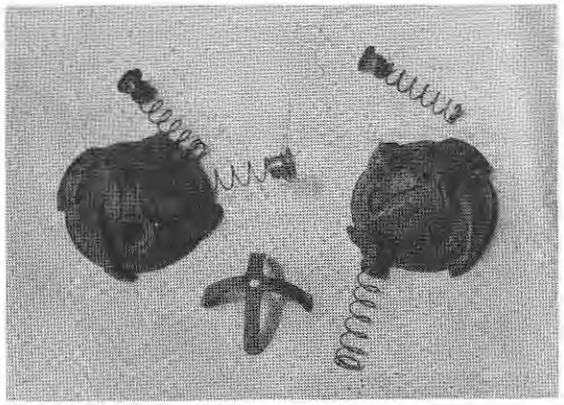
* The use of Wide Area Antipersonnel Mines (WAAPMs) in the central highlands of South Vietnam in 1969 was described by Army general D.R. Pepke in the Army magazine Military Review (Nov. 1970). According to General Pepke, the mines were dropped in such a way as to encircle "known enemy base and supply areas." This trapped the "enemy" and artillery and tactical air fire could then be "programmed" into these "clearly defined target areas" to "destroy him" /and whoever else was there/. What General Pepke described is an offensive action since the "enemy" is sought out and attacked (and hopefully "destroyed"), even though this is done largely by remote control.



Wide Area Antipersonnel Mines (WAAPMs). Note springs and tripwires. (North Vietnamese photo)

The Gravel mine was described by an Army general at a 1967 Congressional hearing as "a small canvas-covered charge of lead azide which is laid from helicopters, airplanes, or can be spread from the ground by individuals or from a truck." When dropped from the air it flutters to the ground (hence the Vietnamese nickname, "leaf mine"). Unlike most antipersonnel weapons, the Gravel mine works by blast rather than fragmentation. "The only kill mechanism is blast, Gravel will blow a man's foot off but it will not blow a hole in a truck tire," Air Force major R.D. Anderson stated at the 1970 Senate "electronic battlefield" hearings.

The Dragontooth mine is a jagged-looking object that weighs only 0.7-ounce. Major Anderson stated at the same hearings that "It is purely antipersonnel. If a person steps on it, it could blow his foot off. If a truck rolls over it, it won't blow the tire." He also volunteered the information that "Dragontooth has a (censored) feature" and that "A (censored) version of Dragontooth was under development, but because of technical problems, this effort was discontinued."

The WAAPM, Gravel mine, and Dragontooth mine are used mainly with the SUU-13 and TFD dispensers (see section 4). The Dragontooth mine is so small that 4,800 of them can be carried in a single SUU-13 dispenser.

HONEYWELL has been a leading developer of "area denial" munitions under a series of military contracts. Their work goes back as far as 1963-64 when the company conducted three "system concept studies" and six "engineering investigations" on "air-delivered area denial weapons" under contract AF08(635)-3070. Some of this early work may have involved the development of the WAAPM and the Tactical Fighter Dispenser, which Honeywell later produced. As recently as December 1971 Honeywell was awarded an additional $240,000 on Army contract DAAA21-68-C-0353 for "Design and development of an area denial munition."

DRAGONTOOTH

Dragontooth mines are dropped in clusters of 120 and in the words of Major Anderson, "The mines disperse as they flutter to the ground. Application of sufficient external force, such as a foot step, activates the mine." (Air Force photo)

Many companies have worked on Gravel mines. ATLANTIC RESEARCH CORP. developed an early version of the Gravel mine, the XM27, and the original aircraft dispenser for Gravel mines, the XM47, under a series of Army contracts going back at least as far as 1966. Atlantic Research also made an engineering study to adapt the XM27 mine to the SUU-13 dispenser. FMC CORP. designed and developed the XM4, trailer-mounted dispenser for Gravel mines in 1964-66 and was awarded contracts in fiscal year 1968 for "One semi-automated system for XM41E1 antipersonnel mine" (a more recent version of the Gravel mine), "Development of automated test equipment for XM27 antipersonnel mine," and "Design, development, and fabrication of sterilization fuze system for Gravel antipersonnel mine." Altogether the Army paid Atlantic Research more than $400,000 and FMC more than $1,800,000 for their work on Gravel mines and dispensers.

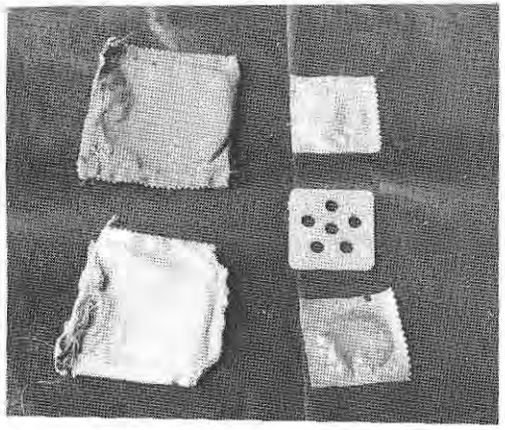
In 1964 CORNELL AERONAUTICAL LABORATORY submitted a report under Army contract DA18-108-CM-16628A on the feasibility of adding a "complementary chemical agent capability," called "Stomp", to the XM22 mine (possibly an early version of the Gravel mine). The laboratory considered designs ranging "from a simple, 'add-on' agent container to a sophisticated airburst adapter yielding high agent dispersion." They concluded that the designs considered were not worth the extra cost and complexity, but that

FMC Corp., developer of a trailer-mounted Gravel mine dispenser and onetime producer of nerve gas and Beehive projectiles, needs ordnance engineers to help build for the future. (Ad in Ordnance, Mar.-Apr. 1972)

"techniques developed for the study program appear to be of value for other munitions." This work was done under the Army's "Project Chord."

Several other companies were awarded contracts in 1967 and 1968 for developmental work on Gravel mines. HERCULES INC. was given contracts for "Research and development of a Micro-Gravel concept" and "Micro/Macro-Gravel mine analysis." DU PONT was awarded a contract for "Research and development of a Micro-Gravel concept" and ESSO RESEARCH AND ENGINEERING had a contract for "Sensitivity studies for Project Gravel," the Army project under which the Gravel mines were developed. PERRY INDUSTRIES had a contract for "Automated mine loading machinery system for XM45E1 high explosive micro-Gravel antipersonnel mine" and THIOKOL CHEMICAL CORP. had a contract for "Design and development of a new system of sterilization for the Gravel mine." AERONCA MFG. had a contract for production engineering of the XM3 dispenser, which according to DMS Market Intelligence Report (June 1971) is used to dispense XM27 Gravel mines. The work of these six companies on Gravel mines cost U.S. taxpayers more than $900,000.

If the Air Force and the Army have aerial mines, the Navy has to have one too. "Deneye," an area denial mine, has been under development for a number of years as one of the Navy's "Eye"-series aerial munitions. AVCO CORP. was awarded a $3,778,-547 Navy contract (number N00123-71-C-0200) in June 1971 for "Phase I engineering development for the Deneye."



The Gravel mine, which looks like a leaf or a tea bag and contains enough explosive to blow a person's foot off. Left, canvas covers of Gravel mines; right, the contents. (North Vietnamese photo)

6 Miscellaneous Projects

Many companies have worked on other developmental projects involving antipersonnel weapons. Some of these projects may have been connected with the weapons described in other sections of the booklet.

BECKMAN AND WHITLEY, INC. prepared a 1961 report on "Cavity formation in gelatin by projectiles penetrating lightweight personnel armor" under Army contract DA19-129-QM-1574. (Gelatin is used as a flesh simulant in studies of the effects of projectiles on "personnel targets.")

HONEYWELL submitted a 1964 report under Army contract DA11-022-AMC-579A on "unique booby trap devices." SPECIAL DEVICES, INC. in 1965-66 worked on an "harassment explosive device" under Air Force contract AF08(635)-5265. The secret report on this was submitted to the Air Force in 1966 and indexed by the Defense Department under "Antipersonnel Ammunition--Feasibility Studies."

NORTHROP CORP. in 1963 submitted its first semi-annual project report under Air Force contract AF08(635)-3100 on the provocative subject "Advanced antipersonnel mechanisms." In case anyone wants to guess what this secret report contained, the Defense Department indexed it under "Antipersonnel Weapons--Release Mechanisms," "Antipersonnel Ammunition," "Programming (Computers)," "Bomb Clusters," "Explosion Effects," "Flechettes," "Spin-Stabilized Ammunition," "Effectiveness," "Feasibility Studies," "Bomb Cases," "Bombs," "Bomblets," and "Rocket-

Assisted Projectiles."

THIOKOL CHEMICAL CORP. in 1965-66 conducted "Investigations of low density area denial mine systems" under Army contract DA36-034-AMC-0166A. This may have involved both antitank and antipersonnel mines. The Army paid Thiokol more than $260,000 for this work. In 1968 Thiokol was awarded a $537,730 Army contract (number DAAA21-68-C-0755) for "Development of a reliable chemical fuze for antipersonnel mine."

AVCO CORP. in 1968 was awarded an $87,420 Army contract (number DAA21-68-C-0655) with the picturesque title "Services and materials for an investigation of improved antipersonnel kill mechanisms."

McDONNELL DOUGLAS CORP. in 1967 or 1968 was awarded a $2,500,000 Army contract for "Engineering development and test of an antipersonnel companion round for the Dragon weapons system" (Research and Development Directory, 1969). The Dragon is a small guided missile that is meant to be fired by soldiers at enemy tanks.

Tompkins reported that a "California research firm" had developed rocket-propelled projectiles from 40mm. down to 1/16-inch in diameter. "Called 'Microjets,' these small projectiles are, in effect, self-powered flechettes. As such they are adaptable to salvo-style weaponry and to bombs, shells, and mines where controlled fragmentation is desired" (The Weapons of World War III, p. 128; emphases added). The California firm that Tompkins had in mind was probably MB ASSOCIATES, which conducted studies under a series of military contracts starting in 1960 on "miniature rockets," "Microjet detonation of land mines," "Dispersion and ignition of miniature spin-stabilized rockets (Gyrojets)", and "spin-stabilized microrockets." RAND CORP. prepared reports under defense contract SD-79 on "Microjet: its problems and its applications" (1961) and "Design characteristics for a family of micromissiles" (1962).

JOHNS HOPKINS UNIVERSITY's Operations Research Office prepared a 1958 report on "Multiple flechettes for small arms" (Technical Abstract Bulletin, 1959, no. 11; contract not specified). This may have been

on a flechette rifle like the Special Purpose Individual Weapon (see section 8) or it may have covered a variety of uses of flechettes. STANFORD RESEARCH INSTITUTE in 1961 submitted a final report under Army contract DA04-200-501-ORD-844 on "Flechette studies."

Several companies helped the Army develop proximity fuzes for mortar ammunition which would make the ammunition more effective against people on the ground by causing it to explode in the air. AVCO CORP. in 1964 or 1965 was awarded a $2,795,047 Army contract (number DA49-186-AMC-162A) for engineering and fabrication of the XM532E1 81mm. proximity fuze. HAMILTON WATCH CO. in fiscal year 1967 was awarded a $50,670 Army contract (number DAAG-62-C-0041) for tooling for the M532 81mm. proximity fuze safety and arming device, and in fiscal 1968 the company received a $34,000 contract to develop a modified version of the M532 fuze, according to DMS Market Intelligence Report (June 1970). MOTOROLA, INC. in 1966 or 1967 was awarded more than $200,000 on Army contract DA49-186-AMC-374A for the development of integrated circuitry for the M532 fuze and RAYTHEON CO. in 1968 was awarded $60,477 on Army contract DA11-173-AMC-630A for change of detonators in the M532 fuze. HONEYWELL in fiscal year 1967 was awarded an Army contract (number DAAG-67-C-0060) for the design and development of a safety and arming device for the XM588 60mm/81mm. proximity fuze and RADIO CORP. OF AMERICA from fiscal 1967 to 1969 received more than $300,000 in Army contracts for the initial fabrication of XM588 fuze components.

7 "Basic" Research

Basic research, according to The United States Air Force Dictionary, involves "the discovery, testing, or illustrating of a fact, relationship, or principle."* Since 1950 a series of companies and universities has worked on the principles that are basic to the design of antipersonnel weapons. Some institutions have also designed the instrumentation that is needed for experiments; some have worked on the collation of information that reveals the current "state-of-the-art" in weapons development.

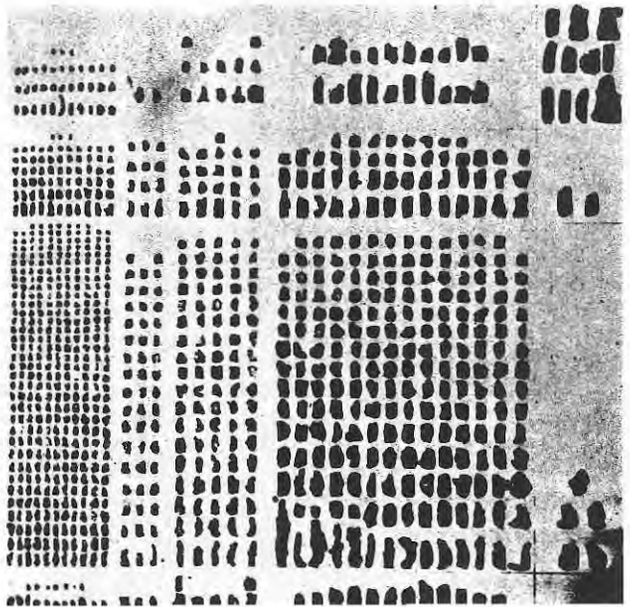
BARKLEY AND DEXTER LABORATORIES under Army contract DAI28-017-501-ORD(P)-1087 worked from 1953 to 1957 on "an automatic fragment separating machine for separating, counting, and weighing fragments resulting from the explosive bursting of a container. Fragments are separated into ten weight groups from 0 to 750 grains." (The machine would have facilitated the study of the fragmentation of general purpose bombs and artillery projectiles. The fragments in modern antipersonnel weapons are at the low end of the range; "guava" bomblet steel balls, for example, weigh about 10.6 grains.)

TECHNICAL OPERATIONS, INC. worked on another useful device: In a 1957 report the company described the results of "a brief study of individual-type (standing man) targets for use in field tests of the effects of fragmentation weapons....Considered in the study were available target materials, target shape and size, and layout of the effects field. Recommendations are made for an interim design pending further study by cognizant agencies and final standardization" (Technical Abstract Bulletin, 1960, no. 1-1; contract number not specified. Emphasis added).

* The Air Force dictionary also defines it as "...research concerned with adding to man's knowledge."

STANFORD RESEARCH INSTITUTE in 1961 submitted a final report under Army contract DA04-200-501-ORD-844 on "Flechette studies." This was probably a general study and it may have covered the use of flechettes against equipment as well as people.

RESEARCH ANALYSIS CORP. in 1961 prepared a report on "A method of evaluating effectiveness of field artillery," and in 1963 the company reported on "Tank gunnery techniques to exploit HEP /high explosive plastic/ fragmentation effects." Both reports were made under Army contract DA44-188-ARO-1 and both were indexed by the Defense Department under "Antipersonnel Ammunition," so "personnel targets" must have been one of the areas of concern. (High explosive plastic ammunition is intended mainly for shooting down "enemy" tanks; RESEARCH ANALYSIS CORP.'s second study would have shown how to use it against "enemy personnel" as well.)



Fragments from a World War II 220-lb. fragmentation bomb, sorted by weight and laid out to illustrate the work that goes into studies of fragmentation. (Army Materiel Command Pamphlet AMCP 706-107)

RAND CORP. in 1964 prepared a report by M.B. Schaffer on "Wound ballistics in perspective--a historical review and some unsolved problems." Much of this was probably a survey of the studies of wounding that had been made at the Army's Edgewood Arsenal in the early 1960's (Technical Abstract Bulletin, 1964, number 15; contract number not specified).

FALCON RESEARCH AND DEVELOPMENT CO. in 1964 prepared two reports on the mathematics of killing under Air Force contracts AF08(635)-2949 and AF08(635)-4081. In the first report, as the company explained in its abstract, "Personnel and hard target casualty criteria have been examined to form the basis for the development of mathematical models for evaluation of weapons effectiveness which include the effects of varying types of terrain features." The company prepared mathematical models of the probability that "personnel" or other targets would be hit by a warhead fragment, and in an appendix, a "flow chart" was presented for "digital simulation of a cluster of fragmenting munitions delivered against a surface target complex sheltered by a mix of upright cylinders." (The upright cylinders were apparently intended to simulate a natural obstacle of some sort.) In the second study, in which "personnel and light vehicles" were the "principal targets of concern," the company tried to find out whether "lethal area" was an appropriate measure of the effectiveness of ammunition fired from aircraft guns.

Under "Project Fibre" in 1965 CORNELL AERONAUTICAL LABORATORY under Army contract DA30-069-AMC-459 submitted a 400-page report on the ways in which small projectiles lose their effectiveness when fired into vegetation. According to the abstract of the report, "Controlled experiments were conducted with fragments, flechettes, and bullets in grass, shrubs, and trees." Data on loss of velocity and deflection were obtained and mathematical models were developed for estimating loss of velocity in some cases. The laboratory also began compiling a "world-wide data base" involving the "quantitative description of world vegetation in terms of the parameters which appear to be significant" in causing projectiles to lose their effectiveness. It drew "maps of grass density and height for major geographic areas of the world" and it

compiled "information on trees (such as heights, diameters, spacings, types, and frequency of occurrence of types) for geographic areas where information is available." This study is an indication of the global interest of the U.S. military, and it is a step ahead in the scientific design of munitions, in that it would enable designers to predict which munitions would be most effective in which parts of the world, or show them how to design the most effective munition for a particular place--instead of having to do it by trial and error. The report was indexed under "Antipersonnel Ammunition" by the Defense Department, and would obviously be of interest to engineers designing munitions for use against people hiding in grass or trees.

DENVER RESEARCH INSTITUTE submitted a 1966 report under Navy contract N123(60530)-35560A on a "Vulnerable area analysis of a representative foreign fire control radar subjected to attack by fragments." This study is of particular interest because the Defense Department indexed it under both "Fire Control System Components" and "Radar Operators"; proof that fragmentation weapons such as those included in the study are intended to knock out both the "foreign" radar equipment and the "personnel" who operate it.

Special mention must be made of the UNIVERSITY OF PITTSBURGH's work in preparing technical information reports and long-range forecasts on "items of mater-

Successful hit on a personnel target exemplifies modern munitions design for optimum fragmentation. Count them--there are more than a hundred puncture wounds in the target's back. (North Vietnamese photo)

iel and weapon systems under development for the U.S. Army" (as stated in the abstract of one of the University's reports) under Army contracts DA36-034-AMC-3785 and DA49-186-AMC-214D. The University's work began in 1954; at first it was done in Pittsburgh but in 1966 the project was moved to a special office in Washington. As of 1968 the University had received more than a million dollars on the second contract alone.

From 1961 to 1967 the University prepared at least 25 reports that included antipersonnel munitions. Of them some 11 were on aircraft armament, eight were on mines, and the rest were on canister projectiles and infantry weapons. In a typical report dated March 1967, the University explained (in its abstract) that the XM4 antipersonnel mine dispenser "rapidly sows XM22-series and XM27 Gravel-type mines in an effective and extensive antipersonnel barrier pattern," and stated that the dispenser "greatly improves the speed, economy, and flexibility of antipersonnel mining operations."

PITTSBURGH's work was probably useful to the Army simply as a means of keeping track of what was going on. Some of the reports were on individual weapons; others surveyed groups of weapons that might often have been under development by several companies and military agencies simultaneously. Many reports were only a few pages long and contained brief descriptions of the weapon and a few details on the developmental program. Often reports were brought up to date as new developments were made.

8 Weapons of the Future

Plenty of "personnel" have been "destroyed or obstructed" in Southeast Asia over the last ten years, but the military is still eager to find ways of doing the job better. Military witnesses appeared at 1972 hearings of the House Armed Services Committee to justify their requests for research and development funds for fiscal year 1973. Of the projects they had in mind, more than ten were concerned with antipersonnel weapons.

Special Purpose Individual Weapon (SPIW)

Bullets aren't enough; the Army wants to be able to riddle the enemy with little darts. The Special Purpose Individual Weapon (SPIW) is an infantryman's rifle that shoots flechettes. Its effects, "psychological" and otherwise, were described in an article by Hanson Baldwin in the New York Times (March 15, 1964):

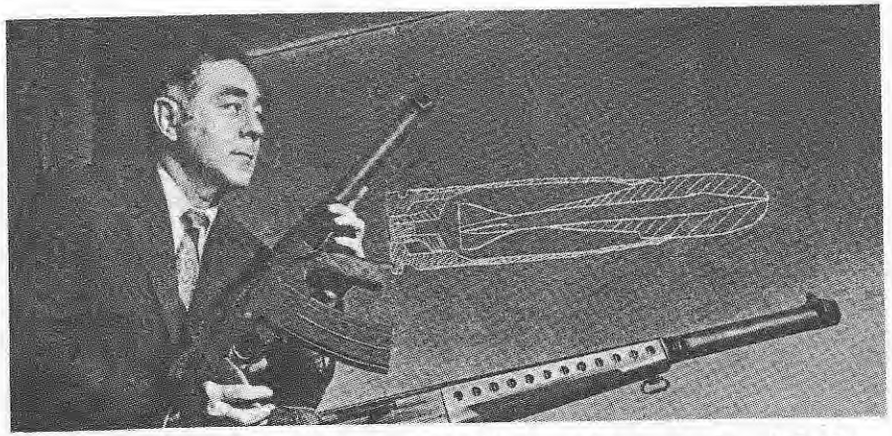
> The flechettes have a tendency to tumble on impact, or to penetrate the flesh sideways, or end over end, thus inflicting tremendous wounds, most of them lethal.
>
> A recent article in The Army Times, unofficial Army newspaper, reported the comment of an officer who was asked about the medical task of healing a man wounded with flechettes.
>
> "Don't kid yourself," The Army Times reported the answer, "it is not a job for a surgeon but for graves registration."

> Thus, the flechette could have considerable psychological effect on the battlefield...(Emphases added)

The Army has spent $28.5-million on the SPIW thus far, and plans to spend somewhat under a million dollars on it in fiscal 1973. At present two versions of it are being considered for possible adoption as the Army's Future Rifle System (FRS). The two versions differ in their ammunition systems, as explained by Lieutenant General W.C. Gribble, Jr., U.S. Army Chief of Research and Development, at the 1972 hearings:

> One of these is a multiple flechette, which (sic) in a single cartridge there is bundled three very small barbs and with a single trigger pull, these three barbs are simultaneously sent in the direction of the target. It is a kind of modified shotgun approach to the use of an individual hand-held weapon.
>
> The second ammunition system differs from the first in the sense that each one of these barbs is somewhat larger than the ones in the system I just described, and they are fired serially. So with a single trigger pull you are actually engaging in semi-automatic fire in the sense that three flechettes are sent out, not simultaneously but in close sequence to one another, and impact on the target. (Emphases added)

General Gribble did not say what happens when the flechettes "impact on target" or whether the "very small barbs" produce a more desirable pattern of impact than the "somewhat larger" flechettes in the second version.



The Special Purpose Individual Weapon (SPIW) is a brain child of Irwin R. Barr, vice-president of AAI CORP., who first tried firing steel phonograph needles from a bolt-action rifle at the age of 14. In this photograph from the Baltimore Sun magazine August 15, 1971, Mr. Barr is

The Army began the SPIW developmental program in 1962, according to DMS Market Intelligence Report (July 1971). At the beginning of the program AAI CORP., HARRINGTON & RICHARDSON, INC., and OLIN DA36-034-504-ORD-16 on "Research and development won out and the company continued with its work. The second version in General Gribble's description is the XM19 serially fired flechette rifle which was developed by AAI.

AAI's work on flechettes goes back before 1962: In 1957 the company submitted a report under Army contract DA36-034-501-ORD-68RD on "Analytical treatment of the dynamics of fin-stabilized fragments possessing large yaw" (presumably flechettes) and in 1959 it made a final report under Army contract DA36-034-504-ARD-16 on "Research and development activities on flechette ammunition test rifles." AAI also worked on tracer ammunition for the SPIW--something to produce a streak of light along the line of fire so that soldiers can see where they are shooting--and in 1965 the company reported on this topic under Army contract DA36-038-AMC-210A. (The flechettes are so small that it is hard for a soldier to see where he is firing unless there is a tracer. SPIW tracer ammunition is "very difficult" to develop, according to General Gribble.)

Although OLIN lost out in the original competition, it later did more work on the SPIW. In 1966 the company submitted a report under Army contract

Each flechette is enclosed in a fiberglass sabot. When it is fired from the SPIW, the sabot strips off and disintegrates and the flechette con-

DA19-058-AMC-1103Y on "Olin SPIW launcher," and according to DMS Market Intelligence Report, Olin has developed a "pusher-type Multiple Flechette Rifle (MFR)" which is one of the contenders for adoption as the Future Rifle System. DMS also indicates that AEROJET-GENERAL CORP. has developed a "puller-type" Multiple Flechette Rifle. HONEYWELL has designed production equipment: In 1964 or 1965 Honeywell was awarded a $135,754 Army contract (number DA36-038-AMC-2419A) for a "Process to mass produce components for Special Purpose Individual Weapon," and in June 1971 the company received a $365,340 Army contract (number DAAA25-71-C-0594A) to design, fabricate, and build a prototype automated machine line for production of a sabot that would enclose the flechettes in the SPIW.

TECHNIK INC. in 1965 submitted a one-volume final report under Army contract DA30-069-ORD-3734 on "Sabot, flechette and tracer flechette investigations.

Vehicle Rapid Fire Weapon System (VRFWS)

The Vehicle Rapid Fire Weapon System (VRFWS) or "Bushmaster" is conceived of as an automatic gun, somewhere from 20mm. to 30mm. in size, which would be mounted on tanks and other armored vehicles. DMS Market Intelligence Report (June 1972) describes its "mission" as "antipersonnel, antivehicle, and antiaircraft," and states that its "ammunition family" consists of "armor piercing, high explosive, and multiple flechette rounds" (emphases added). The Army has requested $5.6-million for continued development of the VRFWS in fiscal 1973, and an Army witness at a 1972 Senate hearing stated that "We have some work in process right now looking at improved penetrators, improved fragmentation of the small HE /high explosive/ rounds, improved fuzing, and things of this nature" for VRFWS ammunition (emphases added).

According to DMS, the VRFWS developmental program was conceived in 1962 when the Army found it had an "immediate field requirement" for such a weapon (translate: in Vietnam). AAI CORP. was apparently involved in the program from the start: In December 1962 the company commenced developmental work on the "Rapid Fired Weapon System" under Army contract DA30-144-AMC-105W. In May 1972, AAI,

GENERAL ELECTRIC CO., and PHILCO-FORD CORP. were awarded developmental contracts of more than $1-million each for the VRFWS; according to DMS, the three companies are developing competing prototypes and the Army will then choose among them. As DMS notes, large sums of money are at stake; the three companies "are vying for a procurement program whose initial total production cost could reach $180-million." GENERAL AMERICAN TRANSPORTATION was another early developer: In 1963 the company's MRD Division commenced work on a cannon for the Rapid Fired Weapon System under contract DA30-144-AMC-108W.

Close Air Support Gun

"The 30mm. close air support gun system GAU-8/A is a high rate of fire gun system optimized for high effectiveness against ground targets such as personnel, trucks, armored personnel carriers, guns, and armor. It will be effective against selected targets at long ranges," an Air Force general stated at a 1972 Congressional hearing (emphasis added). The Air Force needs $9-million to continue working on it in fiscal 1973. GENERAL ELECTRIC and PHILCO-FORD were listed at the hearing as the main developmental contractors.

Scatterable mines; Area Denial Artillery Munition (ADAM)

At a 1971 hearing, General Gribble stated:

> The Army is developing a family of scatterable, self-destructing mines. These mines offer a radically new concept in the techniques of conducting mine warfare. Previously, mines had been relegated to a principally defensive role and mine warfare was typified by vast amounts of manpower, time, and logistics expenditures. Now we have mines in advanced and engineering development that can be delivered by /censored/ artillery /censored/, helicopter, fixed wing aircraft, and ground ve-

> hicles. This offers the potential of using mines in an offensive role, accurately delivering the minefield to a target or location identified by any combination of intelligence means. (Emphasis added)

One reason for the Army's scatterable mine program ($17.4-million requested for fiscal 1973) is probably to overcome some of the technical difficulties that seem to have afflicted aerial mines to date. The Air Force asked Congress for $63,600,000 to buy Wide Area Antipersonnel Mines (WAAPMs) in fiscal 1971 but later cancelled the request, and about the same time, the House Appropriations Committee noted in a 1970 report that there had been "technical problems" with the SUU-13 dispenser, which is used to dispense Dragontooth mines and other munitions. Another reason for the Army's program is to find still more ways of "delivering" mines: by helicopters, ground vehicles, and artillery.

The Army's artillery-delivered mine, the Area Denial Artillery Munition (ADAM), was described at the 1972 hearings. The military censor left the testimony on it reading like a piece of advertising copy for a peep show:

> General GRIBBLE. The efforts which are being pursued in this engineering development program include a /censored/ called the Adam. Do we have that model with us?
>
> Colonel JOY. Yes.
>
> General GRIBBLE. I have a cutaway model of this particular mine which you may find interesting. This is one segment of that portion of the /censored/. There would be a number /censored/. They would be delivered in the same way as an /censored/.
>
> But, at the target, or above the target, in an /censored/ these would be separated from the /censored/. When they land, out of these gold depicted devices, /censored/. Anyone encountering /censored/.
>
> This is in the engineering development stage. (Emphases added)

HONEYWELL INC. is the developer of the Army's artillery-delivered mine. In 1969 Honeywell was awarded a $1,479,500 Army contract (number DAAA21-70-C-0096) for "Design and development of Area Denial Artillery Munition, Phase I," and in October 1971 the company received an increment of $2,700,000 on Army contract DAAA21-71-C-0599 for "Research and development on Area Denial Artillery Munitions," bringing the total on this second contract to $5,038,400.

Lance warhead

The Lance is a surface-to-surface missile with a range of 72 miles. The Army is developing a non-nuclear warhead for it that contains "guava" bomblets. General Gribble said in his prepared statement at the 1972 hearings:

> The Lance XM251 conventional warhead which contains a large number of the Air Force BLU-26 anti-light materiel bomblets,* has been spectacularly successful in recent tests against a /censored/. (Emphases added)

The military is doing an about-face once more. Missiles were developed in the 1950's but no one wanted to have a nuclear war.

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* Don't they like the sound of the word "antipersonnel" any more? An Air Force general was describing the "guava" bomblet at a hearing in 1967. Just to make sure, a Congressman asked:

> Mr. RHODES (Ariz.). Antipersonnel bomb?
>
> General GOLDSWORTHY (U.S. Air Force). BLU-26 is antipersonnel. It has the steel ball bearings from which we get the lethal fragments.

Most Vietnamese would probably agree with General Rhodes. But now the generals seem to be changing their minds. At the 1970 Senate "electronic battlefield" hearings, Major Anderson of the Air Force showed a picture of the side of a truck with small puncture holes in it that supposedly were made by CBU-24 cluster bombs (containing "guava" bomblets). "The CBU-24 is one of the most effective and widely used anti-truck munitions used in Southeast Asia," he said. "The CBU-24 fragments puncture tires, gas tanks, radiators, and kill or wound the drivers."

Perhaps it is true: In World War II, fragments were found to be effective both against people and against light materiel. But does this make the "guava" bomblet an "anti-truck" munition?

Non-nuclear warheads were added to the missiles but as Tompkins (writing in the 1960's) observed, "...few of them will ever be worth firing with such puny payloads... For ranges up to about twelve miles conventional artillery would be cheaper and more effective. And tactical bombers would be better for anything farther away" (The Weapons of World War III, p. 90).

The military fell back on its old ways and pounded Vietnam with artillery and dropped millions of "guava" bomblets. But American planes were being lost, so the Army took a second look at the problem and concluded (as General Gribble testified at the 1972 hearings) that the "relative cost-effectiveness" of the Lance non-nuclear warhead was "a function of the attrition rate of aircraft." In other words, if lots of planes are being shot down, the Lance is a cheaper way of dispatching "guava" bomblets to the "target."

With an eye to the future, General Gribble told the Congressmen that the new Lance warhead would be especially useful "in the early stages of any conflict, when tactical aircraft are for the most part busily engaged in trying to attain a posture of air superiority. It is very effective against the large targets, such as the surface-to-air missile systems, and could quite conceivably pave corridors by selectively attacking the surface-to-air missile systems thus enabling tactical aircraft to go in to deep penetration targets" (emphases added). In other words, plaster them with "guava" bomblet fragments, shoot down their planes, and then go in and bomb the hell out of them.

HONEYWELL, which once produced large quantities of "guava" bomblets, now appears to be helping the Army develop this promising new munition. In September 1971 Honeywell was awarded $482,301 on Army contract DAAA21-68-C-0353 for "Research and development of warhead systems for Lance missile." DMS Market Intelligence Report (May 1972) specifies that Honeywell's work is on the "non-nuclear Lance." AVCO has also worked on the Lance missile: In 1966 or 1967 it was awarded a $214,870 Army contract (number DA28-017-AMC-3191A) for "Development of sub-components for Lance warhead system." This may or may not have been for the non-nuclear warhead.

The Lance missile is now considered "cost-effective" for delivering "guava" bomblets where enemy ground fire has placed American planes at an unfair disadvantage. (U.S. Army photo)

Other projects

The military has requested various amounts to pay for many other developmental projects in fiscal 1973. Among them are:

A helicopter-launched "air defense suppression missile" which would be used for the "air-to-ground attack of antiaircraft systems" and would "reduce helicopter vulnerability." As a start the Army would try mounting a new "dual sensor" on either the Redeye surface-to-air missile or the 2.75-inch rocket. The Army wanted $2.9-million for this effort.

An "advanced antipersonnel/antimateriel cluster weapon" whose bomblets "have the capability of distinguishing between whether they are hitting hard armor or soft ground and behaving accordingly." (This may be an elaboration of the antipersonnel/antimateriel version of the Rockeye bomb.)

A lightweight machine gun, "improved grenade launchers," and "mini-grenades" that are "smaller caliber than our present 40mm. grenades and multiple projectiles out of a single tube rather than a single projectile." These fancy new weapons are being developed under the Army's Small Arms Program which has been going on for several years and is expected to cost $10.4-million in fiscal 1973.

Projectiles, propelling charges, and fuzes to improve the "range, payload, and lethality" of Army artillery and mortars. In fiscal 1972 under this program the Army "planned the work to complete engineering and expanded service test of the M60 tank antipersonnel round." The Army has asked for $8.7-million for this program in fiscal 1973.

"...advanced development to try to improve the antipersonnel and antimateriel capabilities of our family of improved conventional munitions. These are the fragmentation munitions," General Gribble explained.

A "Surface Look-Alike Mine" with the mighty acronym "SLAM." The Air Force wanted $1.7-million for it in fiscal 1973. An Air Force general explained at a 1972 hearing:

> These are a pair of mines, one being an antivehicle mine and one being an antipersonnel mine, which externally have an identical appearance. That is what gives rise to the name "SLAM." It is a mine with a dual seismic or a magnetic detector and with rather sophisticated target discrimination logic so that these can be seeded in the area and determine when it is appropriate for them to go off. This renders it difficult for the enemy to go through the /sic/ clearing because of the inability of people to get around there and clear them because the antipersonnel mines are mixed with the antivehicle mines and so forth. It is an advanced state-of-the-art sort of thing, and we presently have no mine of this sort available within our production inventory.

"The Lance XM251 conventional warhead which contains a large number of the Air Force BLU-26 anti-light materiel bomblets, has been spectacularly successful in recent tests against..."--or were they talking about something else? General Gribble, left, and Dr. Marvin E. Lasser, right, Army Chief Scientist, frequent witnesses at Congressional hearings, in a friendly chat with Maj. Gen. W.K. Ghormley, executive vice-president of the American Ordnance Association, at a mine detection symposium in 1971.

A 105mm. "Field Artillery Direct Support Weapon System" for the Army ($3.3-million) and a $1,250,000 "Marine Corps Weaponry" program that "includes /censored/ ordnance, in this case for the 155mm. and large projectiles. We have demonstrated as I mentioned in connection with my statement, that we can make a gun projectile /censored/ so we can now provide close support gunfire to marines with a projectile that can hit directly on the /censored/ designated by the marine on the ground," a Navy witness explained at the 1972 hearings.

> "Close supporting fire" is defined by the Joint Chiefs of Staff as "Fire placed on enemy troops, weapons, or positions which, because of their proximity, present the most immediate and serious threat to the supported unit." "Direct support" is defined as "A mission requiring a force to support another specific force and authorizing it to answer directly the supported force's request for assistance." Both definitions suggest a battlefield situation and in such a situation, what could be better than antipersonnel ammunition for wiping out those "enemy" troops?
>
> The Army's "direct support" program goes back to 1965-66 when GENERAL ELECTRIC CO. under Army contract DA11-070-AMC-1169W made a "Feasibility study of a 105mm. rapid fire direct support artillery weapon." The idea was to give a 105mm. Howitzer a "rapid multi-shot capability" by converting it so that it could fire several shots in rapid succession. Think of the thousands of fragments you could produce in a few seconds this way!

9 The Developers

Many institutions have aided the military in its quest for ways to "destroy or obstruct personnel." More than 60 companies, universities, and research institutes have done developmental work on antipersonnel weapons under military contracts as documented in this booklet. Some have contributed their special talents: Watchmakers, familiar with timing devices (General Time, Elgin), have worked on ordinary fuzes; electronics firms (Motorola, Zenith, RCA) have worked on proximity fuzes. Some deserve mention for outstanding work on particular lines of weaponry: Case Institute for its studies of aerial mining, General Electric for Gatling-type guns, Ford for grenade launchers, Whirlpool for Beehive projectiles. But of all the institutions, four take top rank--Avco, Aerojet-General, AAI, and Honeywell--and of those four, Honeywell is unquestionably first.

AVCO CORP. was frank enough to say in its 1965 annual report that "antipersonnel weapons" and "special weapons for limited warfare" were two of the "operations, products, and services" of its Ordnance Division at Richmond, Indiana. Avco has worked on an 81mm. proximity fuze, a "repeating antipersonnel mine," the CBU-18/B antipersonnel cluster bomb, and the Deneye aerial land mine. Avco has also, largely on its own initiative, developed "Avroc" ammunition that would make it possible to shoot 40mm. grenades into jungles. Avco's main production line for the war in Vietnam has been helicopter engines but the company's Ordnance Division in Indiana has also had millions of dollars in production contracts for antipersonnel munitions.

AEROJET-GENERAL CORP. is a large defense contractor specializing in rocket engines; its work on antipersonnel weapons has been done at its branch in Downey, California. In the 1950's Aerojet developed what was probably the improved, M18A1 Claymore mine, and in

the 1960's Aerojet developed the SUU-14 cluster bomb dispenser, the Sadeye dispenser (for "guava" bomblets), and a low velocity 40mm. grenade launcher. Aerojet and its manufacturing subsidiary, BATESVILLE MANUFACTURING CO. in Arkansas, have had many millions of dollars in production contracts for antipersonnel cluster bombs and 2.75-inch rocket warheads.

AAI CORP. got into the antipersonnel field with its studies of "fin-stabilized fragments" and flechette ammunition test rifles in the 1950's. AAI has been the principal developer of the Army's forthcoming flechette rifle, the Special Purpose Individual Weapon (SPIW), and has worked on 40mm. "scatter ammunition" and other improvements in 40mm. ammunition since 1960. AAI has also worked on antipersonnel mines, and at present is working on the Vehicle Rapid Fire Weapon System (VRFWS) in hopes of large production contracts that may come to it some day.

HONEYWELL INC. has a most impressive list of accomplishments. Since 1963 the company has been working on air-delivered "area denial" munitions, and in 1969 it began working on the Area Denial Artillery Munition (ADAM); its latest contracts on these projects were awarded in late 1971. In 1964 Honeywell came up with a report on "unique booby trap devices" and since 1965 it has been working on mass production equipment for components of the Special Purpose Individual Weapon (SPIW). In 1968 Honeywell received a contract for work on the BLU-3/B (probably the "pineapple" bomblet); Honeywell also developed the Rockeye bomb and has recently done pilot production of a new antipersonnel/antimateriel version of the Rockeye. Honeywell has worked on a number of fuzes, among them 40mm. fuzes and 60mm. and 81mm. proximity fuzes. Keeping up with the changing times, Honeywell has recently been developing a warhead for the Lance missile that contains "guava" bomblets and would avoid having planes shot down as they deliver this important cargo.

Honeywell in particular has come in for criticism because of its work on antipersonnel weapons. In a press release April 28, 1972, Honeywell complained of "harassment" on the part of protestors and took exception to the position "that industry should, in view of today's unpopular war, refuse to do business with the U.S. Department of Defense, or at least exercise a unilateral decision-making function to limit the type of weapons to be made available to our forces--and that this would hasten the end of a war we all want finished.

> We cannot agree with this reasoning /Honeywell's statement continues/. So long as a military or defense establishment of some sort is needed, and most Americans agree that one is needed, the ultimate decision as to types and quantities of weapons to be available and used

must be the responsibility of the Department of Defense, monitored by the national administration and Congress as representatives of all the people.

It is essential for the survival of our democracy that corporations carry out public policies declared by elected representatives of the people. It would be intolerable if every corporation in the land had its own domestic and foreign policies and attempted to use its power to implement them.

An aspect of the current protest that is difficult to understand is the idea of laying at the doorstep of any corporation the responsibility for an unpopular and tragic war. Honeywell has been on record for a number of years as wanting the war ended as quickly as possible. Honeywell people share the same human feelings and respect for life that our critics claim as their justification.

Another idea expressed that we feel needs comment is that the war is somehow good for Honeywell's business. From any standpoint we would prefer to conduct business in a world of peace. War is wasteful. It uses tax dollars that could be better utilized to strengthen the economy and meet the needs of our society... (Emphases added)

Would that all of us shared these lofty sentiments! But don't we all? Isn't there some part of us, some inner recess at least, where all of us want to think well of ourselves?

Why does the chairman of Honeywell (Yale '38, Minneapolis Club, Gulfstream Bath and Tennis Club) sit down with protest leaders ("whose sincerity and good intentions we do not question," the press release says) and refuse to look at pictures of Vietnamese victims of fragmentation bombs--"We've seen them already," he says, in a tone suggesting that he, too suffers when he sees them. Is he really suffering, or is he only trying to take the wind out of the protestors' sails? Why does the president of SCOVILL MANUFACTURING CO. (Hotchkiss School, Yale '44, Woodbury American Red Cross, Connecticut Republican Finance Committee), producer of cluster bomb components, invite a self-announced protest leader to his house for coffee and cakes? Are they black-hearted villains, or are they only lambs who have gone astray?

Publicly, many companies try to maintain liberal images through good works. Honeywell banks on its minority recruitment and training programs in Minneapolis. AMRON CORP., producer of antipersonnel grenade components, takes a piece of an adjoining cemetery and

converts it into parking space for its employees, but makes up for it by donating a room to the local hospital. Companies are also known through their products: Honeywell makes thermostats, Whirlpool makes washing machines, and while this is not presented in the same benevolent way as the "liberal" side of the image--Whirlpool doesn't say "Our washing machines get clothes cleaner, and Whirlpool people are sincere and want the war to end as quickly as possible"--neither do they say "Our washing machines clean clothes, and our flechettes shred Communists and nail them to trees." Quite the opposite, companies are often sensitive on this point and try to keep the general public from finding out about their war work.

Public images are one thing; other images are presented to other interested parties. When a company is talking to its stockholders, it tells them what fortunes it is making (so that they will invest more). When it is negotiating with labor, or when it is talking to the tax collector or trying to avoid installing pollution control equipment, it complains that it is barely breaking even. The public isn't supposed to know about its defense work, but when the company advertises in a defense industry magazine such as Ordnance, or when it is trying to get the government to give it a new contract, it stresses its expertise.

"War is wasteful," as Honeywell says in its press release, but as long as money is being wasted, why not try to get some of it for yourself? In its 1967 annual report, Honeywell assured its stockholders: "Conventional weapon programs promising steady growth potential in future years include the Navy's Rockeye munition-dispenser system and several aerially delivered mine-dispenser systems, which went into volume production during the year." The Air Force cut back on its "mine-dispenser" program in 1970 but Honeywell has had more than $100-million in Rockeye production contracts to date, and if the antipersonnel/antimateriel version of the Rockeye, recently under pilot production by Honeywell, ends up costing $7,000 apiece (as implied in an admiral's testimony at a 1970 Congressional hearing), then Honeywell may be in for some more "growth potential in future years."

Our "elected representatives" decide on "public policies" and cor-

"In the aerospace and defense field, government demand for the types of products we make is up in total and we are advancing in rank among Department of Defense suppliers in both size and performance."

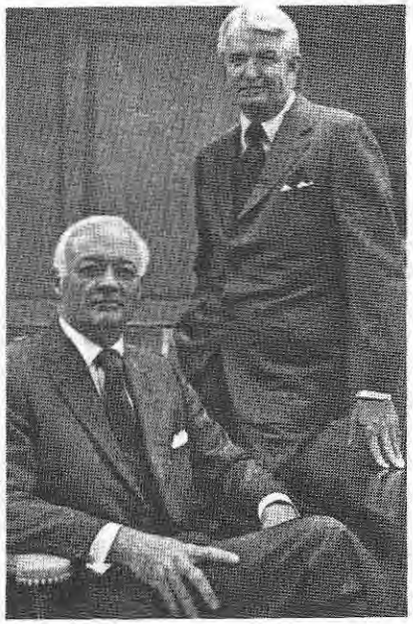
Charles L. Davis
Vice President
Aerospace & Defense Group

Promising news for stockholders in Honeywell's 1967 annual report

porations simply carry them out, but who gets anywhere in the world today unless he can blow his own horn (and why not raise money for Congressional campaigns so that the right representatives will be elected)? In a lengthy proposal attempting to convince the Army that it should be given a contract for development of a new artillery fuze, Honeywell in 1968 stated:

> Honeywell's Ordnance Division has been involved in munition R&D /research and development/ and production for many years, and has an excellent record of carrying these munitions and munition components through development into production. In fact, we feel that during the past several years we have emerged as the country's leading developer and supplier of munitions. We have produced over 200,000,000 fuzes. (Emphases added)

They tell me one thing and the guy down the street hears a different story. It all goes back to organic solidarity and the "need-to-know." The way the companies see it, everyone will be better off if some people "know" one thing and others "know" something else. Here is where the protesters have an important and useful job to do. By breaking down the barriers between separate realms of "knowledge," by making connections and exposing contradictions that the companies would rather brush under the rug, the protesters are breaking down old relationships in society and opening the way to the formation of new relationships and new concepts of society.



James H. Binger, chairman, and Stephen F. Keating, president, posing for a portrait for Honeywell's 1971 annual report. Honeywell people share the same human feelings and respect for life that their critics claim as their justification.

But there is also an internal problem, one that is within us. Do the company men, in some sense, believe their own lies? Can't a person say two contradictory things and believe both of them?

In his book Culture Against Man, the anthropologist Jules Henry offered the interesting suggestion that there are two contradictory sets of urges in contemporary America: "drives" such as dominance, achievement, and competitiveness, which animate the world of business, and "values" such as kindness and generosity, which belong to family life and friendship. Henry wrote: "...in our culture a central issue for the emotional life of everyone is the interplay between these two."

The director of a munitions company is like a madman: He plans for making money by "destroying or obstructing personnel," yet he shares the "human feelings and respect for life" of the protesters. A munitions designer contributes to the art of murder on an eight-hour-a-day schedule, but he thinks well of himself and is kind to his wife and children. Somehow a different balance between the two sets of "urges" must be achieved, not only among these people, but also among those of ourselves who abhor antipersonnel weapons (in accordance with our "values"), yet can respond sympathetically to the language of Honeywell's press release.

Honeywell says it must carry out "public policies"; this is the extent of its "responsibility." We must seek new concepts of a society in which we are responsible to our fellow men in ways other than to "destroy or obstruct" them.

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