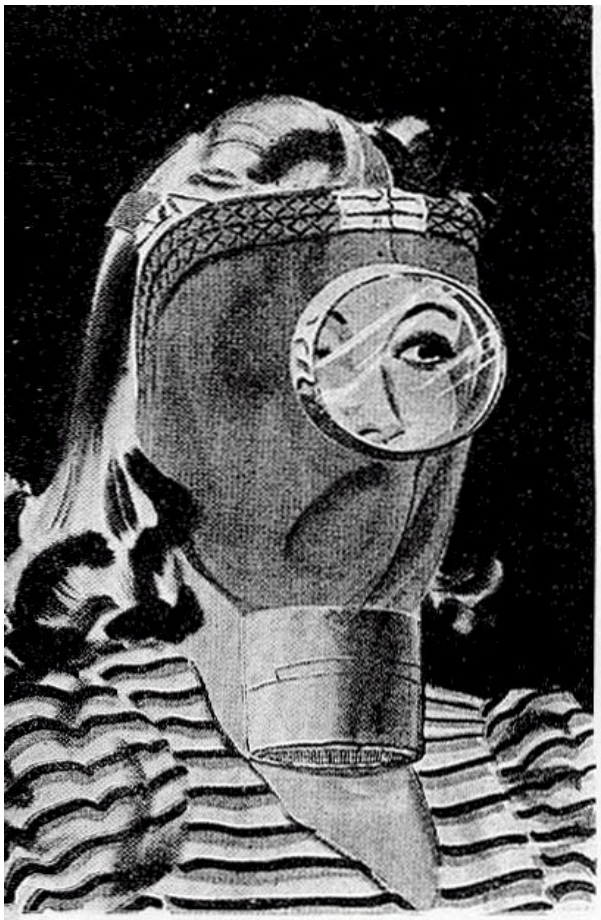
Making An Emergency Gas Mask



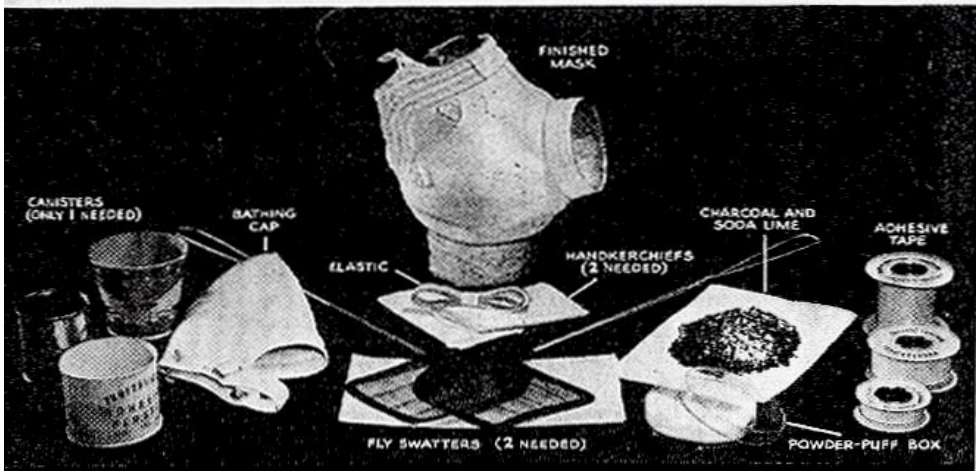
HOW TO MAKE AN *Emergency Gas Mask*

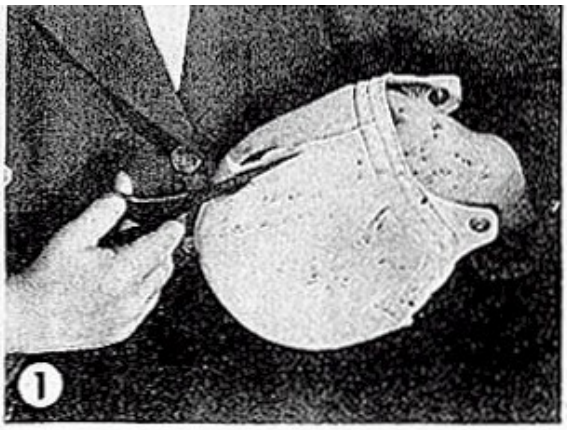
(from Popular Science - December 1942)

THERE still aren't enough gas masks available to outfit all of our civilian population, and with military demands at a peak no early production on a basis of a mask for every civilian can be hoped for. Rather than go without any protection at all, the alert citizen can make gas masks for himself and his family.

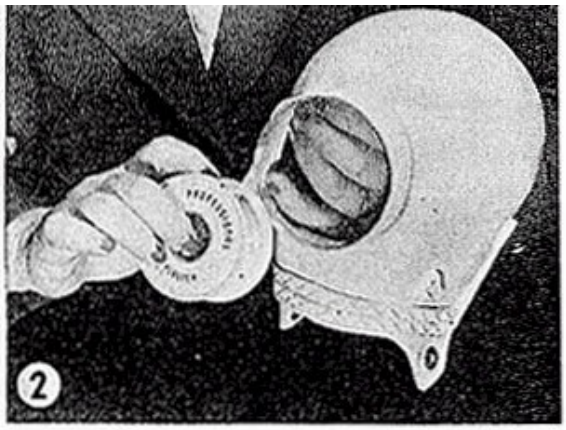
Such homemade masks must be looked upon as nothing more than temporary emergency equipment. They cannot take the place of approved masks, but they should, if carefully made, afford more protection than towels, blankets, or similar

Air-Raid Protection from Common Materials

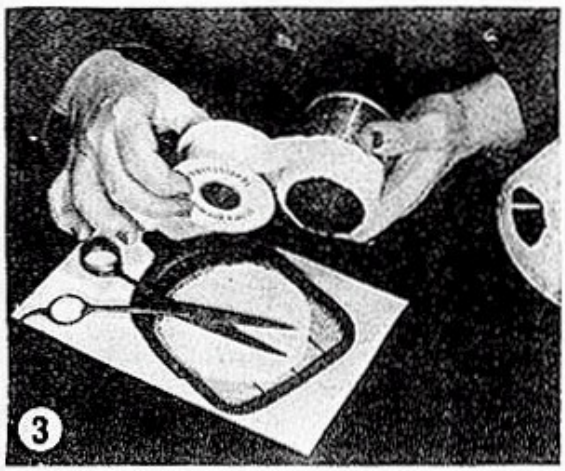




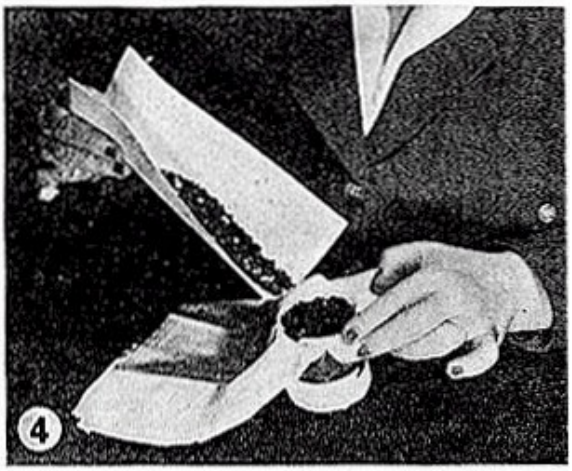
First step in making the mask is to cut a round hole on the center line of the cap, about 4" from the back edge. This hole should be about 1½" smaller in diameter than the celluloid powder-puff box



Insert the celluloid box (without its lid) in the hole, stretching the rubber over the turned-up edge and halfway across its width. Tape it fast all around. Bottom of box faces outward from the mask



Both ends of the canister must be open. Cut a disk about 1" larger in diameter from a piece of screening or a fly swatter. Hold this over one end of the canister, bend down the edge, and tape it fast



Place two handkerchiefs together and push the cloth into the canister against the screen. Pack tightly with two parts charcoal to one part soda lime and fold over the cloth. Leave wide margin all around

makeshift filters in case of a gas attack.

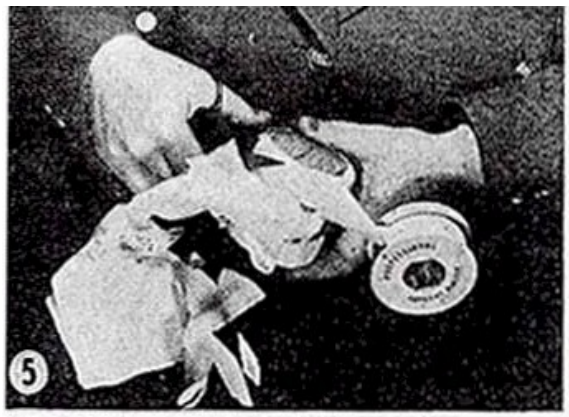
The Air Raid Precautions Department of the American Women's Voluntary Services, under National Director May Singhi Breen, is teaching civilians how to make gas masks from rubber bathing caps. This type of mask, designed by Dr. Simon L. Ruskin of New York City, is intended to protect the wearer only against the common, known gases used in chemical warfare. It is useless against smoke, illuminating gas, and carbon monoxide (automobile exhaust).

How such a mask is made is shown in the accompanying photographs. Use a heavy bathing cap, not a thin one. Make joints airtight so that the wearer can breathe only through the canister.

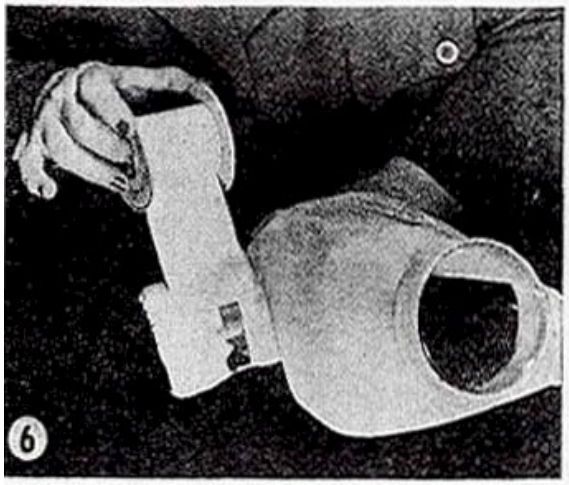
The physical filtering agent in the canister is activated granular charcoal, which can be obtained at drug stores and wholesale drug houses. To test it for acivity (the ability to take up and hold gases), place a small amount, such as a tenth of a gram, in the palm of the hand and pour on it five drops of carbon tetrachloride. The charcoal should become warm. If not, it's unsafe.

Either one half 10/20 mesh and one half 4/10 mesh, or the coarser charcoal alone, may be employed. With it mix one half as much coarse-mesh soda lime (sodium calcium hydrate), also available at drug stores. Pack the canister solidly. No air must enter without passing through the charcoal.

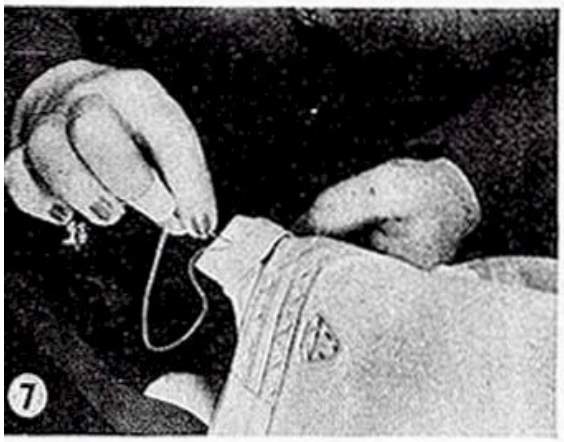
Do not forget to seal both ends of the canister with tape or heavy waxed paper. If left unsealed, the charcoal will absorb moisture from the air until it is saturated, and the mask will be useless. Unseal the canister only when the mask is to be put on for protection against gas. Once the mask has been used, the canister must be refilled with fresh charcoal and soda lime.



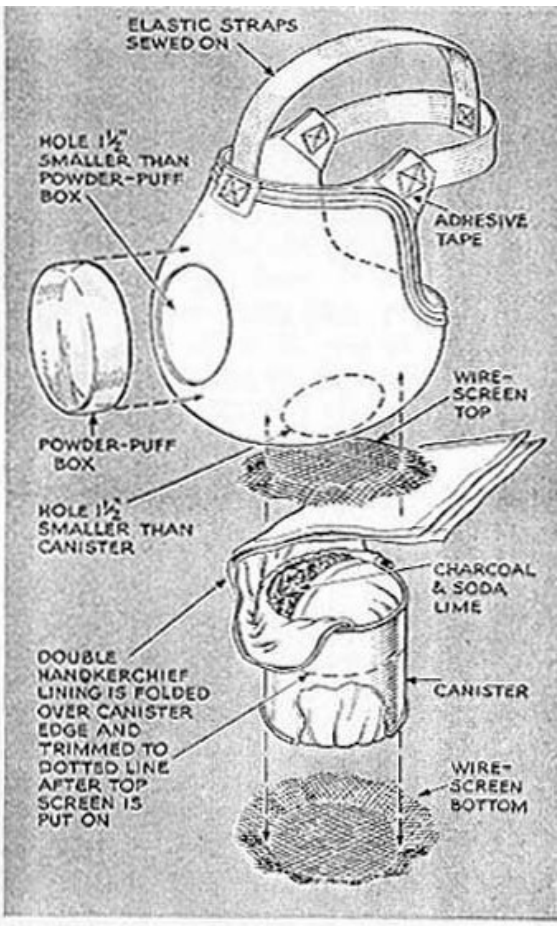
Cut a second disk of screening and bend it down all around over the cloth. Hold it with a turn of tape while cutting away surplus cloth. Afterward, apply more tape to hold the screening firmly on canister



Cut another hole, about 1½" smaller than the canister, in the lower part of the cap. Insert the canister and tape as with the powder box. Cover screened ends with tape to keep charcoal active



Make a head harness of ¾"-wide elastic and attach it as shown in the drawing. Try the mask on to make the straps the right length. Put a thickness of tape over the elastic, another under the rubber before sewing, to make the thread hold securely

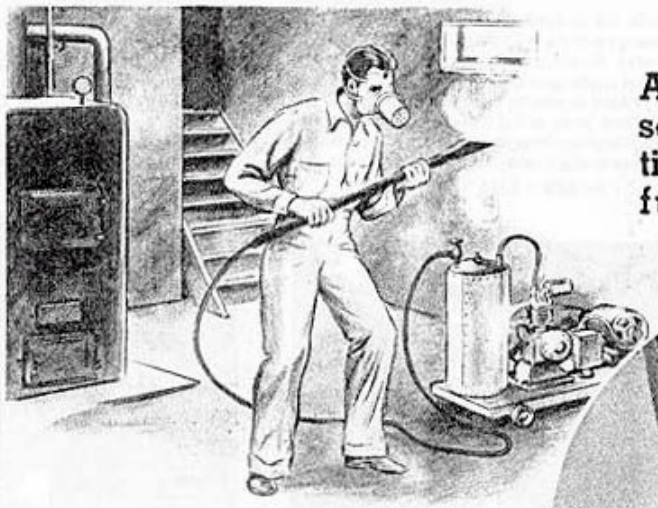


PARTS OF FINISHED MASK, and how they are assembled. The canister is kept sealed until the mask is needed. Otherwise, charcoal loses activity

Put on the mask by hooking the edge nearest the canister under the chin. It should make an airtight seal all around the face. To test the seal, cover the canister with the hand and draw a deep breath. If all the joints are tight, the mask will collapse

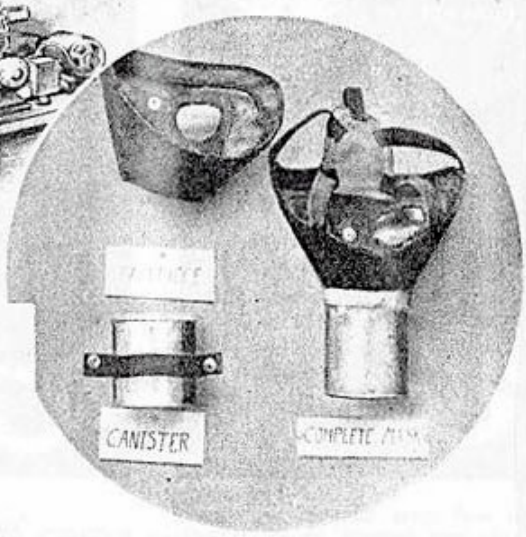
A GAS MASK For Fumigating Purposes

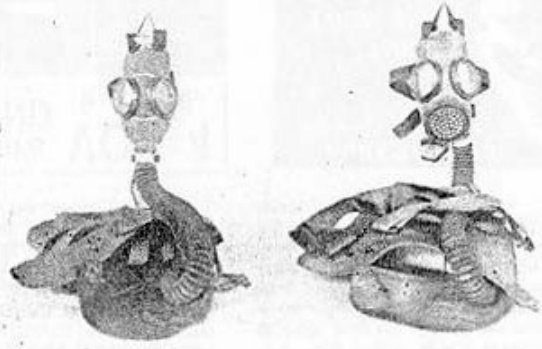
(from Modern Mechanics - 1938)



A mask for spraying and fumigating purposes is a necessary protection against dangerous fumes. This practical gas mask is made from ordinary household materials.

An army officer describes the construction of a practical fumigation mask.





The completed gas mask and basic materials used in constructing mask are pictured above. Left—Two types of commercial masks of practical design.

A SERVICEABLE gas mask which will prove highly efficient when working in smoke and dust can be easily constructed by anyone from common materials and at little or no cost. While the respirator unit about to be described is not as efficient as some commercial types it is, nevertheless, quite satisfactory for ordinary disinfecting use.

A few pieces of duck cloth, leather, celluloid, a tin container, cotton wadding and activated charcoal comprise the materials used in making the mask. Most any workshop will yield all necessary materials except the activated charcoal and this can be obtained at the corner drug store.

To make the respirator a pattern is first drawn on stiff cardboard to the shape and size shown in the pattern illustration. This size is satisfactory for the average adult. If one has an unusual face, a little experimentation will enable one to make the required changes in dimensions to meet his particular needs.

The facepiece is made from double thickness of tightly woven medium weight waterproof duck or leather which is treated on the contact surface between the layers with boiled linseed oil to which has been added 10% of castor oil.

The two faceblanks are cut from selected duck cloth according to pattern made as outlined above. The contact surfaces of the facepieces are dampened with the oil and then stitched in place by hand prior to sewing on a shoe machine. With a little patience all the sewing can be done by hand.

Eyepieces are next cut from clear celluloid or cellulose acetate film in the form of squares approximately three inches on the side with

A GAS MASK For Fumigating Purposes

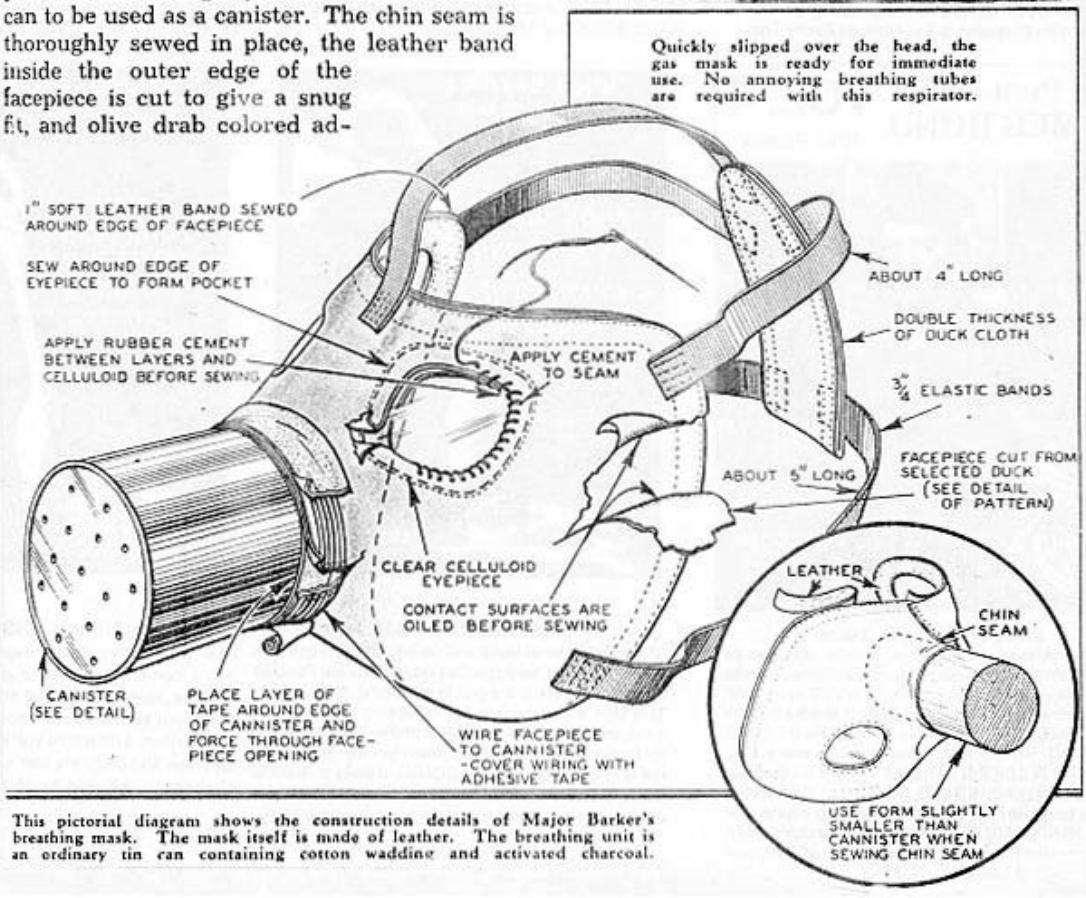
by Major M. E. Barker, C.W.S.

the corners rounded. The eyepieces are then slipped in place between the two layers of the facepiece and the facepiece served around the edge of the eyepiece. Cellulose acetate or rubber cement is then applied between the lens and the two layers of the facepiece and the facepiece is sewed through the eyepiece and cement applied to the seam. This procedure is necessary in order to produce a gas tight fit of the eyepieces in a facepiece of this design.

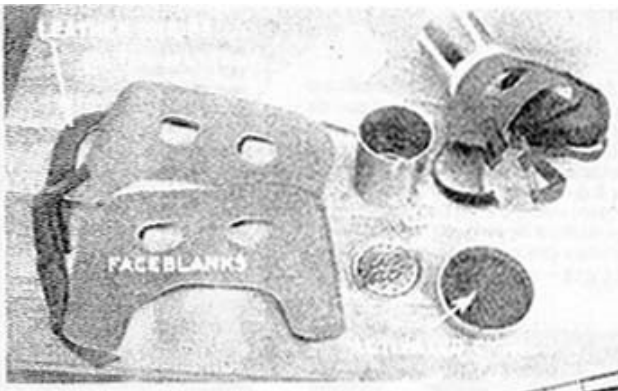
A band of soft leather about one inch wide is cut to fit the inside of the facepiece. This is sewed in place with two seams. The purpose of the soft leather is to give an air tight fit between the edges of the facepiece and the face.

The chin seam is now put together over a piece of wood slightly smaller than the tin can to be used as a canister. The chin seam is thoroughly sewed in place, the leather band inside the outer edge of the facepiece is cut to give a snug fit, and olive drab colored ad-

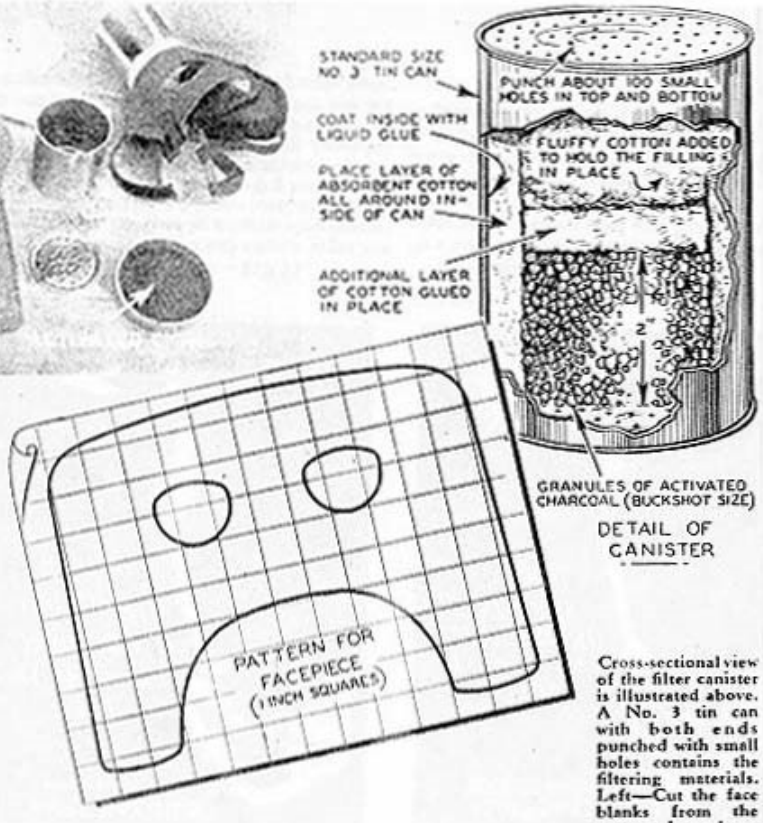
Quickly slipped over the head, the gas mask is ready for immediate use. No annoying breathing tubes are required with this respirator.



This pictorial diagram shows the construction details of Major Barker's breathing mask. The mask itself is made of leather. The breathing unit is an ordinary tin can containing cotton waddine and activated charcoal.



Here is the gas mask before the assembling operation. Celluloid eyepieces are sewed between leather face blanks. A completed mask, ready for use, is shown at upper right.



Cross-sectional view of the filter canister is illustrated above. A No. 3 tin can with both ends punched with small holes contains the filtering materials. Left—Cut the face blanks from the pattern shown here.

hesive tape is used to bind the seam and render it airtight.

Five pieces of standard elastic ¾ of an inch wide are sewed to the facepiece so that one elastic strap passes over the center of the forehead, one along each temple and one just above the point of the jaw on each side of the face. This spacing of the head harness elastic straps is necessary to give the facepiece a snug fit on the face and to carry the suspended weight of the canister.

A pad about three by four inches in size made of two thicknesses of duck cloth of the same variety as used in the facepieces is now sewed to the ends of the elastic so as to give a tight fit to the facepiece for the average wearer. This is best determined by actual test. However, the temple straps should be about four inches long between the pad and the edge of the facepiece while the chin and forehead straps should be approximately five inches in length.

The cannister is made from a standard size No. 3 commercial tin can by perforating the top and bottom each with about one hundred small holes such as produced by a six-penny nail. The can can be cut off about one inch in length and still produce a satisfactory canister which is easier to wear, although the can as purchased is satisfactory.

The inside of the canister is coated with liquid glue or a good grade of adhesive of some other type. A piece of absorbent cotton pad in the form of thin layers, is now cut to fit the can. These two layers are now placed in the can and the edges pressed against the can to secure adhesion.

Activated charcoal in granules about the size of buckshot is now filled in the canister to a depth of about two inches, then an additional layer of absorbent cotton cemented in place and ordinary fluffy cotton added on top to hold the filling in place. The top is then rolled into place on the can. This can be done in satisfactory fashion with a pair of small round nosed pliers.

The hole in the facepiece is now sewed with two seams about $\frac{3}{16}$ inch apart. A layer of adhesive tape is fastened around the top of the canister and the canister is slipped through the hole in the facepiece. If the work has been well done a small amount of force is required to push the canister through the facepiece, but there is ample stretch to the facepiece to accommodate the canister. The facepiece after being wired to the canister and the wire covered with adhesive tape is now ready to wear.

The mask outlined above is highly effective in removing dust, smoke and obnoxious gas from the air breathed by wearer.

Gas Mask: A PopSci Fan's Step-by-Step Guide

Step 1: Check Out What Popular Science Had to Say in 1942

"Rather than go without any protection at all, the alert citizen can make gas masks for himself and his family."

The following steps are from a December 1942 Popular Science article on how to make an improvised gas mask.

The following information may help you understand the instructions.

"10/20 mesh" and "4/10 mesh" specifies the grain size of the crushed charcoal. Sorting grains by size is called "screen classifying". To do it you put a stack of sieves on a sieve

shaker with the coarse one on top. To make 10/20 you'd put a sieve with a 10 mesh (ten wires per inch) screen on top of a 20 mesh sieve. You'd pour your crushed charcoal in the top and shake the stack. The 20 mesh sieve would fill up with the good stuff, you'd dump that into your gas mask cartridge.

In other words the charcoal grains they use are between .05" and .25" diameter. I've read that that resistance to breathing while doing strenuous work is the major problem with gas masks. A mask made with such large grains might have very easy air flow.

Soda Lime (w'pedia) is calcium carbonate (lime) reacted with aqueous sodium hydroxide (lye). It absorbs carbon dioxide among other things.

Carbon tetrachloride is dry cleaning fluid, very common in those days when synthetic fibers were rare and many people wore clothing such as suits that would be harmed by laundering in water.

Star says "CCl4 note that carbon tetra chloride is carcinogenic like pasta sauce is red, and you probably don't want it in your house or on your hands or anywhere"

The text continues: "This type of mask, designed by Dr.Simon L.Ruskin of New York City, is intended to protect the wearer only against the common, known gases used in chemical warfare. It is useless against smoke, illuminating gas, and carbon monoxide (automobile exhaust).

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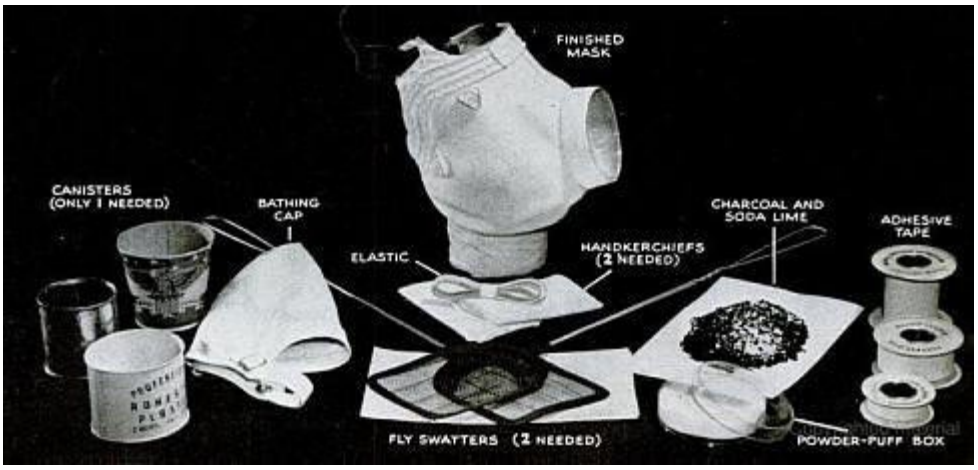
If not, it's unsafe. Either one half 10/20 mesh and one half 4/10 mesh, or the coarser charcoal alone, may be employed. With it mix one half as much coarse-mesh soda lime (sodium calcium hydrate), also available at drug stores. Pack the canister solidly. No air must enter without passing through the charcoal. Do not forget to seal both ends of the canister with tape or heavy waxed paper. If left unsealed, the charcoal will absorb moisture from the air until it is saturated, and the mask will be useless. Unseal the canister only when the mask is to be put on for protection against gas. Once the mask has been used, the canister must be refilled with fresh charcoal and soda lime. "

Step 2: "Common Materials" back in 1942



In case you can't read the little labels, they read: From left to right:

Canisters (they appear to be ordinary tin cans)

Bathing cap

Elastic

Handkerchiefs

Fly Swatters

Charcoal and Soda Lime

Powder-Puff Box

Adhesive Tape

They sure had some odd stuff laying around back then. Dirt roads and horses caused a lot of fly swatting and nose blowing.

Step 3: 1942 Mask step-by-step

Put on the mask by hooking the edge nearest the canister under the chin. It should make an airtight seal all around the face. To test the seal, cover the canister with the hand and draw a deep breath. If all the joints are tight, the mask will collapse

The powder-puff box has a clear lid, this is the window the user looks through.

The bathing cap is the mask that fits about the face.

There is no valve. The breath goes in and out through the filter.

The charcoal/soda-lime mixture is wrapped in two layers of hanky and packed into the can.

The pieces of screen are taped over the ends of the can and any excess cloth cut off.

Then the can shoved into a hole in the mask and sealed on with tape.

Step 4: Start a Fire

I need to filter paint fumes and sanding dust, not phosgene, so I didn't bother adding soda lime to my filter.

Start a fire. That's the first step in making charcoal. Coconut shell charcoal is standard for gas masks. I wanted to try coconut husk charcoal. So I husked some of the driest, lightest coconuts I could find. Three of them were starting to sprout. Yay! I ate one of the sprouted coconuts.

I started a fire. It was horrible. I couldn't get the coconut husks to burn properly. It smoked a lot and wanted to smolder. In Mexico the husks had flamed out and burned down to a nice bed of coals in minutes. I guess they were a lot drier than the husks here in Maui.

I tried all my fire making tricks. I ripped the husks into strips and stacked them like a log cabin. I added tinder of various kinds. I finally dumped paint thinner on the burning pile. That flamed for a while but then it went back to smoldering. I finally gave up and decided to let it smoke. Eventually the heat would make some of the stuff in the middle into charcoal. I piled a whole lot more husks on and after an hour or so it looked like the final picture, ready for my coal mining operation.

It's a calm day and the smoke followed me around everywhere. I needed a gas mask.

Step 5: Eat Canned Pears

I needed a can.

So I had to eat some canned pears. Life is hard.

Then I cut an 'X' in the remaining end of the can to make a hole for the snorkel

Step 6: Fit Snorkel to Can

While that nasty fire smokes up the neighborhood, get back to tinsmithing. Bend up the flaps of the 'X' and fit the can to the end of the snorkel.

Step 7: Affix the Can to the Snorkel

Make sure the tube doesn't protrude all the way into the can.

Drill a hole through the can flaps and the end of the snorkel tube.

Insert a wire through the holes.

Bend the ends of the wire over.

The assembly will feel pretty secure.

Step 8: Seal the Joint Between Can and Tube

Wrap the end of the can and the joint with the tube with plastic cling-wrap and tape.

Try sucking air through the tube while the open end of the can is blocked. It shouldn't be possible.

It's very much easier to seal vacuum leaks than pressure leaks. Vacuum leaks tend to suck things into them and seal themselves.

Step 9: Quench Some Coals

I looked into my fire and saw some good coals glowing inside. So I knocked it apart, grabbed some good coals with tongs made from two sticks, and quenched them in water.

I was wondering whether my charcoal would be "activated" or not. After some reading I decided my wasteful way of making it pretty much guaranteed it would be "activated". That means no hydrocarbons left in the pores and all the carbon being short chains with their little arms out ready to grab molecules.

Step 10: Crush Some Charcoal

After quenching the coals I set them on some cardboard to drain and dry out a little. Then I dumped the water out of the pot and used it for a mortar to crush the charcoal in. I used a section of bamboo as a pestle.

Quenching had drawn a lot of water into the charcoal. It turned to wet paste as I crushed it. I mashed it til the largest grains were well under .25" in diameter. The volume decreased a lot as I crushed it. This husk charcoal wasn't very dense. I needed to grind a few batches to get enough to fill my canister.

Step 11: Dry the Crushed Charcoal

I spread the crushed charcoal paste on some newspaper and put it in the sun.

It was still wet after a day in the sun so I dumped it onto tinfoil on a pan and put it in the oven.

I tasted a mouthful of charcoal to see if it was any good. It didn't taste like a smoldering fire, which is what I was afraid of. I couldn't figure out what the taste was. Then I realized the taste was the taste of no taste at all. It was absorbing all the stuff from my mouth that could activate a taste bud. This was a non-taste I've probably never experienced before. I remembered how the old nuns in the old-folks convent at home used to eat burned toast for the charcoal. Those nuns were the best educated people in the area for a hundred years or more, so I figured they knew a thing or two. I chewed it up and swallowed that mouthful of tasteless carbon with gusto. I smiled with clean black teeth.

Step 12: Base Manifold Wad

I put a loose wad of paper towel in the base of the can. I wanted the airflow to spread out from the tube into the can without restrictions. I put a disk of folded paper towel on top of that to keep charcoal dust from going into the tube and my lungs.

Step 13: Pack the Can with Charcoal

I packed the can with charcoal til it was about as high as the longest gas mask cartridge I've seen. The can was taller than that, so I added some wadding on top of that. to hold it in place.

Step 14: End Cap

I taped a folded paper towel over the end of the can, cut off the excess, and taped it some more, just like the 1942 version. I don't know what the function of the screen was in that model. Probably it was for durability. They probably intended people to actually fight and dig through rubble while wearing those swimcap and baby pants gasmasks on their faces.

Since I'm just going to do some light varnishing, I'll stick to mere paper towels.

Step 15: Exhale Valve

This snorkel has an exhale valve so air doesn't have to get forced back out the filter. The air flow is one direction, which means there's no dead air going back and forth in the tube for CO2 to build up in. Because of this exhale valve, I could use a longer more flexible tube. That would probably make it more comfortable to wear.

Step 16: Varnishing!

I considered trying the "clothespin on the nose" to keep me from inhaling through my nose, but it turns out to not be a problem. Something about a snorkel makes a person not want to inhale through their nose. Not to mention there's a bad varnish smell to remind me if I forget.

The whole thing works great! I didn't get a headache and get all stupid from fumes. I tried shoving the tube up against a nostril and inhaling through it that way, and couldn't smell anything through it.

If I start smelling anything through it, I'll repack it with new charcoal.

The only problem was condensation dripping out of the exhale valve onto the varnish. I tied a rag over it to catch that. When I wore it as seen in the opening photo, no drips came out.

This respirator works so well I'm thrilled. I'll look for a flexible hose so I can hang the canister on my belt. It will be perfect for welding, since a welding hood won't hit the mouthpiece.

Can any chemists or welders in the audience tell me if I need to add the soda lime to filter welding fumes? Apparently manganese, manganese dioxide are in the fumes and cause harm.

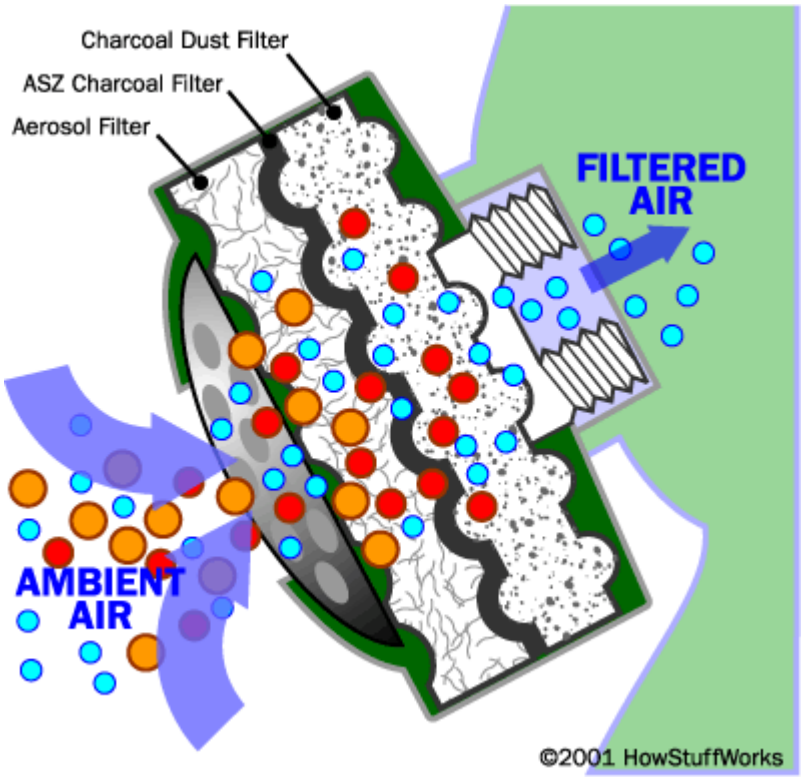
How Gas Masks Work

How Filters Work

Because of the problems with SCBA systems, any respirator that you are likely to use will have a **filter** that purifies the air you breathe. How does the filter remove poisonous chemicals and deadly bacteria from the air?

Any air filter can use one (or more) of three different techniques to purify air:

- Particle filtration
- Chemical absorption or adsorption
- Chemical reaction to neutralize a chemical



A typical disposable filter cartridge for a respirator: When you inhale, air flows through the inlet on the left, through a particulate filter, through an activated charcoal filter, through another particulate filter (to trap charcoal dust) and through the outlet on the right into the mask. When the particulate filter clogs or the activated charcoal becomes saturated, you must replace the cartridge.

Particle filtration is the simplest of the three. If you have ever held a cloth or handkerchief over your mouth to keep dust out of your lungs, you have created an improvised particulate filter. In a gas mask designed to guard against a biological threat, a very fine particulate filter is useful. An anthrax bacteria or spore might have a minimum size of one micron. Most biological particulate filters remove particle sizes as small as

0.3 microns. Any particulate filter eventually clogs, so you have to replace it as breathing becomes difficult.

A chemical threat needs a different approach, because chemicals come as mists or vapors that are largely immune to particulate filtration. The most common approach with any organic chemical (whether it be paint fumes or a nerve toxin like Sarin) is **activated charcoal**.

Charcoal is carbon. (See this Question of the Day for details on how charcoal is made.) **Activated charcoal** is charcoal that has been treated with oxygen to open up millions of tiny pores between the carbon atoms. According to Encyclopedia Britannica:

> The use of special manufacturing techniques results in highly porous charcoals that have surface areas of 300-2,000 square metres per gram. These so-called active, or activated, charcoals are widely used to adsorb odorous or coloured substances from gases or liquids.

The word **adsorb** is important here. When a material adsorbs something, it attaches to it by **chemical attraction**. The huge surface area of activated charcoal gives it countless bonding sites. When certain chemicals pass next to the carbon surface, they attach to the surface and are trapped.

Activated charcoal is good at trapping carbon-based impurities ("organic" chemicals), as well as things like chlorine. Many other chemicals are not attracted to carbon at all -- sodium and nitrates, to name a couple -- so they pass right through. This means that an activated-charcoal filter will remove certain impurities while ignoring others. It also means that, once all of the bonding sites are filled, an activated charcoal filter stops working. At that point you must replace the filter.

Sometimes, the activated charcoal can be treated with other chemicals to improve its adsorption abilities for a specific toxin.

The third technique involves **chemical reactions**. For example, during chlorine gas attacks in World War I, armies used masks containing chemicals designed to react with and neutralize the chlorine.

> Destruction by chemical reaction was adopted in some of the earliest protective equipment such as the 'hypo helmet' of 1915 (chlorine was removed by reaction with sodium thiosulfate) and in the British and German masks of 1916 (phosgene was removed by reaction with hexamethyltetramine).

In industrial respirators, you can choose from a variety of filters depending on the chemical that you need to eliminate. The different filters are color coded by NIOSH standards for things like acids and ammonia.

DIY Gas Mask

by

Bill Riley

With Tom Ridge drumming up fears of terrorist chemical attacks in America, gas masks have become real hot survival items. Of course, survivalists have stocked such things for years. And you'd think -- especially in the wake of the WTO protests -- that political activists would, too.

Of course, most conventional gas masks have a major drawback for the fury folk among us: they don't seal around beards. A hood is called for.

I saw a newspaper article about improvised gas hoods in Iraq, designed for the Kurds. Basically, it was a vinyl hood, with a clear plastic panel to see through, and an activated charcoal filter sewn between layers of cloth and stitched over a bunch holes in the hood. At first glance, it seemed like a good idea, but then I saw a huge problem.

When a person wearing such a hood inhales, that soft, flexible hood is going to collapse like a balloon wih the air sucked out. When he exhales, it'll reinflate with the used air. Repeat infinitum. There's going to be very little air flow through the filter.

I've seen a better concept in survival gear catalogs, usually billed as an emergency escape hood, to protect the wearer from smoke in a burning building. It's nothing more than a plastic bag with an activated charcoal filter in a canister with a mouthpiece. You draw your breath directly through the filter, avoiding the problem of your "hood" acting as a counterlung. It's pricey, though. I think we can make one of these at home for a lot less.

You're going to need:

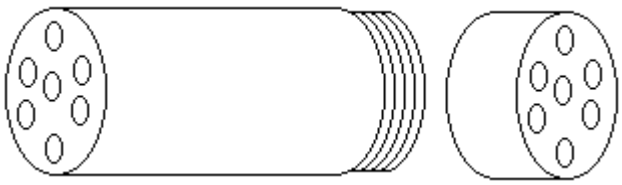
- Large oven bag (those plastic bags for roasting turkeys)
- Small plastic jar (1 1/3/4" by 4" spice jar is great)
- Flannel
- Activated charcoal
- RTV adhesive
- Duct tape
- Drawstring

Any plastic bag that will fit over your head will do, but a heat resistant oven bags makes this useful fires as well as riots.

The news report I read claimed that you can "activate" your own charcoal at home by baking ordinary charcoal (with no added started fluids) in your kitchen oven for one hour at 500°C. I don't know about you, but *my* oven doesn't get anywhere near that hot. If you have a pottery-firing kiln, give that a shot.

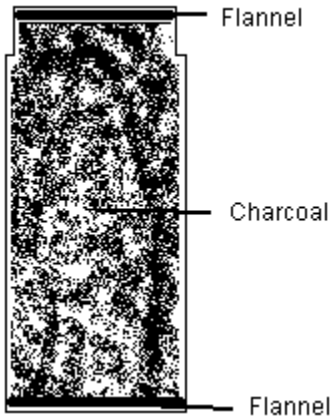
I bought my activated charcoal at a pet store, in the fish/aquarium department.

Construction
1. Let's start by making the filter canister. Drill or punch as many holes as possible in the base of your jar.



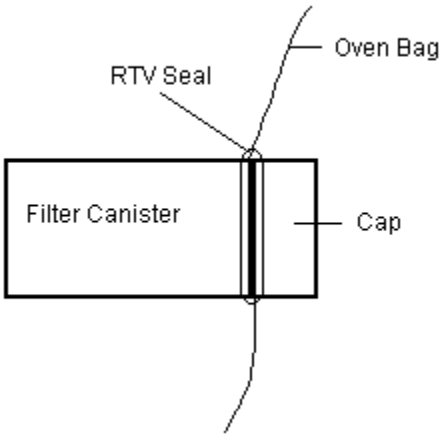
You are going to breathe through these holes, so make as many (and as large) as you can without removing the base completely. Do the same to the cap.

2. Place a circle of flannel in the bottom of the jar. This soft, fuzzy fabric will work as a particulate filter to block some smoke and keep the charcoal from falling through your holes. Fill the jar to the brim with said charcoal. Put another circle of flannel on top of that.



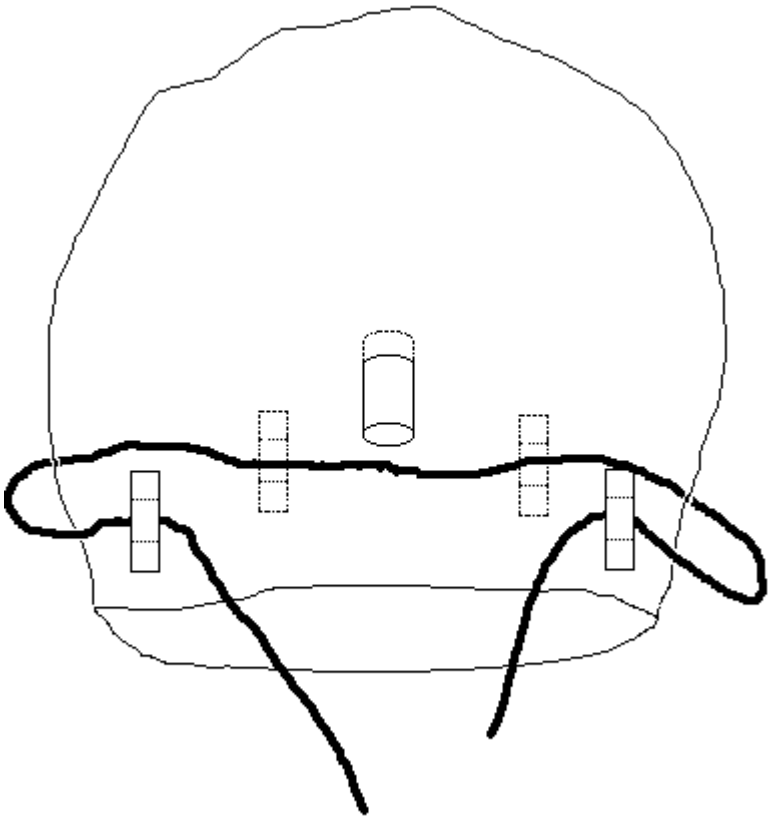
3. You need o fugure out where on the bag to mount your filter. Pull the oven bag over your head just long enough to find a place to put the filter where your mouth can reach it. Please don't smother yourself; I need all the readers I can get.

Cut a small hole -- a little smaller tahn the diameter of your filter jar -- in the bag. Stretch that hole over the jar, being careful not to tear the bag. It should seal snugly around the jar-top. Now screw the cap into place. Finish up with a bead of RTV around that joing to thoroughly seal it.



4. Once the RTV has set (or you could do this *before* mounting the filter canister), attach your drawstring near the bag opening so you'll be able to seal the bag around your neck.

You can make little drawstring "belt loops" by cutting strips of duct tape, then covering the middle section of each strip -- on the sticky side -- with smaller squares of duct tape. Place those around the circumference of the bag, and thread your drawstring through.



That's it. You are the proud owner of a gas "mask." To use it, pull the hood over your head, put the end of the canister in your mouth, and tie the drawstring around your neck to seal it. Don't pull it tight enough to restrict any blood flow to your head; you just want to keep stuff like wisps of tear gas from drifting up into your hood.

Advantages and Disadvantages
This hood is not as eficient as a standard comercial gas mask. On hot days, it'll get hot and humid in there. But...

It is "one size fits all." It will fit an adult or child. Check the jar width against a child's mouth first, you may need a smaller jar for very young children. You can use it over a full beard or glasses. And at this price, you can outfit your whole family (or protest group).

Size is another factor. You may remember that the mayor of Seattle banned gas masks during the WTO meeting. This hood is small enough to fit unobtrusively in your pocket until needed.

Gas!

Treated clothing and mask equip soldier for gas warfare.

LOOK carefully at the pictures on these pages—if you've been wondering what we would have done in case the Axis powers had introduced deadly chemicals in the recent war.

It seems fantastic, weird and remote, now that the shooting is over. But here are the brutal facts, revealed for the first time by the Army's Chemical Warfare Service. It was alert and ready to retaliate in heaping measure had our enemies used gas. Although the U. S. is not a party to any

America was ready to give and take if the Axis had turned loose with the most inhumane of all modern weapons!

Thousands of barrels of deadly gas were ready in U.S. arsenals.

Infant respirators and gas-proof headcoverings for hospital patients, right, were ready for use had our enemies decided on gas warfare.

treaty or other agreement not to use gas, we have long been committed to the policy that we would not resort to this horrible weapon unless it was first employed by our foes. The fact that our troops were fully prepared for offensive and defensive gas warfare undoubtedly stopped the Axis from challenging us on this score.

Chemical mortar battalions in every combat theatre, having won their spurs by firing smoke and high explosive barrages from their chemical mortars, immediately could have turned to toxic agents for which this death-dealing weapon originally was developed. At the same time every active front had decontamination companies available for neutralizing gassed areas; processing companies for analyzing enemy chemical agents on the spot; maintenance companies to reservice gas masks and other equipment, and depot companies ready to supply gas munitions. By the same token, chemical air operations companies, which had been busy storing and loading incendiary bombs and filling airplane spray tanks with smoke mixture, speedily could have switched to preparing gas for release from the [*Continued on page* 159]

The soldier at left demonstrates the Army's anti-gas bag, issued to all combat troops. Below: Horses and mules had gas masks, too.

Gas!

[Continued from page 67]

air. Huge storage depots maintained by the Chemical Warfare Service in this country and abroad were stocked with enough bulk chemicals and gas-filled bombs, grenades and shells for large-scale gas offensives. Four secret arsenals and other special plants, having produced an enormous reserve of toxic agents, stood by for additional production if needed.

Ready for use were various types of war gases, ideal for special purposes. Included were casualty producers which blister, choke and poison the blood and nerves and harassing agents which cause tears and nausea. The blister agents include mustard, a dark oily liquid with an onion odor, which vaporizes when released and contaminates the ground for days and even weeks; lewisite, with geranium smell and similar characteristics; and the new nitrogen-mustards which, being odorless, can be detected only with special devices. These chemicals in gas or liquid form, attack the lungs, produce blisters on unprotected skin and also injure the eyes. Because of their persistency they are mainly useful in making areas impassable.

In the choking gas group are phosgene, diphosgene, producing colorless vapors with the odor of musty hay; and chloropicrin, a yellow gas smelling like flypaper that also irritates the eyes. They are especially useful for offense.

Among the blood and nerve poisons are arsine and hydrocyanic acid, colorless, the former with a faint aroma of phosphorus and the latter having an almond smell. These are killers.

In the non-fatal or harassing category are chloracetophenone which, though having the scent of apple blossoms, irritates the eyes, nose and skin, as does brombenzylcyanide. Adamsite and diphenylchlorarsine are irritant smokes, the former with a slight tinge of coal smoke and the latter remindful of shoe polish.

Toxic gas concentrations can be laid down by a variety of methods. The major gas weapons of the Chemical Warfare Service were chemical mortars, artillery shells, bombs, spray tanks, irritant candles, and hand grenades. The chemical mortar (4.2 inch) is a 300-pound rifled weapon which fires twenty shells a minute, each weighing 25 pounds at ranges up to two and a half miles. A chemical battalion armed with these "goon guns" can lay down three tons of phosgene in a minute. Of the artillery shells the 75 mm. howitzer, 105 mm. howitzer, 155 mm. gun and various infantry mortars can all fire toxic agents.

Low-flying attack planes coming in at treetop level can spray hundreds of men within seconds before protective measures can be taken. Another method has been worked out by which high-flying bombers, almost invisible in the sky, can release their burden of toxic vapor thousands of feet in the air, without the knowledge of troops below. Minutes later the invisible and practically

[Continued on page 161]

Gas!

[*Continued from page* 159]

odorless cloud of chemicals descends on the troops as though out of nowhere, producing casualties before the victims realize the cause.

The anti-gas devices issued to our Army in the recent conflict made the American soldier the world's best protected fighting man. Every man carried with him into action his own gas mask and other equipment able to provide split-second protection against gas attack. In addition gasproof clothing was available to all troops entering potential gas areas. Either singly or together, depending upon the situation, these devices gave every soldier head-to-toe insurance against all toxic agents known to have military possibilities including choking, vomiting and blister gases and blood and nerve poisons. Furthermore every soldier was carefully trained before leaving this country to protect himself in any emergency.

Altogether during the war at least 15 different types of gas masks were developed for our service men and women. Model for model the U. S. Army mask provides better vision, is more comfortable to wear, is lighter in weight, more rugged, has less breathing resistance and protects against stronger gas concentrations for longer periods of time than the gas mask of any other nation.

Complete individual gasproof attire has been developed for the use of troops entering areas where gas concentrations are suspected and for decontamination companies. There are two types, both of which are designed to protect the body from mustard, lewisite and other blister agents. Permeable protective clothing consists of garments treated to provide complete protection against blister vapor or droplets, yet permit much comfort and serviceability.

Impermeable clothing consists of a one piece suit with attached hood. Impregnite-treated shoes, over which the legs of the impermeable suit are buckled and gasproof rubber gloves are also worn.

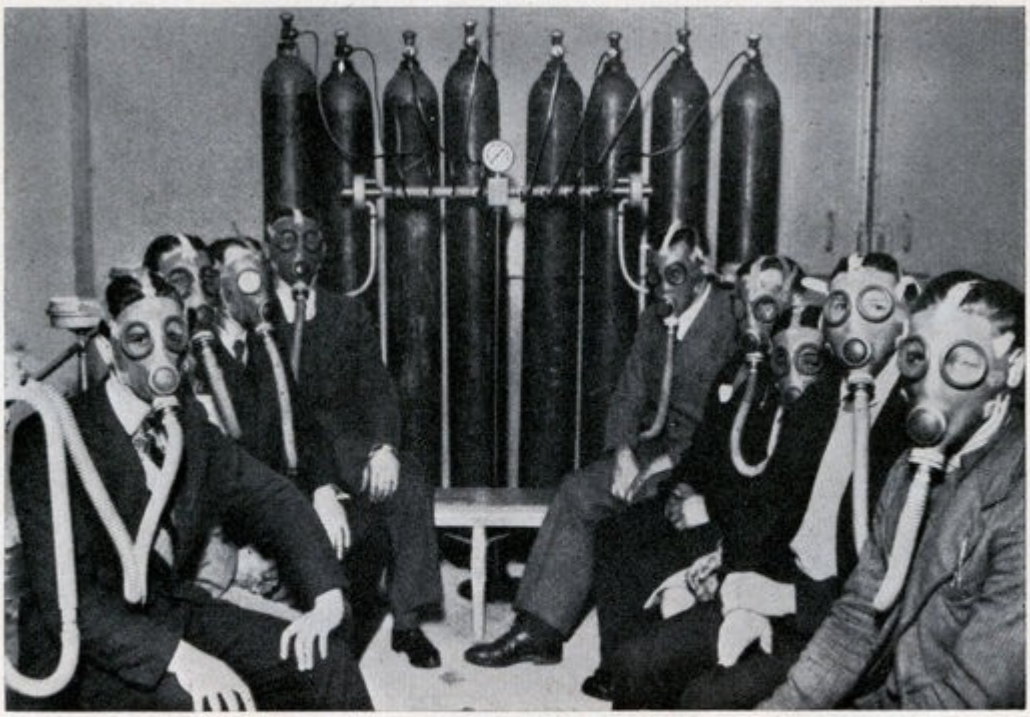
Troops of the Chemical Warfare Service, stationed in every theatre with armies and other large troop units, were the best guarantee that any enemy gas attacks would fail to halt the advance of American forces. The chemical companies were ready to move out to any section of the front where their services were needed. A special unit, the chemical decontamination company was able, if called upon, to conduct large scale decontamination of critical areas or gassed supplies. Besides defensive weapons including rifles, four machine guns and five bazookas, the company was equipped with both permeable and impermeable clothing and several types of decontaminators.

There you are—some of the highlights of how we were ready in case the Axis wanted to play rough. It's obvious that the training and offensive and defensive equipment provided by the Chemical Warfare Service constituted our best insurance against the use of poison gas.

Civilian Designs Simple Gas Mask

While fingers hold the nose, air is sucked through the bag

WITH the threat of gas raids hanging over more and more cities in Europe, the demand for gas masks in many communities far exceeds the supply. To provide some sort of gas protection in case of an emergency, an ingenious Scandinavian inventor has designed the improvised mask shown at the left. It consists simply of a hollow wooden tube and a cloth bag filled with chemicals. Air purified by the chemicals is sucked into the mouth through the tube, while the nose is held shut with the thumb and forefinger of the hand holding the mask.



Air-Raid Vault Uses Chain of Gas Masks

LIKE smokers grouped around a Turkish bubble pipe, users of a new French air-raid shelter inhale from a common source. Tubes connect their masks with a single pipe leading from a battery of oxygen cylinders, as shown above. Thus they are constantly assured of pure air to breathe, without recourse to poison-absorbing canisters that hinder free respiration; and elaborate gasproofing precautions may be dispensed with.

GAS MASKS

by Robert Gordon

Above—Japan, too, is preparing her people against possible gas and bombing raids. Cameraman at left is taking pictures of a mock gas raid staged at Tokyo. Priests, soldiers, and civilians are supplied with masks. Left—Squads of volunteer workers are equipped with portable sirens for warning towns of gas attacks.

ENGLAND is manufacturing 30,000,000 gas masks for civilians at the rate of 250,000 per week. By the end of the year they will be stored at convenient centers available for instant use. Italy has decreed that every new house constructed must have a concrete anti-gas shelter in the basement in accordance with government specifications. Masks are sold in Rome on the installment plan.

French drug stores sell masks. Russia has devised special models for children and conducts gas as well as fire drills in schools. Germany and every other European country have provided masks and fume-proof shelters for civilians operating electric power plants and other vital services. A Czech manufacturer is marketing a mask with a telephone and microphone attachment for the conduct of business as usual in spite of gas.

This all goes to show that Europeans, unprotected as America by wide oceans, from hostile nations, have a genuine personal fear of death from the clouds in a general conflict. Just how real the danger is a matter of argument. Gas figured little, if any, in the first six months of the Spanish struggle and it is obvious that the element of surprise, which made the first World War attacks so terrible, is no longer present.

Chemists agree that the most deadly gases are also the most volatile—the most easily blown away. No less an authority than Colonel Adelno Gibson, chemical officer of the Second Corps Area, says that the reports of "super" gases developed since the World War are myths.

Below — English mothers participate in gas drills, donning masks, and conducting their children to gas-proof shelters. Right — During a mock gas raid, a French soldier summons aid for his fallen comrade who failed to don mask quickly enough

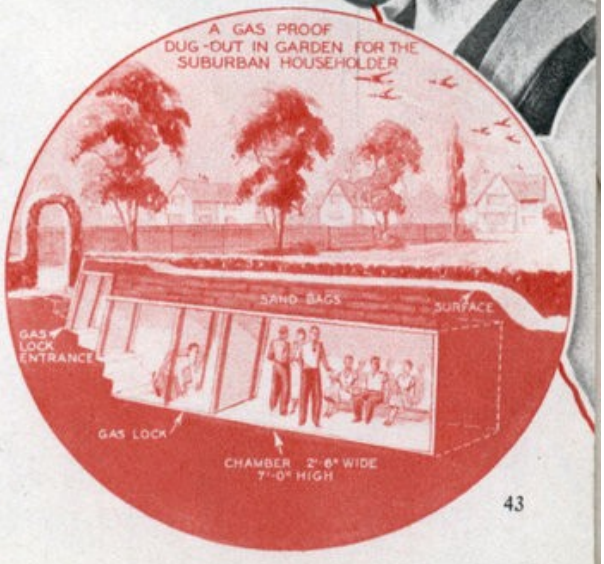
FOR ALL

The possibility of civilians losing morale and being thrown into a panic by gas, however, is everywhere recognized. It is to guard against this that the British have set up an Air Raid Precautions Department as part of the Home Office. In Germany, the National Air Safety League with the slogan "Save Yourself" has distributed 7,500,000 masks to its members. Its most popular model is one selling for $6. The British civilian mask costs the government but two shillings.

What all mititary men know, but what many civilians do not understand, is that the object of an air raid over a large city is to create panic, to cause enough cessation of industry and commerce that armies cannot be supplied, and to so weaken the will of the populace that they will demand peace on any terms without waiting for a decision to be won by their army on the field of battle. Death and property damage are not the end in itself.

The possibilities of destruction by aerial bombing have been greatly exaggerated. During the last nine months of the World War, for instance, according to official figures published in the *Coast Artillery*

Right—In England, gas masks are sold for civilian use at a cost of about 50c each. The respirators are refillable and provide protection for periods up to 12 hours at a time. Below — Proposed gas shelter designed for construction in suburban communities and gardens.



Journal, more than 400 planes took off to bomb Paris. Over half of these planes were brought down before they reached their objective. Those that did release their bombs took a toll of roughly 400 killed and 1,400 wounded.

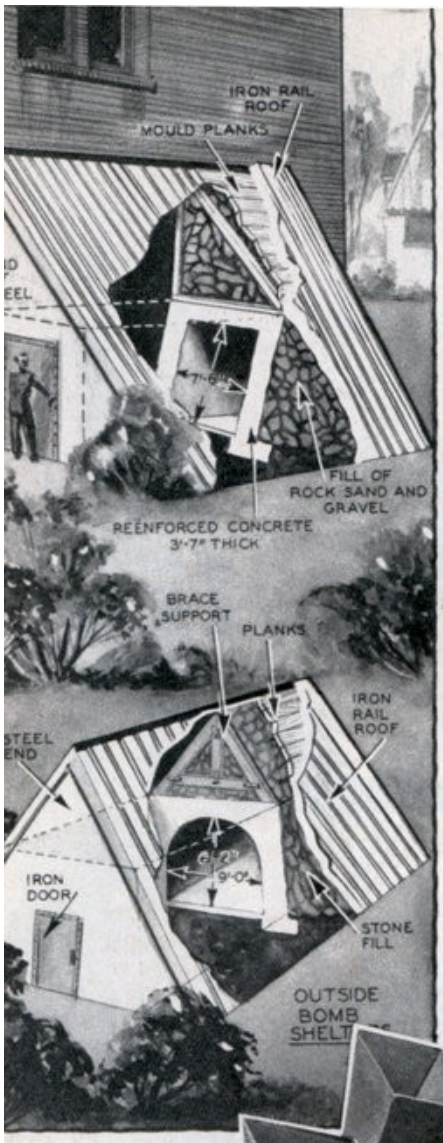
Since then, however, the speed of bombing planes has doubled, their range has been increased five times, and the pay load five times on the most modern types. The largest aerial fleet in existence is the Russian, with 7,000 planes, approximately half of which are bombers.

If we grant that the destructive effect of bombers has increased five times, without any increase in the effectiveness of defensive measures, it would mean that the largest possible raid on a European city would cause about 8,000 deaths and 28,000 wounded. This is a frightful toll, but it is a far cry from the horror pictures so frequently painted, in which a city such as London is wiped out in a few minutes.

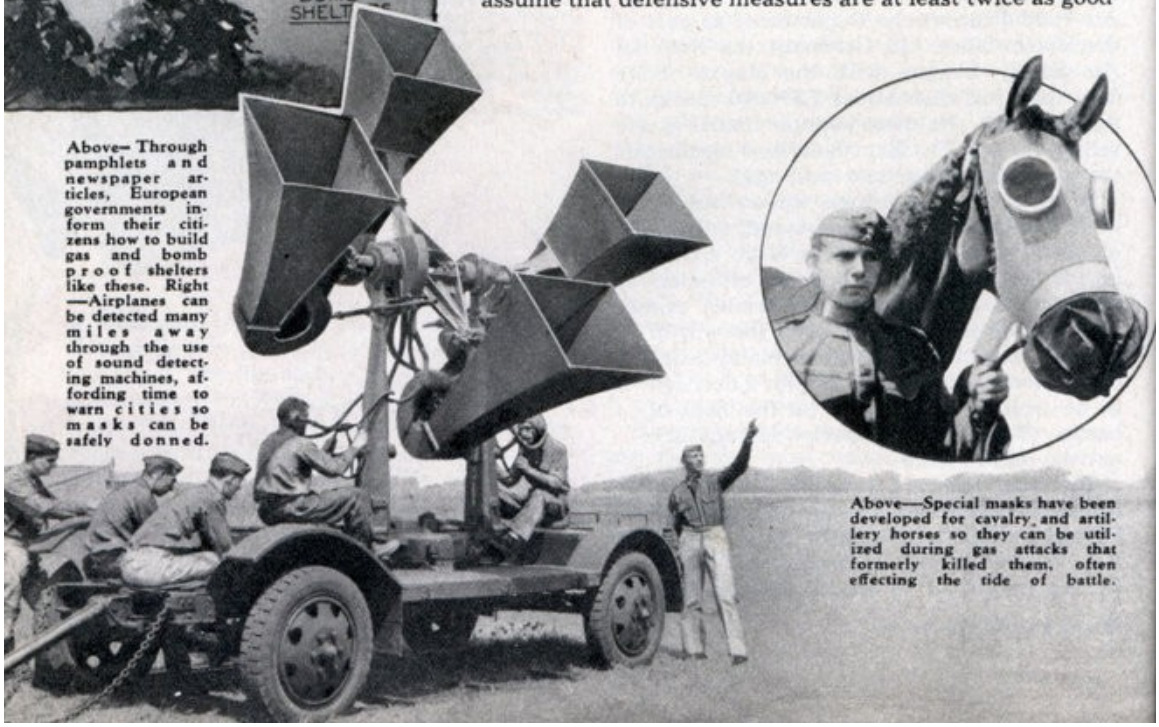
But we cannot ignore the rapid development of defensive measures. All European countries today have elaborate defensive zones, bristling with hundreds of searchlights, sound locators, anti-aircraft guns, and airdromes for fast climbing interceptor planes, all connected up with telephonic warning stations, and all cooperating as a unit under one command.

Dr. Hans Brehm, writing in *Luftwehr,* the leading German aviation magazine, says that with a ground defense system organized within a 400-mile zone, a hostile air expedition would be forced to run the gauntlet of 37 anti-aircraft batteries. With only two per cent hits, this would be equivalent to annihilation of the air force.

Dr. Brehm, however, is an anti-aircraft enthusiast, so we may safely discount his optimism, just as we have discounted the pessimism of the aviation zealot. Having granted that bombing planes have increased in efficiency five times since the World War, we may conservatively assume that defensive measures are at least twice as good



Above—Through pamphlets and newspaper articles, European governments inform their citizens how to build gas and bomb proof shelters like these. Right—Airplanes can be detected many miles away through the use of sound detecting machines, affording time to warn cities so masks can be safely donned.



Above—Special masks have been developed for cavalry and artillery horses so they can be utilized during gas attacks that formerly killed them, often effecting the tide of battle.

as they were then, and cut our casualty list in half—4,000 killed and 14,000 wounded.

Strangely enough, the civilian fears gas more than he does high explosives, though casualty lists would indicate that gas is the most humane form of warfare. Dr. Freeth, Chief Rerearch Chemist, Imperial Chemical Industries, says:

"The amount of nonsense talked about poison gas is beyond belief. Chemical warfare has such a hold on the imagination of the civilian population that the main danger is psychological."

Captain B. H. Liddell Hart, noted British military expert, says: "The death rate among gas casualties during the World War was less than four per cent. Its outstanding effectiveness lay not in killing, but in hindering and upsetting military plans. It was a first class nuisance." As compared with this, less than 63 per cent of the casualties by high explosive lived, and many of these were maimed for life.

The Reverend Julius Arthur Nieuwland. Belgian-born professor of organic chemistry at Notre Dame University, and one of the inventors of Lewisite gas, was quoted in *Time* as saying: "Poison gas is a humane instrument of warfare. By the introduction of gas and other modern instruments of warfare, a progressively smaller percentage of combatants has been killed.

"In Biblical times, thousands of men met in the middle of a plain and slashed one another until only a few were left standing. Today, the primary aim is not to kill but to incapacitate. And poison gas is an ideal way of achieving that aim.

"If a man goes to the hospital suffering from gas he is as useless as if he were dead—and to care for him, several other persons must be kept out of the battle lines. The chances are that ultimately the victim will recover."

The author, having been both wounded and gassed during the World War, heartily endorses Father Nieuwland's theory. The acquiring of a most effective case of mustard

[*Continued on page* 142]

Circle—Interior of proposed shelter room showing supplies and arrangement to provide 12 hours protection without need of ventilation. Wet blankets guard the entrance to shelter rooms against penetration by fumes. Below—Woman entering an impermeable French "balloon" type gas shelter. Inflated by a pneumatic pump, it is quickly set up.

Gas Masks For All

[*Continued from page* 45]

gas burns was no more unpleasant than the acquiring of a severe case of sunburn at the beach—in neither case does one realize what he is letting himself in for until it is too late to do anything about it. Aside from the fact that my eyes and throat were also burned, bringing on temporary blindness and loss of speech, my suffering was not as great from the gas as it has been from severe sunburn, although the gas burns were harder to heal. Two months after the attack, however, there were no after effects. The wound, on the other hand, although classed as slight, caused intense suffering, took longer to heal, and bothered me for years.

Mustard gas and Lewisite are the persistent vesicant gases. Both the vapor and liquid produces burns. Unless splashed by the liquid itself, these burns are seldom severe enough to cause death in a healthy person. Since Lewisite also produces arsenic poisoning in the burns, it has a higher fatality rate than mustard; but it is not considered to be of as great military value, since it is less persistent than mustard. A rain, or the mere flushing of the contaminated area with water, will destroy Lewisite, while mustard continues to give off casualty producing vapors for days—sometimes weeks in cold weather.

Chlorine and phosgene, the common non-persistent asphyxiating gases, produce coughing, irritation of the eyes, pains in the chest, and difficulty in breathing. Long exposure to a strong concentration will cause death by asphyxiation. A good gas mask furnishes complete protection.

Some gases are not really gases at all, but finely divided solids — invisible and odorless smokes—the sneeze gases. The immediate symptoms of these gases are the most unpleasant of all. They cause violent irritation of the nose and throat, spasms of sneezing, pains in the head, teeth and gums, and intense mental depression. Removed to pure air and kept quiet for half an hour, the victim recovers completely. There are no after effects. Tear gas, used by police to control riots, causes an intense smarting of the eyes, a symptom that disappears after a few minutes in clear air.

The World War proved, and subsequent experiments have failed to disprove, that mustard gas is still the most effective casualty producing chemical known. With extreme low volatility, it evaporates slowly. It may remain in contaminated ground, or splashed on buildings, for days, slowly giving off a vapor with the not unpleasant smell of mustard. It may be sprayed as a liquid from airplanes, settling over everything, and making decontamination a gigantic task.

A military gas, to be at all practical, must be heavier than air, so that a casualty-producing concentration can be held on the ground. It must be stable, so it can be transported without danger of exploding. It must not corrode a container of cheap metal.

DEBUNKING *Poison*

by CAPTAIN GEORGE J. B. FISHER,
Chemical Warfare Service, U. S. Army,
as told to James Nevin Miller

ENORMOUS cities blanketed with death-dealing gas fumes. Citizens rushing about in panic as enemy planes roar overhead. Thousands of lives snuffed out in a few minutes. Countless humans coughing and screaming with fear, fighting among themselves to reach subterranean gas-proof cellars.

This is the terrifying picture so frequently painted by fiction writers, the movies, and the sensational press about the horrors of poison gas in the next war.

But is the picture a true one? Is there any basis in fact for it? No, says the Chemical Warfare Service of the United States Army. After more than twenty years experimentation with every kind of poison gas known to science, the nation's acknowledged authority on the subject has come to the conclusion that gas is the "bogey man" of war.

During mimic bomb and gas attack on Berlin, German soldiers set up signs warning citizens their lives were in danger. City was plunged in darkness, civilians hid in cellars during raid.

Above—Berlin street cleaners, attired in gas masks, counteract effects of poison gas by washing streets with special preparation following mimic air raid. Left—Transportable shelter developed by France to save civilians during gas attacks. During raids, rescue workers set up shelters, find overcome citizens, and revive them in the shelter which holds 5 persons.

Gas WAR SCARES

Europe is preparing for war. Her people are being drilled to use gas masks and to fight poison gas air raids. Will deadly gas wipe out American cities, destroy U. S. armies? Here are an expert's views on this "bogey man" of war.

Uncle Sam's chemists, convinced that the public has a right to know the real facts, even go so far as to say that as much as 12,000 tons of mustard gas, most devastating of all war time gases, could not possibly wipe out a big city's population. Not once in history has an aerial gas attack ever been launched against a city. While this method undoubtedly will be tried in the next war, such an attempted slaughter of defenseless millions actually is no more and no less than a fantastic dream.

Even in the World War, with hundreds of thousands soldiers massed in open fields, apparently perfect targets for aerial gas attacks, this method was not as destructive as other weapons of war. To prove this conclusively to the skeptical-minded, the Chemical Warfare Service cites these facts and figures. As little as 20 milligrams of mustard gas absorbed into the lungs will cause death. At first glance it would seem, therefore, that 12,000 tons of this chemical could wipe out a third of the population of the United States. However, this quantity of mustard gas was actually used during the World War. True it incapacitated 350,000 men. But only 2.5 per cent of them died. Thus

GAS IS EFFECTIVE WEAPON SAYS EUROPEAN EXPERT

Although he admits that poison gas is the least destructive weapon in modern warfare, Dr. Herbert Levinstein, one of the leading poison gas experts on the Allied side during the war, declares it is one of the most effective weapons for incapacitating enemy troops and throwing civilians into panic.

He claims that gas has not made war more dangerous because only a small percentage of gas casualties result in death.

"It has introduced fresh possibilities of effecting a strategic surprise which is quite different," he said. "Far more destruction of property, greater mortality and suffering are caused by dropping high explosive or incendiary bombs from aircraft than by using gas-filled bombs or shells."

He added that gas probably would be more effective, however, because it caused panic among uninstructed, unprotected civilians.

Smoke screens laid over a city by planes will make it difficult for enemy air raiders to launch bomb and gas attack. To drop gas raiding planes must fly low, making them vulnerable to anti-aircraft fire. No gas raids were attempted during the World War.

MIMIC AIR RAIDS TRAIN CITIZENS IN GAS WARFARE

it took an average of a ton of gas to injure every 29 victims and a ton and a half for every death!

There is a very simple reason why most poison gases are not more destructive and that is because weather conditions tend to reduce the harmful chemical effects to a minimum. A wind blowing at the rate of only four miles per hour, for instance, can move a huge cloud of deadly gas from a given region at the rate of 352 feet per minute. Result? Much of the chemical will be carried away over the heads of the people intended to be destroyed.

From the military standpoint, according to army experts, a gas attack on a city would scarcely pay. And in the case of such a contemplated attack the pure gases would be out, for obvious technical reasons. Take phosgene gas, for instance. This gas must be released from the ground and in great clouds to produce any material results. The airplane is not adapted for this. It can drop a cloud of smoke which hangs for a few moments while hiding some important operation. But the dispersion of lethal gas in this fashion is physically impracticable.

Nor can gas bombs be used. Simply because it would be impossible to concentrate enough gas to justify the action.

In the case of an aerial gas attack only liquid chemicals are of much value. And in making an attack on a city with a liquid sprinkler it would be necessary to fly low. Towering city buildings would preclude such an operation and the canyoned depths would never be reached. In fact the low flying planes would be shot down by anti-aircraft guns before the attack got well under way.

Lewisite, the deadly gas developed after the World War, a dark green fluid, might be dispersed in some fashion over a city and down into the streets. But water would quickly wash it and its poisonous vapors away. Should the gas rise from the ground, it would scarcely drift above second floor windows.

When poison gas was introduced by Ger-

[*Continued on page* 131]

Berlin realistically used ambulances and cared for "wounded" during mimic raid testing city defenses.

Training army officers at U. S. Chemical Warfare School at Edgewood Arsenal, Md. Officers learn to identify various poison gases by smell and prepare defense against them. Chemical cylinders are being used above.

Debunking Poison Gas War Scares

[*Continued from page 48*]

many into the World War at Ypres, the German General Staff was informed by chemists that the war would soon come to an end. Chlorine, a deadly poison, when released before the Allied position was expected to drift across "no man's land" and rout the enemy from its position. Once in the open the German troops would everwhelm the British and French. True the gas barrage was successful. But the Germans never followed up the attack with troops.

To the Chemical Warfare Service this experience of the Germans at Ypres with chlorine suggests the impracticability of its use in an aerial attack.

Mustard Gas Is Most Dangerous

Searching through old records belonging to large-scale commercial chemists and utilizing the world's most complete data on some 250,000 chemical combinations, the chemical engineers of the warring powers from 1916 to 1918 sought a perfect gas.

The net result of a couple of years search was mustard gas, and it is doubtful, most chemists of today are convinced, if any other gas will ever be discovered with more effective qualities as an attack chemical. Phosgene is no more deadly but is the lightest of all the gases and therefore requires enormous quantities for purposes of destruction. Phosgene is volatile, but not as volatile as chlorine. Therefore phosgene cannot be classed as a real lethal threat to civilian populations in time of war.

Simple Mask Needed for Chlorine

Since the simplest mask is protection against chlorine, the general public need not fear it as an important agent of destruction. Chlorine will kill vegetation on a large scale but salt will do a better job and far less expensively.

Mustard gas is not very volatile. It is a persistent agent which affects the lungs very much like phosgene and is deadly on long exposure to it. The real threat offered by mustard gas lies in its liquid form. When scattered on the ground it gives off a suffocating vapor. Both the vapor and the liquid burn. So that proper protection against mustard gas necessitates the use of gas-proof and fire proof masks and suits.

Fluorine, a newly heralded war gas, has no application to war either as an explosive or poisonous gas. Its effects cannot be controlled—that is, its time of explosion cannot be ordered. Though lethal properties are claimed for fluorine, this chemical is too light for field use.

One of the first things to bear in mind when you hear wild remarks about large-scale

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Debunking Poison Gas War Scares

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"gassing of cities and civilians," according to the experts of the Chemical Warfare Service, is that, as yet, no aerial gas attacks have ever been made. There were none whatever during the World War. In addition to overcoming such defenses against air raids as aircraft guns, attacking planes, smoke screens and dirigibles, it is absolutely essential, in launching a successful gas attack, to have almost ideal conditions of wind and weather.

Night time affords the most desirable conditions for a gas attack. During the night or in the early morning hours, strong winds and ascending air currents are at a minimum. Foggy and cloudy weather are advantageous in keeping the gas on the ground. Heavy rain almost always washes out the destructive effect of poisonous vapors, while woods, grasses, bushes, trees and buildings serve to retard their movements.

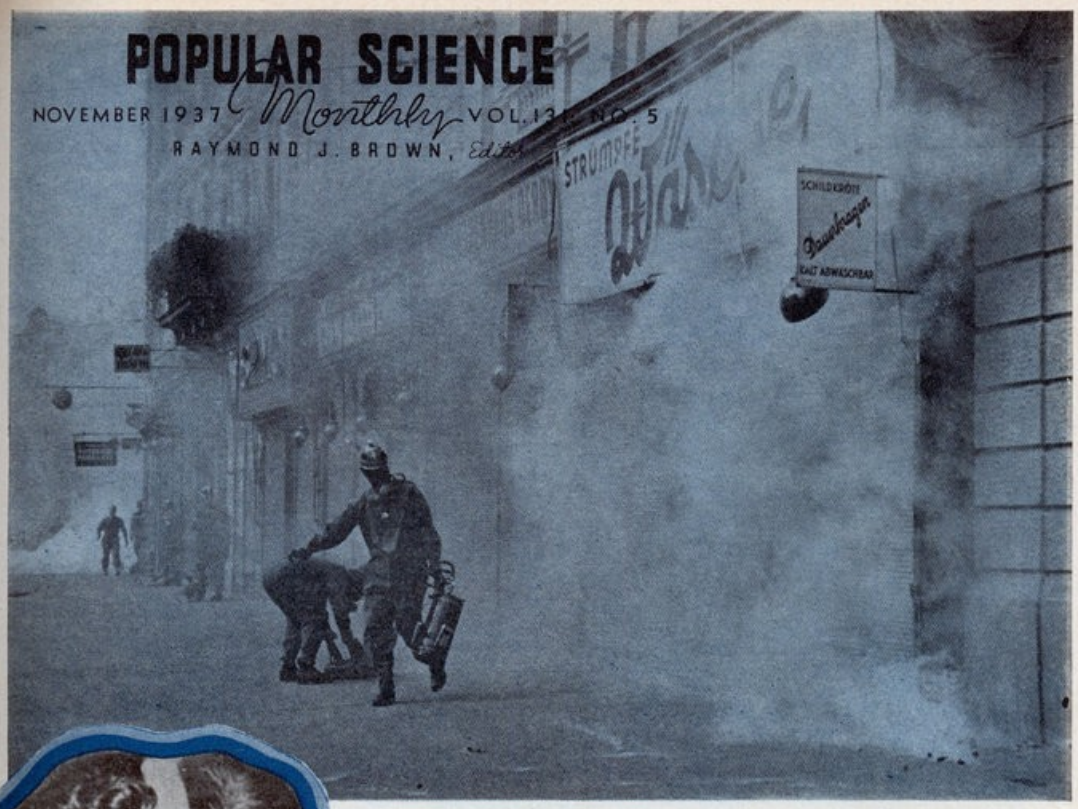
Aerial Gas Attacks Unlikely

All these things point to one rather obvious fact and that is—most aerial gas attacks are doomed to failure. Where civilian populations are concerned, training of every man, woman and child is urged by most of the world's leading powers. In Europe danger from gas attacks is considerably greater than in our section of the world. There great and powerful states, regarding each other distrustfully have more reason to be fearful of sudden aerial gas attacks. Here, on the other hand, we have peaceful neighbors on the north and south and oceans on the east and west.

It is not surprising therefore that in the great centers of Europe the public is taught protection against all types of poison gas. Especially devised masks and suits are being tried out on a large scale. In Berlin and other great national centers, enormous underground tunnel networks have been constructed to which the civilians may retire, not only from aerial gas attacks but from aerial bombing as well.

In this country there is little occasion for preparation, the Chemical Warfare Service contends. Certainly there is no reason for alarm about our cities being wiped out by a gas attack from enemy planes. In the first place thousands of planes would be necessary to accomplish the attack. And, in the second place, from a military standpoint an aerial onslaught of this sort would be of questionable value.

POPULAR SCIENCE Monthly
NOVEMBER 1937 VOL. 131 NO. 5
RAYMOND J. BROWN, Editor



Firemen patrolling the streets of Vienna during a sham aerial gas attack on the city

THE TRUTH ABOUT Poison Gas

By ALDEN P. ARMAGNAC

FRANCE sells gas masks to its citizens on a five-year installment plan. Germany reveals that it has secretly been manufacturing a new type of gas mask for noncombatants, by the million. Startled Britons learn that the world's first factory for civilian masks, at Blackburn, England, has passed its 9,000,000 mark and is turning out 100,000 a day to reach its quota of a gas mask for every man, woman, and child in the British Isles.

Few doubt that poison gas will play a major role in the dreaded "next world war." What will happen then? Will whole cities, teeming populations, be wiped out in an instant by noxious fumes? Are nations secretly guarding poison gases more horrible than we have ever known? At the outbreak of a world war, will chemists leap to their test tubes and create terrible new poisons to order?

How far such nightmare stories depart from fact has just been revealed by Lieut. Col. A. M. Prentiss of the U. S. Chemical Warfare Service, whose authoritative new book, "Chemicals in War," debunks many of the popular misconceptions about poison gas.

From time to time we hear rumors of

DEADLY ON BATTLEFIELDS, IT IS NOT TO BE FEARED BY CIVILIANS

In future wars, trained men, outfitted in special clothing, will quickly rid city streets of poisonous fumes and liquids after an air raid

Civilian preparedness has gone a long way toward removing the horrors of gas warfare on noncombatants. Below, an emergency crew goes to the aid of a civilian "overcome" during a recent French demonstration of gas-defense tactics

Neighborhood stores in many foreign countries sell gas masks to civilians. The group of Swiss women pictured above are purchasing their masks at a drug-store counter

a "supergas," a few hundred pounds of which, dropped from the air, would wipe out the entire population of a city like New York. This country or that is supposed to have discovered it, and to be keeping it in hiding for the next war. Military chemists of a good many nations would like to know of such a gas. The plain fact is that it doesn't exist—except in the imagination of sensational writers.

While two or three new gases have been developed since the World War, none that we know about is startlingly more dangerous than the chemicals used in that conflict. And the mathematical odds are all against the possibility that any nation has secretly discovered such a gas, or will do so in the immediate future.

During the World War, chemists tested more than 3,000 likely chemical compounds and eliminated all but thirty-eight as possible war gases. When these were tried out in battle, not more than half a dozen proved useful for military purposes.

There is a simple reason why additional deadly or disabling war gases are so rare and hard to find. To be a real menace on the battlefield, a gas must be more than poisonous. One of the least effective gases in the World War, for example, was the deadly vapor of hydrocyanic acid. It is one of the most virulent poisons known to man and often is used for the execution of criminals. One or two full breaths cause almost instant death. Fortunately, it has one defect as a war gas. Being lighter than air, it rises harmlessly instead of clinging to the ground and rolling into trenches, dugouts, and city streets.

To be dangerous in wartime use, poison gas must be heavier than air. Raw materials to make it must be readily available. It must be simple to manufacture. It must not spoil in storage. If it is a true gas, it must be capable of being liquefied by moderate pressure in order to be loaded into shells and bombs in concentrated form. If it is a liquid, as some war "gases" are, it must be volatile enough to release clouds of vapor at ordinary temperatures. At least a dozen other requirements could be listed. Discovering a poison gas that combines all these properties is about as easy as finding a left-handed man with blue eyes and a red beard who

weighs between 180 and 185 pounds, speaks seven languages, and plays the piccolo!

However, where chemists have been unsuccessful in their search for a super-gas, the mechanicians of the world's armies have devised new and more horrible ways of using the known poisons.

Aerial gas raids are the latest terror in gas warfare. No World War planes carried gas. Today, aircraft equipped to use it in either of two ways are a part of every important air force. Bombs loaded with chemicals now may be dropped upon a target, exploding and scattering their contents. From tanks beneath the wings, liquid gases may also be sprayed into the air like insecticides, to settle slowly to the ground as a poisonous mist. Italian aviators tried out both methods with deadly effect in their Ethiopian campaign. How much harm they would do against troops of a first-class military power, well trained in gas defense, remains to be seen. Uppermost in the average person's mind, however, is the question of what would happen if they should be unleashed upon the millions of noncombatants of a great city such as New York or London.

But will they be? It has been suggested that certain nations have been deliberately inspiring propaganda exaggerating the likelihood and horrors of aerial gas raids on city dwellers, in order to frighten and bluff other countries and get what they want without actually going to war. There are excellent military reasons, aside from any humanitarian considerations, why a great city is one of the least likely of targets for an aerial gas attack.

First of all, tall buildings make it unsafe for aircraft to fly at an altitude as low as 300 feet, as they must do to spray liquid gases. Planes could drop gas-filled bombs, but many would strike rooftops and release their contents harmlessly. Since war gas clings to the ground, poison-gas bombs are not dangerous unless they reach the streets; and only one bomb out of two would do so, on the average. That may not seem very reassuring, until you realize that the concentration or quantity of poison gas in the air may make all the difference between its being *(Continued on page 137)*

French citizens get five years to pay for masks shown in government testing boxes above

Although aerial gas bombs like these are effective in open country, they would probably have little effect on a large modern metropolis

Experts agree that the work of trained rescue and decontamination crews, like the one at the left, will make a city about the safest place to be during a gas attack

The Truth About Poison Gas

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deadly and its being harmless, just as carbon monoxide gas from automobile exhausts is deadly in a closed garage and harmless in the street. Fortunately, asphyxiating or "killing" gases like phosgene must be present in high concentration to become any great hazard, and are therefore not to be feared in air raids on cities.

Mustard gas and geranium-scented lewisite, a newer blistering gas, might be dropped in bombs and would be decidedly unpleasant to encounter. Neither is usually fatal, however, and people caught on a city street when a gas-raid alarm was sounded could find instant shelter in tall buildings and would be safe from these gases a few stories above the street with windows closed. After a raid, special squads in masks and protective clothing would block off the gassed areas with danger signs, closing them to traffic, and set about "decontaminating" them by hosing the poison down the sewers or destroying it with scrub brushes and chloride of lime.

ABOUT the greatest harm to be feared from an aerial gas raid on a city, therefore, would be the terrorizing of the more excitable inhabitants. For this purpose, army tacticians probably will use the relatively harmless tear and sneeze gases, for they do their work at lower concentrations and in smaller quantities than other war gas.

Civilian preparedness has gone a long way toward removing the horrors of gas attacks on noncombatants. Mimic air-raid drills, the building of gas-tight refuges, and the distribution of masks have acquainted the man in the street with the various methods of gas defense. In Great Britain, "gas schools" and educational exhibits are teaching city dwellers how to use one room of a house as a gasproof shelter. In case of an air raid, the entire family can move into it and seal it air-tight with newspapers and blankets, using gas masks only if necessary as a second line of defense.

Evidently, we do not need to worry much about gas attacks at home. As for soldiers on the battlefield—well, that is another story.

USING every known gas against enemy troops, air raiders may completely revise the tactics of warfare. Troops will have to be moved to the front by motor truck instead of by train; fixed terminals offer targets too promising for aerial gas attacks. If planes discover and attack the motorized columns, the men will not know whether to scatter for safety from explosive bombs or to stay in their vehicles for cover from gas bombs or spray.

Other new gas weapons will add to the soldier's woes. Chemical land mines will be exploded, and areas sprinkled with liquid poison from motorized tank wagons, to block an advance. The latest compressed-gas cylinders for releasing wind-borne clouds of poison gas from front-line trenches have "silencer nozzles," eliminating the high-pitched hissing noise of world-war cylinders that gave warning five to twenty seconds before the gas arrived.

That is the picture of up-to-date gas warfare, according to those who are in the know. *(Continued on page 138)*

The Truth About Poison Gas

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Horrible? Humane? Much depends upon the point of view.

There is nothing particularly humane about blowing men to pieces with high explosives and riddling them with bullets and bayonets, leaving them to expire in agony or to survive as mutilated physical wrecks. In contrast, chemical-warfare men maintain, gas causes less suffering, and leaves a man whole.

Contrary to popular belief, gas seldom causes permanent injuries or after effects. One common idea is that gas predisposes its victims to tuberculosis, but a medical investigator tracking down this belief actually found half again as many cases of tuberculosis among soldiers who had not been exposed to gas as among soldiers who had been gassed!

AS FOR the deadliness of gas compared to other means of waging war, World War figures show that only two percent of the total gas casualties were fatal, while more than twenty-five percent of casualties from all other causes resulted in death. In other words, a soldier incapacitated by gas had more than twelve times as much chance of escaping with his life as a soldier wounded by other weapons.

However effective it may prove on the battlefield, for the civilian at home in a city far behind the lines the menace of gas appears to be much less than sensational writers would have us believe. Even if this weapon should be used extensively in another war, its natural limitations and the improved defensive methods probably would do much to rob it of its terrors.

Hunting Lost Worlds

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colonies, just as pools are left by the ebbing tide of the ocean.

When A. Conan Doyle wrote his imaginative story, "The Lost World," he laid the action on the rocky, mist-enshrouded summit of Mount Roraima, a peak that straddles the boundary between Brazil and Paraguay, in South America. A few years ago, scientists from the American Museum of Natural History set out to scale this jungle peak. In an Odyssey of exploration they crept for days up slanting ledges of rock, losing their way in the interminable mist of the mountain top and having their shoes cut into ribbons by the grinding sandstone. After reaching the top, they spent weeks studying the creatures that live on the twenty-five square miles of the summit. When they returned to civilization, they brought varieties of bird and animal life hitherto unknown to science.

EXPEDITIONS such as this, and the one now flying westward to scale Shiva Temple in the Grand Canyon, comprise a doubly dramatic form of exploration. The scientists do more than penetrate hitherto unknown areas. They penetrate the world of the remote past as well. By discovering ancient forms of life, they seek to turn back the pages of history millions of years, enabling us to visualize more clearly the lost world of prehistoric times.

Cross section of filter of gas mask