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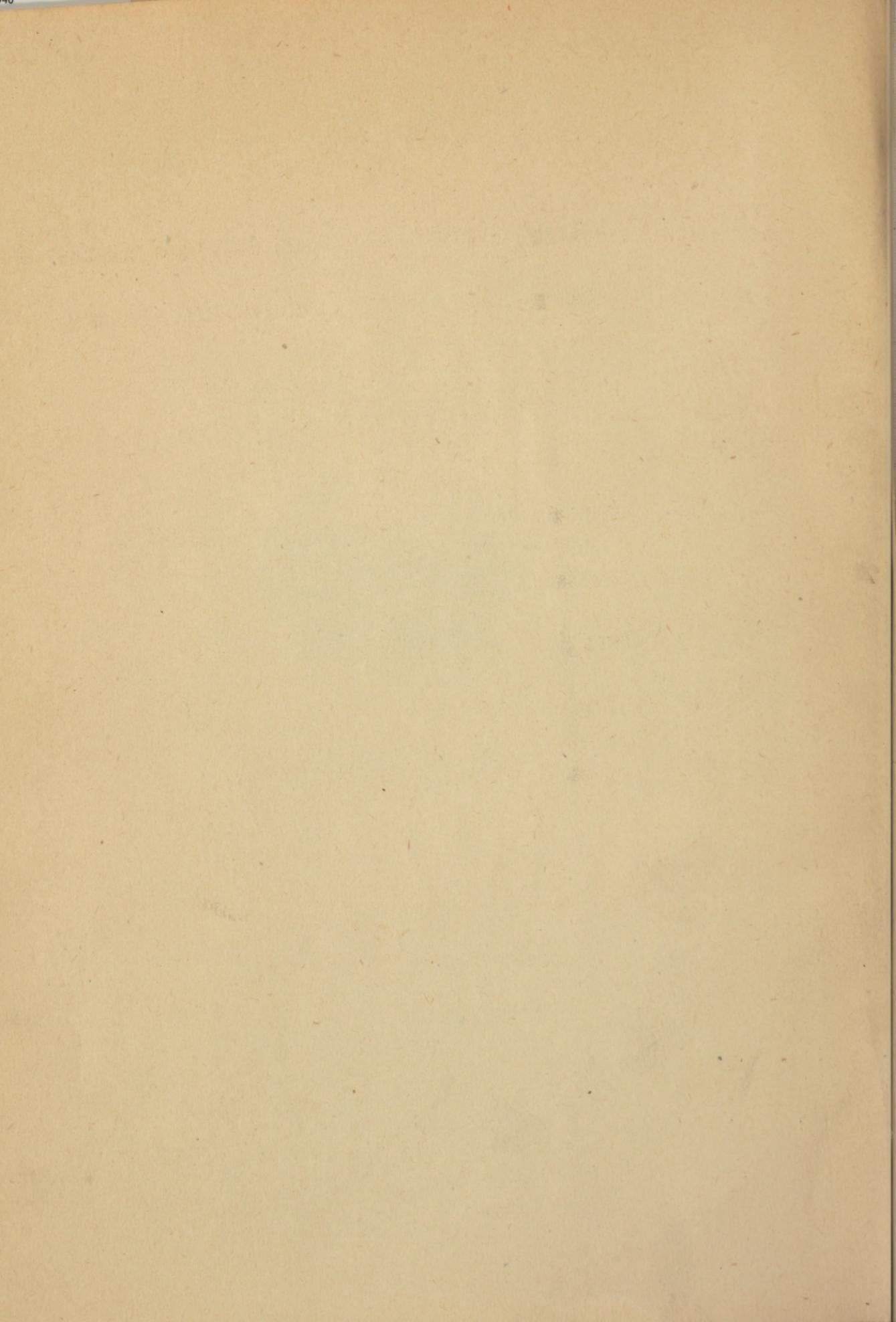
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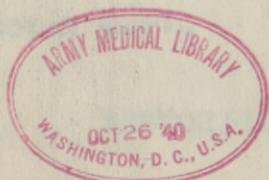
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MEDICAL AND SANITARY CARE OF THE CIVILIAN POPULATION

NECESSITATED BY ATTACKS FROM HOSTILE AIRCRAFT

181535

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bombardment of the residential areas of the civilian population. The objects are, to stop production of necessary supplies MEDICAL AND SANITARY CARE OF THE CIVILIAN POPULATION and to the NECESSITATED BY ATTACKS FROM HOSTILE AIRCRAFT.

181535

(MOTTO: Organization is Better Than Improvisation).
members of the Red Cross has been endeavoring to bring about an international agreement which would secure a strict application of Article 12 of the Geneva Convention. This article pro-

"If England and France oppose me in Czechoslovakia, it will mean war. London and Paris will be bombed by fifty planes, every hour on the hour, until they submit to my will."

When Mr. Hitler spoke those words to Mr. Chamberlain at Munich, in the fall of 1938, he accomplished two important things. First, he sent Mr. Chamberlain hurrying back to London to attempt to delay the inevitable war until the allied countries were better prepared for defense against aerial attack. Second, he brought dramatically to the civilized world a realization that they had failed to appreciate the possibilities of 'total war'.

HISTORICAL BACKGROUND.

The idea of the total war has developed during the twentieth century. According to this doctrine, all the means of weakening the enemy are justifiable, including the intentional

bombardment of the residential areas of the civilian population. The objects are, to stop production of necessary supplies for the military, to disorganize the economic life, and to terrify the people, so that they will bring pressure on the authorities to submit to the demands of the adversary.

Ever since the war of 1914-1918 the International Committee of the Red Cross has been endeavoring to bring about an international agreement which would secure a strict application of Article 25 of the Hague Convention. This article prohibits bombing of a "localité non défendue", but does not define such an area precisely enough to be effective. It was felt to be an obligation of the Red Cross, to find in times of peace a means of protecting the civil population against aerial warfare in times of war. A commission of experts was convoked for this purpose in December, 1931, at Geneva, but their continuing effort to secure effective protection has been consistently checked by a lack of desire of governments to relinquish this powerful weapon of aerial warfare. At present, civilians are far less protected, both legally and materially, than the military. For example, the Red Cross flag or symbol cannot legally be used to shield a civilian or a non-military hospital.

Events in Spain and in the Orient brought to light in a gripping manner the precarious situation of civilians in the new concept of war, but it was not taken to heart by the general population. The bombing of cities in Spain was discounted in the public mind because those wars in which brother has been

arrayed against brother have always been more bitter and ruthless than other wars. That in China was not appreciated because both parties were of the yellow race, and few civilians believed that members of the white race would use such means of warfare against other white nations. Mr. Hitler rudely awakened the world from that dream state.

Efforts to have governments agree on legal means of protecting the civil population have so far come to naught. The International committee of the Red Cross has evolved a scheme of hospital cities and safety zones, to be neutralized and protected by international agreement. Everybody agrees that such an arrangement would be highly desirable, but no important government has yet pressed strongly enough for its adoption, and so it has not progressed beyond the talking stage.

THE GENERAL PROBLEM.

Modern bombers can carry as much as 5 tons of bombs for 2,000 or more miles. The bombs may be gas, incendiary or high-explosive. The effects of these on persons and structures have been determined by observation and experimentation. Based on this information, a comprehensive scheme must be prepared which will care for the civilian population in the following ways:

1. Maintenance of public utilities
2. Control of fires
3. Rescue of persons caught in damaged buildings

4. Dangers from ruptured sewer and water pipes
5. Interruption of electric power and telephone
6. Provision and protection of food and water supplies
7. Transporting and caring for gassed and wounded persons
8. Clearing and repairing roads
9. Maintaining public morale.

In Spain and China, more people were killed and injured by fragments from bombs, and falling hardware from anti-aircraft shells, than suffered from direct hits. Most civilian injuries and deaths occurred because the people were not taught how to protect themselves. The first step in their care is to protect them, using knowledge gained by the experience of those countries already involved in modern warfare.

WHAT OTHERS HAVE DONE.

When legal means of protecting non-belligerents from aerial attacks proved inadequate, governments turned to material and technical protection. Special departments were formed to organize for safety. Millions of people in Europe were placed in training and enormous sums were spent to provide and equip shelters, aid stations and emergency hospitals. From the medical standpoint, it early became evident that if those injured in aerial attacks were to receive proper care, their numbers must be kept as low as possible. Medical men everywhere have been most active in planning and organizing for public

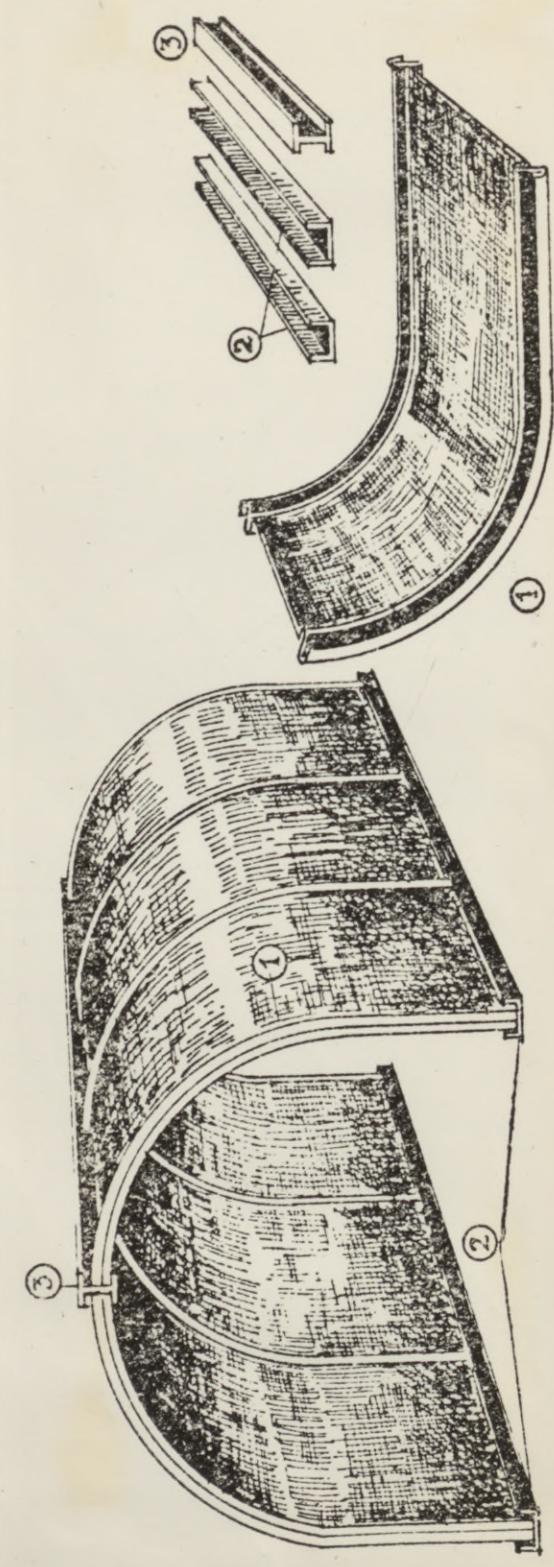
safety.

THE BRITISH SYSTEM: This has been developed as the service of Air Raid Precautions, for which the abbreviation ARP is used. ARP is visioned as action to maintain the life of the country in spite of every attempt by the enemy to disorganize it. So far, it has continued as a voluntary system under an advisory governmental committee. Two coordinating groups exist, one of which decides matters of policy, while the other controls technical civil defence. There are 1574 local authorities, each of which is made responsible for preparing an ARP scheme adapted to its local conditions. The cost amounted to more than £ 70,000,000 for the first year, and this is swelling enormously during the second year. As early as June, 1939, an editorial in the Lancet stated that ARP was becoming an ogre in its powers of devouring recruits for its service. Concentration of attention soon shifted from defense against gas to protection from high-explosive and incendiary bombs. Some of the ARP activities are of special interest to the medical man, within the scope of this essay.

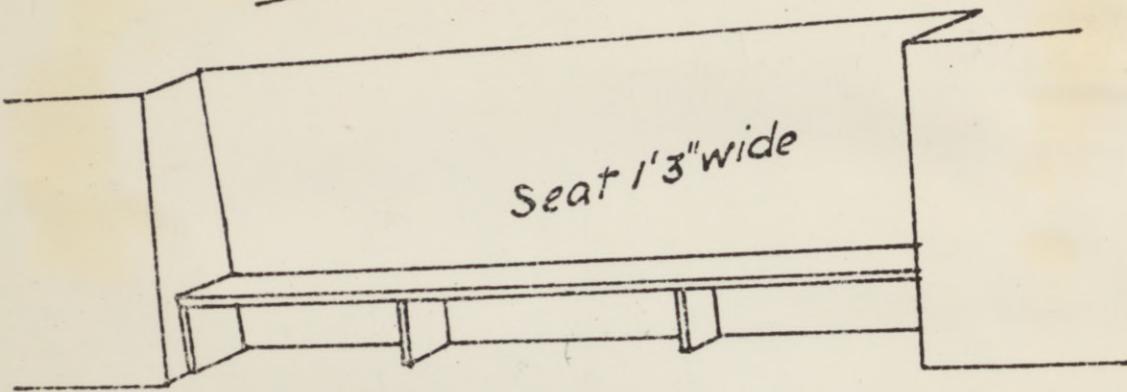
a. PROTECTION: Shelters have been developed for the individual home, and for larger groups (Figures 1, 2, 3 and 4). Pamphlets giving full directions for their construction are on sale at all news stands, and the materials for the single-family shelters are on sale for as little as £ 5. Elaborate group shelters have been built in basements of factories and office buildings, strong enough to withstand collapse of the

SECTION
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rubble

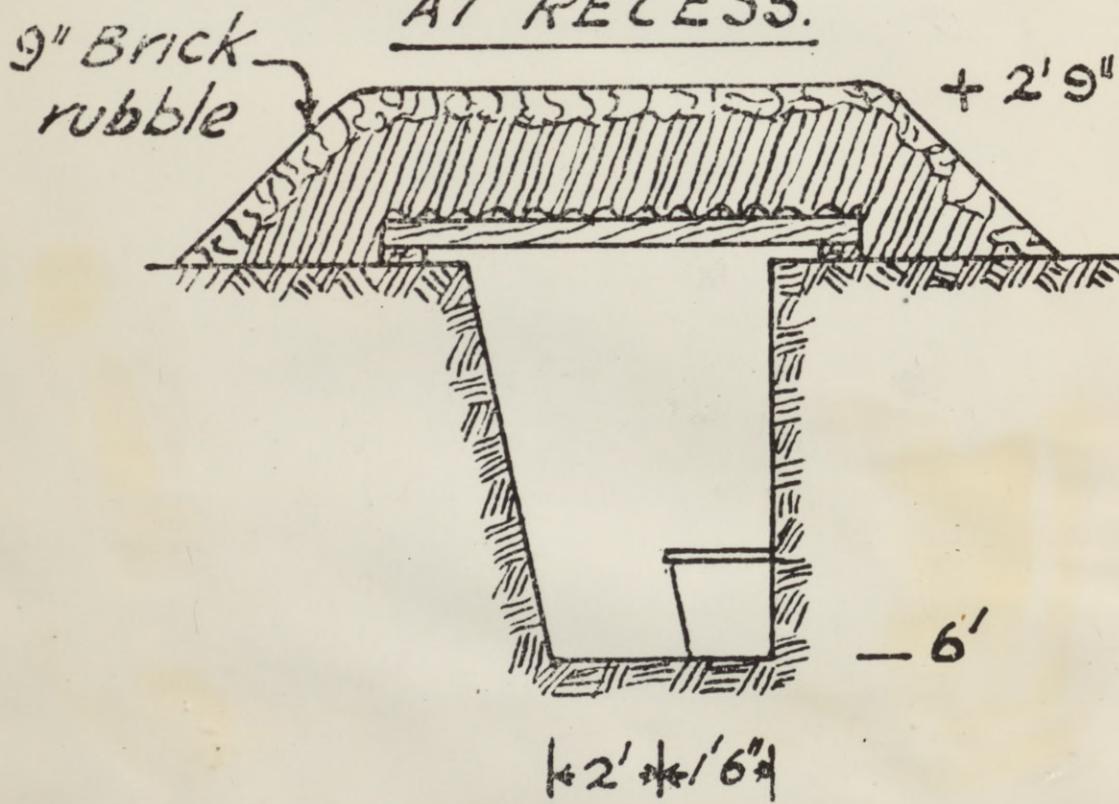
Fig. 1



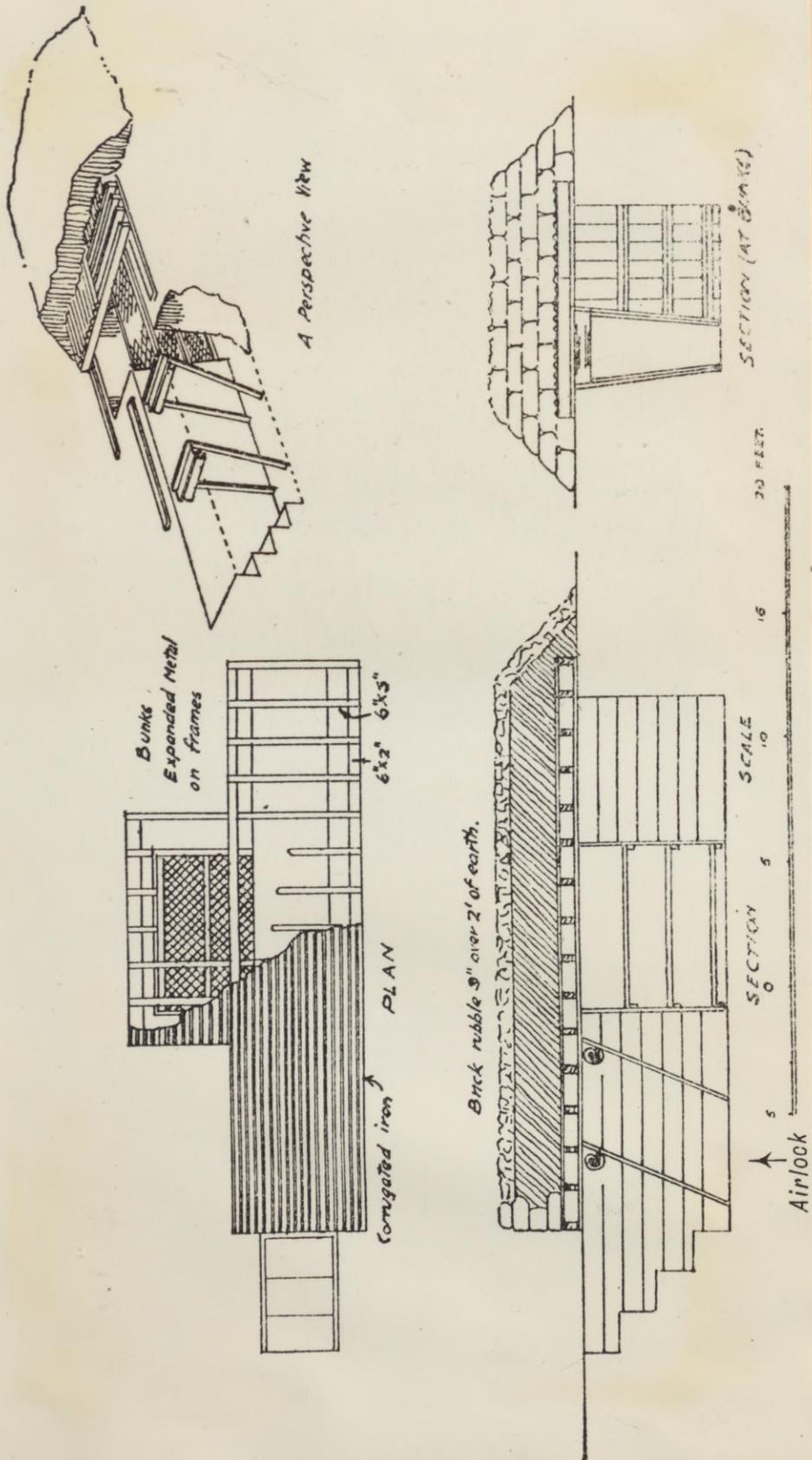
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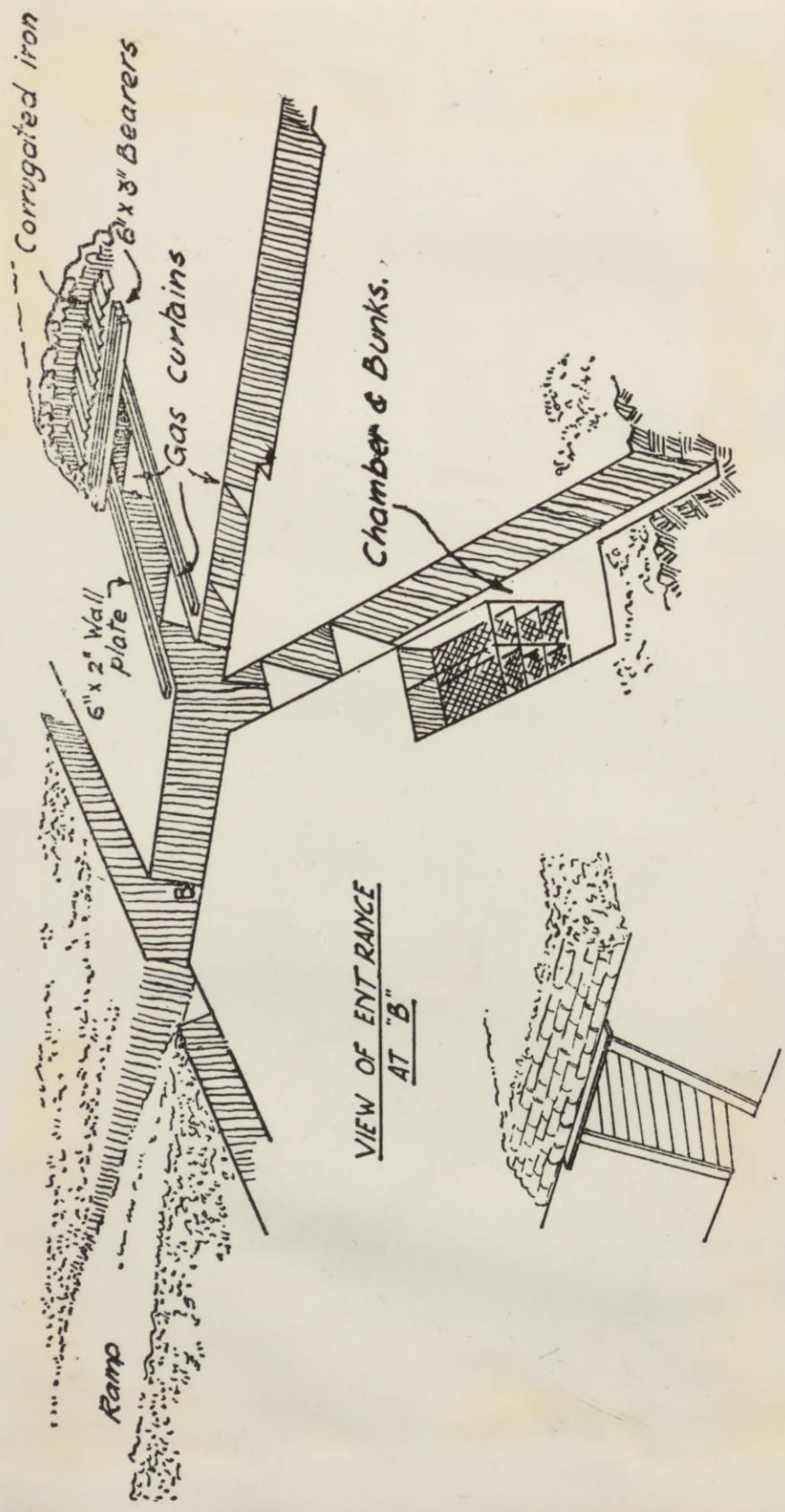
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Temporary refuge for business section of a city



Bomb refuge with Bunks



Arrangement of community bomb shelters

structure. Millions of sandbags have been accumulated to protect against flying missiles. Shelters for 1,500,000 persons have been prepared in London. Gas masks have been provided for the whole population, with special types for babies, workers, domestic animals and other groups (Figures 5 and 6).

b. EVACUATION: Nearly two million of London's 8,500,000 people were evacuated immediately after war was declared. First to go were 129,000 mothers and children (Figure 7), 2900 expectant mothers, 3200 blind persons and all patients in city hospitals who were not too ill to move. This increased the number of beds in London hospitals available for air-raid casualties to 200,000.

c. CASUALTY SERVICES: Hospitals: London has been divided into 10 sectors radiating from the center. The great city hospitals are located at the centers of the sectors, and become casualty clearing stations. At the periphery of each sector, in the country, is the base hospital to which casualties will be evacuated. At first, provisions were made to handle 50,000 casualties a day (Figure 8), but this was later considered to be an under-estimate. The casualty clearing stations provide 30,000 beds for immediate treatment, and it is intended to remove all patients, who are not too seriously injured, from them as rapidly as possible. Twenty-eight evacuation trains were provided for interhospital ambulance service, with 350 coaches which have been converted for use as ambulance cars.



Paris: Special gas mask for
for two small school children.

Fig. 6-

large; ~~specify~~ see mark for
small second edition



London

'Paris: Special civilian type of gas mask
for two children and an adult.

Fig. 6

Parties: Society of Friends of the Poor
for poor children and adults



London: Children with gas masks, blankets and food, being evacuated to the country.

First aid

Fig. 7



First aid squads.

Reporting centers are provided for each district. In each district there are first-aid squads, which are organized into hard hit areas. These squads consist of medical men, nurses, and auxiliaries. They are trained to handle various types of casualties. They are equipped with ambulances, first-aid parties, stretcher bearers, fire units, and decontamination squads.

Blood-transfusion services. More than 100,000 volunteers have been typed and are prepared to donate a pint of blood monthly, or when needed. Blood banks and plasma services have been organized, and aid stations are prepared to provide blood for transfusions. Depots for cold storage of blood, with

London : Anti-slavery publication office
for various classes of converts

The base hospitals are huts of steel or concrete, contoured into the hillsides to make them inconspicuous. Each hut has 50 beds and the special personnel and equipment for its work. Underground operating rooms have been constructed in the hospitals, with special electric and water supplies independent of the main supply.

Aid posts have been provided in London, with decontamination stations and mobile units to evacuate them. These are fixed posts, mostly located in hospitals or in adjacent, substantial buildings with access for trucks and ambulances. They have mess hall, kitchen, rest rooms, offices, special rooms with gas locks for undressing, bathing and decontaminating gas cases, whether injured or not, and separate rooms for men and women. Their personnel includes stretcher bearers, first-aid parties, debris parties, chauffeurs and decontaminating squads.

Reporting centers are provided for coordinating all these activities, and providing special help for areas that are hard hit. They are equipped with telephones, messengers, spare ambulances, first-aid parties, stretcher bearers, fire units and decontamination squads.

Blood-transfusion service: More than 100,000 volunteers have been typed and are prepared to donate a pint of blood monthly, or when needed. Blood banks and plasma services have been organized, and aid stations are prepared to provide blood for transfusions. Depots for cold storage of blood, with

apparatus for collection and storage, have been arranged. A movement is on foot to have the entire population blood-typed. In the Spanish war it was found that an additional 10 percent of air raid casualties could be saved if blood for transfusion was available.

d. AIR-RAID WARDENS (Figure 9) act as a link between the local government and the public. Their duties are to help, advise and encourage their neighbors; to assist them to shelter; to summon skilled help to deal with casualties and damage; to furnish an example of steadiness, and to help to maintain public morale.

Other nations have civil-defence systems which vary according to the type of government.

Germany has a compulsory system, an integral part of the government, which includes every civilian, no matter what the sex or age. The organization for aerial defence is placed by law under the air minister. Formation and instruction of aid groups is a duty of the League for Aerial Defence (Reichsluftschutzbund). There are more than 3,000 schools of passive defence, designed to familiarize the population with its duties in emergencies. Additional instruction is given in all the schools and colleges. The work is guided by 72,000 official and 650,000 volunteer functionaries. Thursday is devoted to exercises in passive defence.

Great attention has been given to safeguarding existing hospitals. New ones must be built on sites remote from



London: Air-raid mobilization.
Civilians being directed to nearest
shelter by air-raid warden.

Fig. 9

industrial, military or administrative centers which might be made targets for aerial attacks. New hospitals must not have more than 600 beds, unless in widely-separated pavilions. They must not have more than 2 or 3 floors. Air-raid shelters must be provided for staff and patients, and specially-protected operating rooms are required.

France had a national committee of passive defence, under the control of the minister of national defence. It provided for instruction of great numbers of persons in the various aspects of protection against gas, high-explosives and fire. Sanitary caravans of cars provided by volunteers were used for transporting evacuees, doctors, nurses, social workers and supplies. The American Hospital, in Paris, had an elaborate operating suite, with first-aid facilities and wards, built underground. There were several entrances, and the construction was designed to make this area safe even though the building collapsed.

All these countries have very elaborate organizations of women, who relieve the men of duties such as gas-mask training, care and preparation of food, clerical work, communications, chauffeuring, and many other functions (Figure 10).

Italy and Roumania have systems very like that of Germany, in which every person is assigned individual duties of aid to the nation, and of civil defence in case of air attack, with mass and individual instruction in those duties.

It may be considered that undue attention is paid in this essay to organization and advance preparation, as contrasted



Paris: Women mobilized with gas masks and gas-proof
rubber suits for air-raid rescue work.

Fig. 10

with medical attention. But the title assigned includes "sanitary care". According to Mr. Webster's latest edition, the word 'sanitary' includes matters "relating to preservation or restoration of health; occupied with measures or equipment for conditions that influence health". The writer is convinced that organization, training and planning for the casualties of air attacks are of tremendous importance in the sanitary care of the civilian population.

The aerial bombing of Poland provided a tragic example of the influence on health and life when advance planning is neglected. Missles fell, buildings crumbled and fires started. The wounded were rushed to the hospitals, some of which were fortunately unharmed. The wards and corridors were quickly overcrowded with victims and their relatives. Urgent calls were sent out for doctors, nurses, stretcher bearers and blood donors. Those responding to the calls found the streets about the hospitals so crowded that they could not get in to offer their services. Those within were so beset with crowds of wounded and their terrified relatives that they were able to accomplish very little, and many died who might have been saved under better conditions. This illustrates the importance of organization, training and planning, as sanitary matters 'relating to preservation or restoration of health'. Organization is better than improvisation.

WHAT WE SHOULD DO.

None of the organizations of the other countries quite fits our form of government, or the mental attitude of our people. Large areas of our country require no protection, either because they are sparsely populated or because they present no vital centers or activities which would merit the attention of the enemy by such a costly weapon as attack from the air. But almost every large community has vital activities, such as administrative, industrial or transportation centers which are well worth a few bombs or parachutists from the enemy. In every one of these an effective organization is necessary, not only to save the lives of the local people, but also for its effect on the national morale.

Full use should be made of existing local and national organizations. For instance, the Red Cross has some 3700 local chapters, each with its disaster-relief committee and persons experienced in handling emergencies. The American Legion and other veterans organizations are prepared, in many localities, to aid in handling disasters of all sorts. Boy Scouts, Girl Scouts, Campfire Girls and similar groups form an organized and disciplined body full of desire to be of aid to the community. Firemen and policemen should be the nucleus of the civilian organization.

The following is suggested as an outline suitable for an American community.

GENERAL ORGANIZATION.

THE STATE: Transportation and care of evacuated persons.

THE LOCAL GOVERNMENT:

1. Evacuation.
2. Shelters, individual and collective.
3. Utilities - protection and repair of water systems, sewers, gas, electric power, telephones, etc.
4. Transportation - ambulances, trucks, busses, private cars, drivers.
5. Special services:
 - a. Fire
 - b. Police
 - c. Rescue, demolition and road clearing
 - d. Sanitary
 - e. Decontamination
 - f. Communications
 - g. Reporting and liaison
6. Casualty services:
 - a. Hospitals, existing, and new construction
 - b. First-aid posts, major and minor
 - c. Personnel - doctors, nurses, dentists, orderlies, stretcher bearers, technicians
 - d. Equipment and supplies.

EVACUATION: Persons whose presence is not essential to the life and work of the community should be evacuated when

air attack is impending. This includes the sick, cripples, expectant mothers, infants and small children. Since they must pass out of the control of the local community, their transportation and care should be under the control of the state, though their selection and preparation for moving are matters for the local authorities to arrange. Once they are loaded on trains or busses, they should be in the care of the state authorities.

SHELTERS. These details have been so thoroughly worked out by others that it remains only for us to decide on the best types, and then prepare for their mass production. This seems to be a matter that could be well placed under the Red Cross. They have a large and active group of workers who are skilled in dealing with disasters and rehabilitation, closely coordinated with the national headquarters. They have the confidence of the community, and the financial backing which would be necessary. The contact with the Federal Government is very close, so that the Red Cross is spoken of as a quasi-governmental activity. To take over the work of providing the individual and collective shelters for all the people would mean only a moderate expansion of existing facilities, and for this they are always prepared.

No perfect means has yet been found of giving complete protection from bombs to all the population. The best we can do is to afford protection from splinters and gas. Fortunately, the effect of the blast decreases with the cube of the distance. The ordinary household shelter, as developed in European

countries, will usually protect from the effect of a bomb exploding 50 feet or more away.

The ideal shelter would protect from the immediate effects of the blast and suction of the counter blast, from flying splinters, from aerial machine gunning, from crushing by falling debris, from burning by fires or explosions, from effects of poison gases, from suffocation, from drowning by broken water or sewer pipes, from electrocution by damaged electric conduits or wires.

UTILITIES. Provisions for maintaining service of water, gas, electricity, sewers and other public requirements make a most intricate problem, but the technical details do not differ greatly in the various communities. It seems probable that the national societies of engineers in these specialties, together with the U. S. Engineer's Office, would prepare plans and instructions which would be of universal application.

TRANSPORTATION. This would need to be in firm hands, possibly the police or a veterans organization. During and after an air attack there would be need of great numbers of trucks fitted as ambulances for the disabled. Private cars would be needed for transporting stretcher bearers and units of the special services, whose aid would be essential. Experience of others indicates that, if vehicles are not strictly regulated, the streets will be congested with sight seers, panic groups and others, who will obstruct necessary traffic.

SPECIAL SERVICES.

- a. **FIRE:** The general public must be instructed in the

method of action of incendiary bombs and the proper manner of fighting the multiple fires caused by them. The regular firemen must be augmented by squads of men with as much special training as possible. Since these bombs produce heat of 1200 to 2500 degrees C. the burns caused by them constitute a special problem.

b. POLICE: The regular force must be supplemented by veterans, and trained as are the air-raid wardens in England. Their main duties are, in time of air attacks, to sound warnings, to report damaged areas, to help people to shelter, to give first aid, to prevent panic, and generally to aid in limiting damage to persons and property.

c. RESCUE AND DEMOLITION PARTIES: They should be trained to save persons trapped in burning or damaged buildings, to control floods due to damaged water or sewer pipes, to shore or demolish buildings which have been rendered unsafe, to clear and repair roads. Without the assistance rendered by this group, many persons will be unable to reach the aid stations for treatment.

d. SANITARY SQUAD: Their duty is to reestablish as quickly as possible the sewers, toilets, waste removal and other sanitary services. When these are wrecked, men quickly revert to the habits of other animals and deposit their excreta promiscuously. This tendency appears very quickly after any major catastrophe, and is a serious menace to public health. Collection, identification and disposal of dead humans and domestic animals is also their duty, and it may prove a big

problem. Nobody who has not actually had the job of disposing of large numbers of dead bodies can conceive the difficulties involved.

e. DECONTAMINATION SQUADS: These have the task of counter-acting gas contamination of areas, buildings, vehicles and materials. They should be specially trained in first-aid treatment of gassed persons.

f. COMMUNICATIONS: These must be maintained so that help can be summoned for fires, for gassed or injured persons, or any other emergency. Telephones, radio and messengers are the most valuable means, and they are controlled through the report centers.

g. REPORT CENTERS: These are the nerve centers of the organization during an emergency. They receive the reports of damage and notify the special services which are required. They are the headquarters where the special service squads and their equipment are concentrated, and they may well be located adjacent to the first-aid posts.

CASUALTY SERVICES. These should be organized and controlled by the local medical society. A close liaison with civil authorities and special service groups will be necessary. In England doctors 35 or younger are assigned to the military services, those over that age to the ARP and emergency hospital organizations. In our last war, 68 percent of physicians were found unavailable for service in the Army. Most of these would

be suitable for care of civilians in air raids.

a. Hospitals: Existing hospitals must be made as safe as possible, but often those within the target area will be buildings of considerable age. Alterations must be made which will enable them to carry on their functions during and after an air raid. The following measures should be adopted:

1. Protection of sick and wounded against fire, missiles, and collapse of the building, by shoring, sand bags, etc.
2. Protection from damage by rupture of water mains, sewers, gas mains, steam pipes and electric conduits.
3. Provision for emergency heating, lighting and water supply.
4. Protection of drugs and supplies from gas, fire and water.
5. Protection of food and its services, kitchens and laundries.
6. Provision for first aid and reception of patients.
7. Fire-fighting and repair facilities.
8. Protected entrances for unloading supplies and patients.
9. Decontamination facilities, safe operating rooms, rest rooms for patients and staff.

Hospitals which are unable to provide these necessaries should be evacuated until the emergency is over.

Hospital beds must be provided in rural areas, to which

patients from the target area can be speedily evacuated. Many new structures will be necessary. They must be located where they can be effectually concealed from observation by enemy planes, and must be structurally fitted to survive bomb attacks. They must not seek the protection of the red-cross banner, for experience in other countries has shown that, instead of protecting, it acts rather as a magnet for attacks. Concealment and camouflage give greater safety. Their personnel and equipment must be those of a complete modern hospital and, in addition, they must be specially fitted to care for large numbers of gassed and burned persons. Gas-proof store rooms will be required for food, medical supplies, linen and clothing. Wards, living space for the staff, operating and receiving rooms must be gas proof and bomb proof.

The new Westminster Hospital in London has been protected by a 6-inch layer of concrete over the whole area of the roof and of the two floors next below the roof. Additional columns were necessary to support the added weight. It is believed that this will protect against penetration of even the largest bombs. One must not lose sight of the fact that most bombs still have some forward motion when they strike, and impact is almost always at an angle, so protection of side walls is equally necessary.

Separate shelters will be needed for patients with contagious diseases, for children and for mental patients. Hospitals

in target areas will need special facilities for treating shock, burns, crushing injuries, face and jaw wounds, and neuroses. Specialists in all branches should be assembled for any emergency. Teams should be specially trained in resuscitation, transfusion, and handling of gassed persons, for faulty handling may contaminate the whole area. Hospital teams should practice working with gas masks on.

AID POSTS: These differ materially from the ordinary first-aid post. The serious nature of air-raid injuries makes early and complete surgical treatment imperative, so these posts must be equipped and staffed for major surgery. Their work must be carried on during the attack, and the patients evacuated as soon as possible after it. One thousand air-raid casualties average 300 killed, 100 walking, and 600 seriously injured, so the number of slightly injured will be relatively small.

They should be located in basements of concrete buildings, made gas proof, and stout enough to withstand collapse of the building. Several protected entrances should be provided, for one or more may be blocked by debris. They should have spaces for:

- a. Wounded or gassed who are not contaminated with persistent gas.
- b. Wounded or gassed who are contaminated with persistent gas.
- c. Unwounded persons who are contaminated with persistent gas.

Where possible, separate facilities should be provided

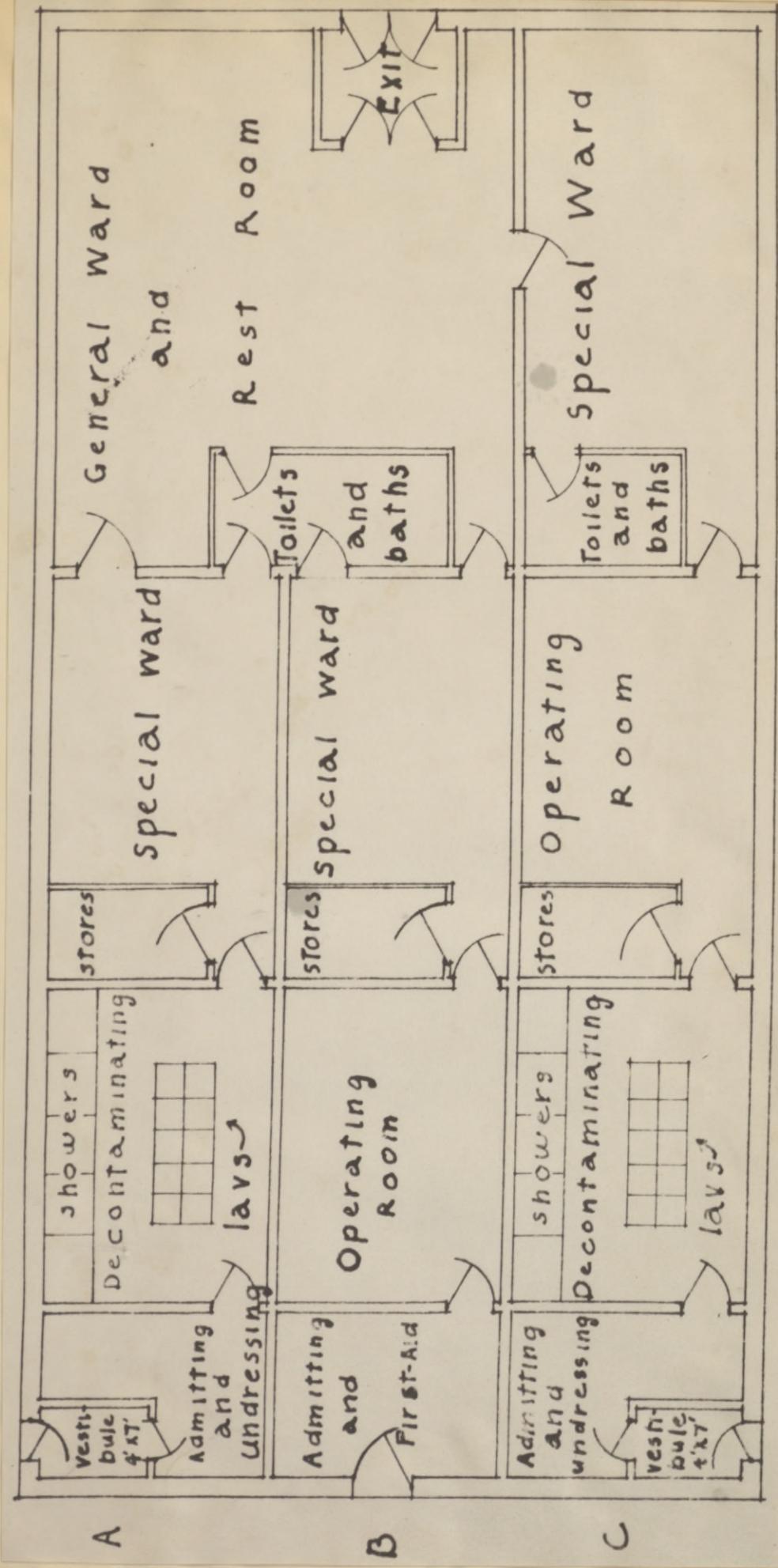


Figure 11. Layout suggested for an aid station. A. is for gassed, not wounded; B. for wounded, not gassed; C. for those both wounded and gassed.

for the two sexes. If complete segregation cannot be provided, all contaminated persons should be admitted into one room, all uncontaminated ones into another. Persons working in the contaminated section must be thoroughly trained, so that they may not suffer injury themselves, or contaminate clean areas of the post.

REPORTING CENTERS: Sufficient mention has already been made of these to indicate their functions, equipment and personnel. They should be in a protected place, and continuously manned by one or two persons. When information of damage or casualty within their area is received, they should be ready to send ambulances, first-aid parties, stretcher bearers, decontamination squads, fire fighters, rescue or demolition squads, as needed.

Observers in Europe report that the personnel of the casualty services appeared to be insufficiently informed about their duties, and that the telephone service usually failed soon after the air-raid warnings were sounded. Training in handling of gassed cases was considered most deficient. Fortunately, there has been little gas used thus far, for it has been found that more havoc per pound of plane load can be wrought with high-explosive and incendiary bombs. However, this may quickly change as war moves into another phase. The popular horror of gas increases the danger of panic when it is used, and so it is doubly important to have the personnel

well trained in handling of gassed persons, and in decontamination.

TYPES OF CASUALTIES.

We have available a large number of reports from observers in China, Spain, Poland, Finland and other countries whose civilian populations have been subjected to attacks from hostile aircraft. These give a very clear picture of the classes of injuries and disabilities that we may expect, and must be prepared to handle. The principal ones are:

1. Neuroses.
2. Burns.
3. Penetrating, perforating and lacerated wounds from missiles.
4. Crushing injuries from collapsing buildings.
5. Fractures, simple and compound.
6. Special wounds, head, face and jaw, chest, abdomen, etc.
7. Shock, primary and secondary.
8. Hemorrhage.
9. Gas.

Neuroses.

Human nature being what it is, and human behavior not always what it should be, reactions to impending and actual danger are most variable. We can learn from the experience

of other countries what to expect in our own. In the early stages of organizing and training the public we must expect to observe every attitude from enthusiastic cooperation to ridicule and opposition. As danger nears, there will be panic of various degrees. Actual bombing, especially if severe and repeated, usually produces in the survivors a grim determination to live and to continue the resistance. This was observed in China, and also in Barcelona, where air attacks were bitter and prolonged for months. The number of neuroses was much less than was expected. Many of the psychiatrists were transferred to general medical work.

Gases are likely to cause panic, and if arsenical dust is used, it may produce a wild delirium in its victims. Such persons may rush about, screaming, and cause great confusion. They require firm handling and definite treatment.

It is commonly observed in times of danger that those persons whose conduct in the emergency has been such as to satisfy their own ideals do not develop neuroses. Those who feel that they have shown cowardice or inadequacy are apt to produce some neurotic ailment, as a subconscious effort to salve the wounded ego and to change public opinion of them from contempt to sympathy. The use of gas and machine-gunning from aircraft appears to have produced more neuroses than has the use of high-explosive or incendiary bombs. Knowledge of these facts should aid in planning for the care of those who develop neuroses.

Burns.

In the European arena, burns have been very frequent after air attacks on civilians. They have varied so greatly in type as to tax the ingenuity of the most resourceful clinician. Some have been caused directly by near-by explosions; others from the molten metal or the fierce heat of incendiary bombs; very few from mustard gas or phosphorus. Many persons have been rescued from burning wreckage of buildings, with burns of various degrees and extent.

Reports of the use of tannic acid, either with or without silver nitrate, have not been very favorable. The British have never accepted this therapeutic measure with any great enthusiasm, and have apparently applied it mostly in the form of ointment. This is much less effective than the fresh solution, and its use makes it more difficult to secure proper tanning after the emergency is over and the time for definitive treatment arrives. Despite the criticisms from abroad, the tannic acid method has produced such good results in the hands of many surgeons in this country that first-aid stations and hospitals should be prepared for its use. A convenient method is to use a considerable number of 500-c.c., wide-mouth bottles, each containing an amount of tannic acid powder that will, when the bottle is filled with water, make a fresh solution of the desired strength. The choice of individual surgeons ranges from a two-percent to a 20-percent strength.

Bombs of thermite produce sufficient heat to cause extensive charring of the body. It is a mixture of iron oxide and finely-powdered aluminum, with a suitable detonator. Heat of 2000° C., or more, is produced when these substances combine, and the molten iron is scattered about. Burns so caused are likely to be deep and severe, and even small burns are extremely painful. They are said to do very well with the tannic-acid treatment.

Mustard-gas burns require careful prophylaxis and after treatment. Any drops remaining on the skin should be carefully removed by dabbing with absorbent gauze or blotting paper. Then the involved area should be cleaned with a solvent, such as kerosene, alcohol or carbon tetra-chlorid; with an emulsifying agent, such as soap and water applied with a scrubbing brush; or with a neutralizing chemical, such as bleaching powder made into a creamy paste with water. When seen in the blister stage, the vesicles should be opened aseptically and the raised skin excised. Tannic acid treatment has been found effective.

Mustard-gas burns of the eyes may cause protracted blindness, for damage to the surface of the cornea is rapid and intense. Irrigation with two percent solution of sodium bicarbonate appears to be helpful, but one should not expect too much from any local application. Mustard combines rapidly with the free amine groups of the proteins in the cornea, to produce a permanent, toxic substance, for which no safe local antidote has yet been found. In experimental animals, the use of cod-

liver oil by mouth, and ascorbic acid intravenously, has helped to reduce the keratitis and conjunctivitis. Cocaine is not recommended, as some claim that ulceration is more likely with its use. Some very positive form of treatment of these patients during the emergency is advisable, otherwise the pain and blindness are likely to make them panicky and difficult to control. Repeated irrigation with warm solution of sodium bicarbonate is recommended, and some advise the use of pantocaine in one-percent solution as a local anesthetic. If the eyes are bandaged, they should be very loosely covered, so that the swelling will not increase the pain.

Some observers report that local application of sulfathiazole and related compounds has been found valuable for burns, especially those due to mustard gas. Their oral use is also said to be beneficial, though less so for burns which have been tanned. Like other phases of chemotherapy, this subject is receiving intense study, but its evaluation is far from complete. Aid stations should be well stocked with these drugs, for it would be inexcusable to neglect this possibility of benefit.

Proponents of the use of a one-percent solution of gentian violet for burns claim that its use prevents loss of fluid, reduces pain by covering the nerve endings, and prevents toxemia. Similar claims are made for a mixture of gentian violet, brilliant green and neutral acri-flavine. Either of these agents may be used with the tannic acid method.

It has long been a moot point, whether the most important

step in treatment of burns is to reduce the loss of plasma, or to prevent the absorption of toxins derived from tissue decomposition. Tannic acid appears to accomplish both to a considerable degree. But extensive burns are usually followed by exæmia and cellular concentration of the blood for which intravenous injections of plasma should be given early and frequently. Plasma is now available in several forms, fresh, dried, or preserved in vacuum bottles. Pooled plasma requires no typing and can be given freely. The claim has recently been made, that plasma from beef blood, obtained at the slaughter house, can be substituted for human plasma. The matter is being subjected to study to determine its value. Intravenous injection of crystalloids, such as sodium chlorid, should be avoided, for they are quickly lost from the circulation, carrying with them a part of the plasma which it is so important to retain. Administration of concentrated oxygen, and the suprarenal cortical hormone are strongly recommended by some authorities, as is the local application of cod liver oil.

A few of the many treatments for burns have been mentioned, to indicate their great number. It would be impractical to try to assemble adequate quantities of all these agents in aid stations. So, it would be well, as soon as the professional staff of the aid posts is determined, to have them choose the exact methods and materials that will be used, and to train all the personnel in their use. This principle should apply not only to burns, but also to fractures, wounds, shock, gas treatment,

transfusion, anesthesia and other procedures.

Wounds.

Civilians in Europe have sustained a wide variety of wounds. The most frequent have been penetrating, perforating and lacerated wounds from missiles, with many crushing wounds from collapsing buildings and falling debris. Shrapnel wounds have been very few, but injuries from secondary missiles such as stones, concrete and glass have been numerous. The many wounds of the head, face, jaw, chest and abdomen suggest the importance of special teams in the personnel of aid stations and emergency hospitals.

Wounds received in air attacks have proved much more serious and extensive than those commonly seen in civil life, and they have usually been multiple.

The antiseptics of the last war receive little attention in wound treatment today. The old timers speak with nostalgic reverence of the wonders they used to accomplish in cleaning infected wounds with the Carrell-Dakin treatment, but its technique is so meticulous and time-consuming that few have time for it now.

Debridement still holds its place as the first essential in whatever mode of treatment we may adopt. There must be careful cleansing of the part, followed by complete exposure of the injured tissues; removal of all clots, devitalized tissue and foreign bodies, with accurate hemostasis. These are the fundamentals, and with them may be combined local and general

chemotherapy, radiation therapy, the closed plaster method, or any special technique that the individual surgeon may choose.

The time element must be considered in deciding on the treatment. There is a variable period, perhaps 6 hours or less after the injury is sustained, before the contaminated wound becomes a seriously infected one. If we can, within this time, remove all the clots, devitalized tissue and foreign matter, thus converting it into a clean wound, we have a good chance for healing by first intention. After 6 hours, our percentage of success will rapidly fall. Perfect debridement is an ideal rarely attained, so we should also use other therapeutic aids.

Zinc peroxid, dusted into the wound, is claimed to have a powerful action against the anaerobes. It has a considerable number of influential advocates, and is being subjected to thorough study to determine its exact value.

Sulfanilamide and its derivatives are assuming great importance in wound treatment, both as local applications and for internal use. In addition to their action against the streptococci, sulfathiazole in particular has been shown to have strong bacteriostatic action against staphylococci and some of the anaerobes. These drugs can be given even though the patient is in severe shock. They have been found extremely valuable in belly wounds, for they are active against most of the intestinal bacteria. Soldiers of several armies in Europe were provided with doses of sulfanilamide in their first-aid packets, with

instructions to take the drug immediately if they were wounded. It was planned to replace this drug with sulfathiazole as soon as production of the latter was adequate, but the fortunes of war may have interfered.

Experimentally, it has been found that if there is a small amount of one of the sulfonamide drugs in the circulating blood when streptococci reach the tissues, bacterial growth is inhibited. Since many war-time infections develop after reaching the hospital, it is recommended that the drug be continued for at least 4 days. Sulfathiazole in 3-gram doses, 3 times a day, is most strongly recommended for this prophylaxis, and it is also valuable for established infections. It is stated by some that sulfathiazole produces a dry wound when used as a local application, while sulfanilamide produces a wet one, indicating a preference for the former, but some surgeons prefer sulfanilamide.

These drugs have little direct bactericidal action, but they delay bacterial growth, and do not seriously interfere with the body's own protective agents. At present there is no consensus on the best dose or technique for their use, but they are suited for use in wounds due to air attacks, and the treatment is too promising to be neglected.

The closed plaster method of treating wounds was found very valuable during the Spanish civil war and has been adopted in other warring countries. In Barcelona, where air attacks on the civil population were daily events for long periods, more than 25,000 cases were so treated, and the excellent results indicate that it would be well suited to our needs under similar

conditions. Deaths, serious complications and secondary amputations were very few as compared to other methods of treatment.

Trueta, the principal advocate of the closed plaster method, recommends the following steps as essential:

1. Organization to assure rapid transport of the patient to the aid post; complete undressing and careful examination all over; skilled selection of cases for operation in order of urgency; surgery as early as possible.

2. Anesthesia; nitrous oxide-oxygen, nitrous oxide-ether, rarely spinal or local.

3. Cleaning by scrubbing the wound and the area about it with soap, water and stiff brush; painting the skin about the wound, but not the wound, with weak solution of iodine.

4. Excision of skin edges; removal of all contused or non-viable tissues; careful search for and removal of clots, foreign matter and detached fragments of bone; drainage of deep cavities by opening intermuscular spaces and inserting gauze or rubber drains.

5. Reduction of fractures by traction.

6. Packing wound with dry gauze. (At first he used vaseline gauze, but now prefers the dry.)

7. Complete immobilization of the part and the joints above and below by incasement in plaster, which is applied directly to the skin with no intervening padding.

8. Injection of tetanus antitoxin.

9. Plaster to remain without redressing for 15 days in summer to 30 days in winter, or until the stench is intolerable. Clinical indications for earlier removal are, edema of distal part of the extremity with inability to move toes or fingers, and marked lassitude with increasing pain and rising pulse rate.

He believes that immobilization insures a faster growth of new tissue, while elimination of the painful daily dressings also reduces the danger of secondary infection. Chemotherapy with the sulfonamide drugs has proved to be a valuable adjunct to the closed plaster method.

RADIATION TREATMENT. Several years ago the doctrine was brought out that all bacteria could be killed by X-rays; that each organism was vulnerable to some certain wave length; that all we had to do was to determine what bacteria were present in a wound or disease, treat it with the proper wave length, and sterilization would be accomplished. It didn't prove to be quite as perfect as that, but it did lead to a very valuable adjunct treatment, both prophylactic and curative, for many infections. Radiation is an extremely useful aid in treating wounds that cannot completely be debrided. It will greatly reduce the growth of streptococci and staphylococci, and it is almost a specific against the gas-producing organisms. With its use, the percentage of successful primary closures will be greatly increased. It does not interfere with chemotherapeutic treatment.

Radiation treatment appears to be ideally adapted to the

needs of victims of air attacks on civil communities, so the necessary equipment should be provided at aid stations and emergency hospitals. Like chemotherapy, it is more effective if debridement be complete, but both agents help to compensate for inadequate wound preparation.

WOUNDS OF THE HEAD, FACE AND JAWS. These will be numerous. In air raids there are countless fragments falling from great heights, with momentum sufficient to penetrate protective helmets and also the skull. Certain centers should be provided with teams of neuro-surgeons, and suitable cases must be brought under their care as soon as possible. The same is true of face and jaw injuries, and the specialists for their treatment. The ultimate outcome, and the future usefulness of the patient depend so much on the skill of the surgeon who gives the first treatment, that every effort must be made to get them into the best hands at once. It is reported that the Japanese, in their campaign in China, have adopted the plan of doing an immediate tracheotomy in all severe face wounds occurring in the front area. They follow this by plugging the pharynx, the nasal and buccal cavities. The claim is made that this reduces sepsis, minimizes scarring and accelerates healing.

CHEST INJURIES: These also require special teams and equipment. There are few standard rules for treatment, because it requires special skill and experience to know just how and when to close a large sucking chest wound; when to use artificial pneumothorax as a therapeutic measure; when to wait and when to operate for hemorrhage in the thorax; whether to use

local, spinal, intravenous or intratracheal anesthesia. Most cases in this group require special equipment and team training.

ABDOMINAL WOUNDS. In many of these, the only hope lies in surgical intervention. Time is an important element. In the Abyssinian campaign, a large series of abdominal wounds was studied by an Italian group. It was found that 60 percent of those operated during the first 4 hours survived while, of those operated on after 8 to 12 hours, only 10 percent survived. The same group later worked in Spain with similar results.

In general terms, the operative treatment consists of control of hemorrhage, repair of perforations, debridement as complete as possible, careful search for foreign matter, and closure without drainage if the operation is done within the first 6 hours. We should expect, with the new chemotherapy, results even better than those given above, for sulfathiazole is a powerful weapon against most of the common intestinal bacteria. Radiation treatment also should not be neglected. Opiates have usually been considered an important part of the treatment of abdominal wounds, with the purpose of putting the intestines at rest and lessening the soiling of the peritoneum. But the report comes from China that the Japanese withhold morphine for several days after such injuries. Their idea is that contraction of the gut both above and below an injured segment occurs immediately, and limits leakage. Morphine is said to cause relaxation and so to increase soiling.

TETANUS AND GAS-BACILLUS INFECTION. There has been little new information on tetanus from recent and current wars, except confirmation of the value of protective inoculation. Some time ago, all the horses of the French cavalry were inoculated. It entirely eliminated this formerly prevalent disease, and also made every horse a reservoir of anti-toxin. Inoculation was later made compulsory for every man in the army. An official report stated that, up to June, 1940, there was no case of tetanus in an inoculated man.

This protective measure has also been adopted in the British and German forces. Active immunization has great advantages over the passive treatment. It can be induced before the man is exposed to danger, and lasts for many years. It avoids the dangers of serum reactions. It can be greatly augmented by an additional injection of toxoid when a wound is received, though opinions are divided as to the necessity of this. It is understood that the British continue to give a large dose of antitoxin to protected men who are wounded. At first, it was the custom of the French to give a dose of toxoid to protected persons who received tetanogenic wounds, to augment the immunity. Later reports state that this has been discontinued as unnecessary. Unprotected persons receive one cubic centimeter of vaccine as soon as possible after being wounded, and 48 hours later they are given 3000 units of antitoxin.

It would be a great advantage if we could, in preparing our communities for air raids, accomplish the antitetanic inoculation of every person. It would greatly reduce the terrors

of the wounded, and correspondingly increase the morale. If skilful publicity were used, a very large part of the population could be induced to submit to it voluntarily. Until complete protection of the people is accomplished, aid stations and hospitals must be prepared to give antitetanic inoculations to persons injured in air attacks.

Gas-bacillus infection should be reduced almost to zero if all the wounded can receive proper treatment. The best preventive is early and adequate surgery. Radiation therapy and the sulfonamide drugs are valuable adjuncts. If complete debridement cannot be accomplished, sera may be used, though their prophylactic value is most uncertain. A recent report describes 15 cases of perfringens infection treated with oral administration of sulfanilamide with excellent results in all. Other reports are favorable, though less enthusiastic. When infection is established, sera, radiation treatment and chemotherapy should all be used.

FRACTURES. These will be seen in great numbers. The old slogan of the first-aid teacher, 'Splint them where they lie', will frequently have to be modified. In Barcelona they found it better to rush the wounded to the nearest aid station and do the work in a protected place. This undoubtedly increased the pain, shock and tissue damage in some cases, but it avoided graver dangers.

Primary closure of compound fractures can be done in many cases. The steps should be, debridement, adjustment of the fragments of bone, fixation with vitallium plates if necessary,

dusting with zinc peroxid or a sulfanilamide type of drug, closure of the skin with gauze packed in any vacant spaces, and the closed plaster method, followed by oral administration of sulfanilamide or one of its derivatives. A few cases may require drainage later on, but this can be done without removing the plaster.

Many wounds cannot be closed, even though operated early, and so the judgment of the trained surgeon will be most important. The conditions under which civilian victims of air attacks will be handled, if we make intelligent preparations, will be vastly better than those confronting the surgeon at the battle front, and so more cases will be found suitable for primary closure.

SHOCK.

There are at least 6 major hypotheses to explain the origin of shock, but we are concerned chiefly with its treatment. Pain, cold, hunger, fatigue and loss of sleep are important contributing factors which we must correct by rest, heat, sedatives and nourishment. Control of hemorrhage is one of the first considerations.

A guide to treatment is found in the fact that a marked decrease in the effective volume of circulating blood is a constant feature of shock. The volume output of the heart per minute may be reduced to 25 percent of normal. The loss of plasma from the vessels is proportionately greater than the total reduction of blood volume, resulting in concentration

of the blood and a high degree of anoxemia. The most effective way of correcting this is by intravenous injection of whole blood or plasma, with oxygen inhalations.

Plasma, in dried or fluid form, has so recently become commercially available that authorities do not yet agree on the most desirable preparation. In equipping our aid stations and hospitals for air-raid work, we must not fail to provide for stored blood or plasma in large quantities. Shock was very prevalent among the civilian victims in Spain and Poland, and it will be so with us.

Symptoms of shock are well known to physicians, but the principal difficulty for the first-aiders will be to differentiate it from the effects of hemorrhage. This must be an important part of their instruction. If shock predominates, it has been found better to hurry the patient at once to the aid station. If hemorrhage is severe, steps should be taken to control it before transportation starts.

At the aid station, external heat should be provided for the shocked patient. This should be done with caution, for dilatation of the peripheral vessels and loss of fluid by excessive sweating may accentuate the shock. Relief of pain is an essential, and it can best be done by prompt dressing and immobilization of the injured part, aided by sedatives. Hot, nourishing drinks, especially those containing sugar, salt and gelatin, are valuable aids. Inhalations of concentrated oxygen will be helpful in correcting the anoxemia.

Most important of all is the intravenous injection of plasma or whole blood, whichever is indicated.

TRANSFUSION.

In recent years, the rapid growth of blood banks has made it possible to save many lives. The Spanish civil war was a huge laboratory for experimentation. In Barcelona alone, more than 28,000 volunteer donors gave a pint of blood monthly, or when needed. The blood was citrated and sealed in glass ampoules under a pressure of two atmospheres. This served not only to preserve it but also to drive the blood from the ampoule into the vein. It was transported in refrigerated trucks at two to 4 degrees Centigrade. So long as it showed no visual evidence of infection or hemolysis it was considered fit for use.

Some such organization will prove invaluable for civilian casualties in air attacks. With good publicity there will be plenty of volunteer donors. After the blood has been kept in the bank for the safe period, the unused bloods may be mixed and the plasma separated. This may be preserved in vacuum bottles for long periods without refrigeration, or it may be desiccated by one of several processes. It can be stored in the aid stations and quickly prepared for injection when needed. Some success is claimed for a method of desiccation of the cellular elements, and it is said that they preserve most of their blood-building value in the powdered form.

Plasma is preferred for traumatic shock without severe

hemorrhage, and for treatment of severe burns. Whole blood is best for hemorrhage, either with or without shock. Pooling the plasma reduces the iso-agglutinins, and blood typing is not necessary. Many thousands of injections have been given without reactions. Two thousand c.c. or more can be given at a time and frequently repeated. Our aid stations and hospitals should be equipped and the personnel trained so that blood and plasma can be given on a large scale.

GAS.

Elaborate preparations were made by European countries to protect civilians from aerial gas attacks, but there has been very little of it used up to the present. The reason is that high-explosive and incendiary bombs were found much more effective. As the war enters its final phase, this may be changed.

In addition to the usual gases of the last war, Germany is said to have used glass bombs filled with liquid ethylene on some of the Belgian forts, and to have sent down parachutists with tanks of this gas to be discharged into the ventilation intakes. A similar use is said to have been made of arsenical dusts. For this we have nothing more substantial than newspaper reports.

If the gas cloud be heavy, it may be necessary to shut down the ventilating system of the aid station or hospital, so surgeons and attendants must be trained to work in masks or respirators. If it is planned that gaseous anesthetics are to

be used, the anesthetists must know how, and be equipped, to give the anesthetics through a special mask. An air-purification system is an essential part of an aid station, but every provision must be made to carry on if it fails.

The agents commonly used in gas warfare; the means of detecting them; the agents and methods of treatment and decontamination of gassed persons, show little variance in the reports from the major nations. Each one is assumed to have certain secret chemical agents, and to hope to be able to keep them secret. It is to be expected that the enemy will carefully study our plans for protection against gas, and then use the agent to which we are most vulnerable. A mixed attack with several gases must be expected, so the equipment of our aid stations and the training of our personnel must make provision for all the usual agents and methods of treatment and decontamination.

Pamphlets provided for the German ARP state the probability that 80 to 90 percent of combat gases will probably be mustard. Its advantages are that it is persistent; its vapor is 5.5 times as heavy as air; it has a long latent period, so that contaminated persons may not realize it for several hours, when the damage is done. It requires careful training and diligent care to avoid contamination of aid stations when this agent is being used. In addition to its vesicant action, it may cause severe damage to eyes and lungs. The prophylactic and therapeutic treatment given in articles and text books is so uniform

and has been so widely disseminated that it seems hardly necessary to repeat the details here.

Aid stations must be prepared to care for 3 groups of patients in separate compartments:

1. Gassed, not wounded
2. Gassed and wounded
3. Wounded, not gassed.

Special equipment for gassed persons should include, as a minimum, special beds, hot water bottles, fresh clothing, oxygen respirators, stomach tubes and first-aid materials. Needed for treatment will be bleaching powder, sodium bicarbonate, alcohol, carbon tetrachloride, kerosene, soap, sodium hydroxide solution, boric acid solution, copper sulphate solution, amyl nitrite, tannic acid solution, also various stimulant drugs and intravenous solutions.

Evacuation of gassed persons has its own special problems. They must be removed as quickly as possible after treatment is completed. Even the apparently mild cases should not be allowed to walk, and they should be required to remain in bed for 48 hours. Those who survive the immediate effects of the vesicant agents may require prolonged treatment, and provision must be made for their hospitalization in safe areas.

ANESTHESIA.

The special conditions of air attacks will require a careful selection of anesthetic agents and methods. For gassed persons, the International Surgical Conference, in November,

1918, recommended the use of:

1. Nitrous oxide with oxygen
2. Ethyl chloride
3. Local anesthesia.

Studies recently conducted in France led to the following recommendation:

1. Local or spinal anesthesia for those in shock or with extensive lesions from vesicant gases
2. Local, regional, or avertine by rectum for those affected by suffocating gases.

No known anesthetic is completely satisfactory for all cases, and the agent must be carefully chosen for the individual case. Spinal anesthesia has greatly increased in favor, and with suitable adjuvants can be used even for those in shock. Intravenous administration of barbiturates will be found to be quick, safe and ideally suited to many cases. There will be no time, in most emergencies, for the usual pre-anesthetic medication.

In Barcelona hospitals, regional and local anesthesia were seldom used in air-attack injuries, because of the extensive bruising of the surrounding tissues, the multiplicity of the wounds, and the time consumed. They came to prefer gas-oxygen or gas-ether, but found difficulty in providing the gases and securing enough tanks. Spinal anesthesia and intravenous barbiturates were increasing in favor as their war ended.

Trained anesthetists will be very valuable, and should be provided in the organization of aid stations and hospitals.

They can save a great deal of the surgeon's time and release him from this responsibility so that he can concentrate on his surgical problems.

TRANSPORT.

Bringing the patients to the aid station and removing them from it to the zone hospital after dressing or other treatment, is a most important and complicated matter which will require elaborate planning. With it is intimately associated the problem of selection of patients for priority, aiming to salvage the greatest possible number of useful bodies. We can gain much useful information about it by a study of European lessons.

There will be blockage of streets by fires, by debris, by panic groups and by bomb holes in the pavements. We must rely on the police, the ARP wardens, the demolition and repair squads to clear routes for ambulances and stretcher bearers. First-aid men require careful instruction and training, so that they can know which cases require treatment before moving, and which should be given priority in transportation. The British use the warning labels, 'GUTS' for abdominal wounds, 'BRAINS' for head injuries and 'BONES' for compound fractures, written in red on the diagnosis tags or written on the patient's forehead. Such cases get priority in the order given.

Equipment for the first-aid personnel must be carefully chosen. Light, rigid splints which can be quickly and easily applied to immobilize fractures are necessary. For control of

hemorrhage they must be taught the uses and dangers of the tourniquet and compression dressings. They must be trained in the use of litters, and how to improvise them from debris. Vertebral and other special fractures will require individual handling.

Walking cases must be evacuated quickly to their homes - if any - or to underground rest areas. Gassed persons must be kept under observation for at least 48 hours. The best preparation of fractures for transport is to put them in plaster. Patients in shock must be held in the aid station. In the times of greatest pressure after an air attack, it will prove valuable to have an experienced surgeon devote his entire attention to selection of cases and assigning priority to them. This has been found one of the surest ways to relieve the inevitable congestion at the aid station which, in Poland and Finland, cost many lives which might have been saved. Belly, lung, femur and head cases, in this order, have been found to cause the most difficult problems in priority of transport and treatment. It must be anticipated that the wounds will be much more severe and extensive than those of ordinary civilian practice, and will require many times the usual amounts of dressing materials. From Norway comes the report that eight times as much dressing material was required for wounds caused by bombs as would be required for a similar number of industrial wounds.

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Note: If there should be occasion to publish this essay, references and acknowledgments will be provided.

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