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U. S. Bureau of Ships Manual  
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BOARD OF SHIPS

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CHAPTER 20

SANITATION







# BUREAU OF SHIPS MANUAL

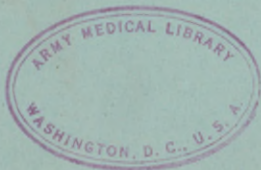
## CHAPTER 36 SANITATION

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U. S. NAVY DEPARTMENT

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U.S.

# BUREAU OF SHIPS MANUAL

## CHAPTER 36 SANITATION

NAVY DEPARTMENT,  
Bureau of Ships,  
1 October 1946.

This chapter is a revision of Bureau of Ships Manual, Chapter 36, "Sanitation," dated 1 October 1942.

This revised chapter becomes effective upon receipt and shall be inserted in its proper place in the Manual binder.

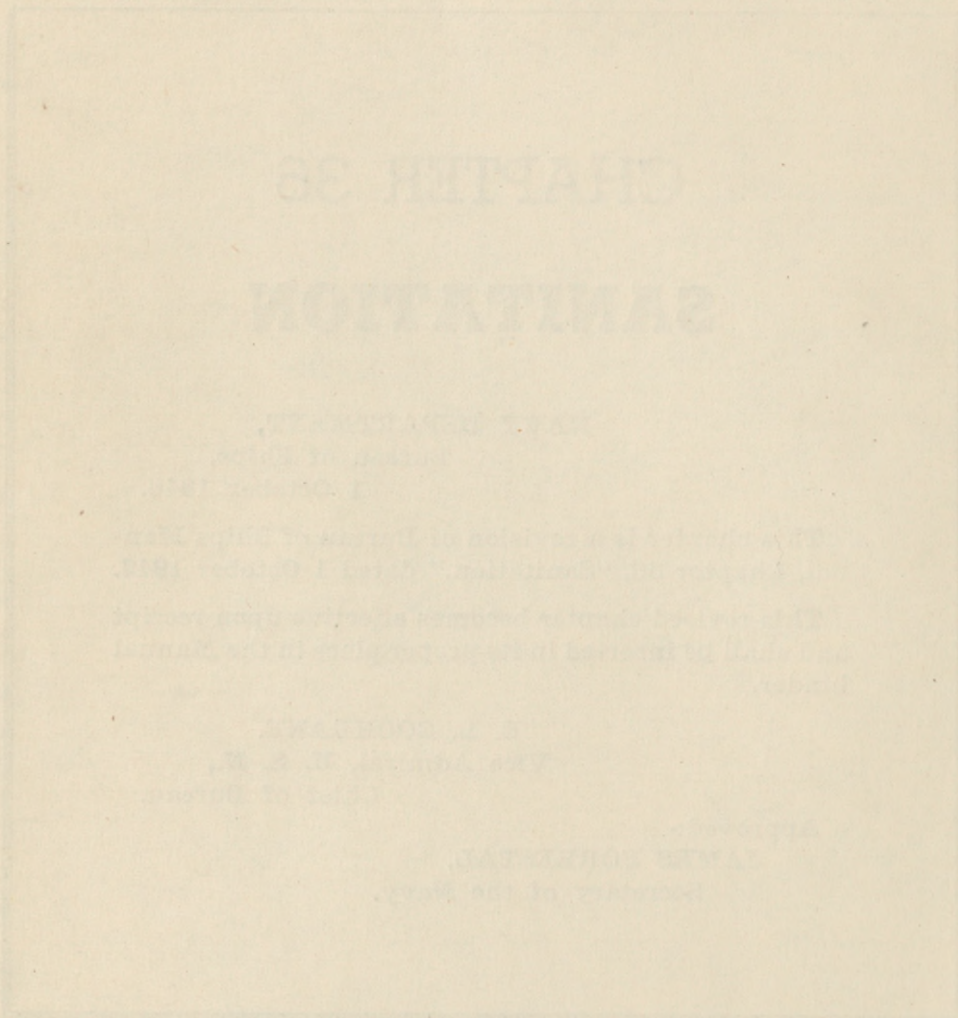
E. L. COCHRANE,  
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Chief of Bureau.

Approved:  
JAMES FORRESTAL,  
Secretary of the Navy.

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# Chapter 36

## SANITATION

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### SECTION I—TRASH AND GARBAGE DISPOSAL

#### 36-1. TRASH BURNERS

Trash burners are designed for the purpose of disposing of easily combustible material such as wooden boxes and crates, cardboard containers, papers, rags, etc.

#### 36-2.

Trash burners installed in converted ships and in newly constructed vessels during the years 1940 to 1942, inclusive, were of one size only, having a burning capacity of approximately 70 pounds of trash per hour. These "Bureau type" units utilize a box-shaped, water spray spark arrester located immediately adjacent to the burner. Practically all of these trash burners, now considered obsolete, have been replaced with units of the type shown on Bureau of Ships Plan No. S3604-74974. These latter units, installed subsequent to 1942, are of various sizes and are designed to operate under either natural or forced draft (see art. 36-3); installations are made in accordance with the requirements as outlined on Bureau of Ships Plan No. S3604-74974.

#### 36-3.

Trash burners operating under natural draft are installed either on decks open to the atmosphere, or in compartments containing openings which insure that an adequate and continuous supply of air, under atmospheric pressure, will be furnished for combustion. Trash burners operating under forced draft are installed in airtight compartments maintained under a positive air pressure, and utilize separate fog nozzle type spark arresters which are installed in the trash burner smoke pipes.

#### 36-4. OPERATION AND CARE OF TRASH BURNERS

The instructions listed below should be strictly followed, in the sequence listed, for the proper operation of the trash burner.

(a) Clean out ash pit, all other chambers, and grates. Remove all wires, metal straps, and all

other noncombustible material left over from the previous burning period.

(b) Open tertiary air connection (smoke pipe air damper at gas outlet of trash burner). This fitting is utilized with all trash burners operating under forced draft.

(c) Open dampers on trash burner to admit "over fire" air.

(d) Open air register in ashpit door.

(e) Close cleaning door having access to secondary chambers.

(f) If installed, place the spark arrester in operation by following instructions as given on Bureau of Ships Plan No. S3604-101780. The spark arrester, which utilizes a water spray to quench sparks, must be operating prior to the lighting off of the trash burner so as to be protected from the hot flue gases. Inasmuch as this equipment is not cooled by flow of air, the utilization of the water is mandatory to keep its temperature within safe limits when the burner is in operation; also, water expelled through the nozzle openings keeps this part of the equipment from fouling. For the above reasons, the trash burner should never be operated without first placing the spark arrester in service, regardless of the necessity for sparkless operation.

(g) For installations designed to operate under forced draft, close all outside trash bin doors and door leading from the trash burner compartment to passageway and start blower. About 2 inches of water pressure should be maintained in the compartment while burner is operating.

(h) For trash burners installed in a compartment and operating under natural draft, insure that a continuous supply of air under atmospheric pressure is available.

(i) Prepare trash for firing by breaking up all boxes, crates, and large pieces.

(j) Light off and slowly build up the fire. Do not load higher than the center line of the firing door since loading above this point will restrict the flow



of "over fire" air, and also will decrease the furnace volume, causing smoke, back draft, and a decreased rate of combustion.

(k) Optimum firing conditions are maintained with the furnace door shut. For this reason, it is desirable that trash be loaded into the furnace in large batches and at infrequent intervals.

(l) Stoke as little as possible.

(m) To secure the trash burner, let trash burn out completely.

(n) Keep blower running for one-half hour after trash is completely burned.

(o) Shut off flow of water to the spark arrester.

(p) Shut off blower.

### 36-5. GARBAGE GRINDERS

Garbage grinders are provided to grind ordinary garbage, such as disposed of from a naval vessel's galley, to a finely divided mash or pulp which can be carried away by water through a sluice pipe discharging into the sea.

### 36-6. DESIGN AND INSTALLATION OF GARBAGE GRINDERS

Garbage grinders approved for shipboard installation are designed in accordance with Navy Department Specification 66G1. Two sizes are furnished. The large size, having a rated capacity of 1,600 pounds of garbage per hour, is furnished vessels having complements of over 500 men. The small size, having a rated capacity of 400 pounds of garbage per hour, is furnished to ships having complements below 500 men. Installation of garbage

grinders is not made on all naval vessels except as approved by the Bureau of Ships. Certain installations have been made, on LST type vessels among others, of a small commercial garbage grinder with a rated capacity of 200 pounds of garbage per hour.

### 36-7. OPERATION AND CARE OF GARBAGE GRINDERS

Prior to operation of the garbage grinder, the instruction book prepared by the manufacturer should be studied. This book includes a description of the machines and instructions for the operation and maintenance of the garbage grinder. The man feeding the garbage into the grinder is to stand in front of the grinder and is to pick out and discard all metal, tableware, glass, crockery, wood, leather, ham and bacon rinds, rags, feathers, and bones (larger than three-quarter inch in diameter for the small size grinder and larger than 1 inch in diameter for the large size grinder). Cans of garbage will be dumped into the feed chute and the garbage will be picked and fed by hand at a rate not to exceed the ratings listed in 36-6. Corn husks, raw meat, and chicken entrails are not readily shredded and must be fed at a slower rate. Feed the garbage at a regular and uniform rate, a small quantity at short intervals rather than a larger quantity at longer intervals. If a large quantity of garbage is accidentally fed into the grinder or some unusually tough garbage is fed into the grinder, allow the grinder time to regain its full speed before feeding additional garbage. The interior of the grinder should be flushed out clean immediately after each period of operation.

## SECTION II—SHIPS' CLEANING EQUIPMENT

### 36-11.

It has been found that rerolling and restowing of collapsible wash deck hose in such a manner that the

old seam, or line of crease, lies flat in the stowage prolongs the life of the hose considerably (by avoiding continued flexing or creasing in the same line). This should be done periodically on all ships.

## SECTION III—INSECT PEST AND RODENT CONTROL

### 36-21. INSECT PEST CONTROL BY INSECTICIDES

Use of standard stock catalog materials, such as aerosol, DDT compounds, powders, and solutions, and roach exterminator in powder or tablet form, is recommended as the most direct, cheapest, simplest, and usually most effective means for control of insects. Cockroaches, water beetles, ants, lice, fleas, and silver fish may be best attacked by application of DDT to runways and hiding places, using such as dusting or blower application of 10 percent DDT diluted powder, or spray application of non-explosive DDT emulsion (NOT xylene-DDT emulsion) or water dispersable DDT powder, preferably in 10 percent strength. Where insect infestation warrants, storerooms should be emptied, cleaned thoroughly, and sprayed with either the nonexplosive DDT emulsion or the water-dispersable DDT powder.

These same solutions, reduced to a 5 percent concentration, shall be used for eradicating bed bugs. One-half pint of the 5 percent DDT solution per mattress and bunk will provide adequate control. Mosquitoes in holds and compartments should be sprayed with aerosol bombs when a ship leaves a malarious area. Mosquito larvae should be destroyed by emptying water containers, and by spraying with DDT those potential breeding sites which cannot be emptied, such as life boats.

### 36-22. INSECT CONTROL BY FUMIGATION

Fumigation solely for the control of insects shall be undertaken only for the eradication of moths, weevils, or beetles in dry food stores aboard ship where other means of control are not practicable. Infested dry foodstuffs should preferably be returned



to shore-based supply depots for fumigation under the supervision of specialists, if such facilities are available and it appears economically feasible to do so. Foodstuffs beyond salvage should be surveyed in accordance with Navy Regulations.

### 36-23. RODENT CONTROL BY HYDROCYANIC ACID GAS FUMIGATION

1. Hydrocyanic acid gas fumigation is most effective and economical, but because of its extreme toxicity, it may be used only by experienced personnel and even in such hands it always requires abandonment of the ship for a more or less protracted period. Fumigation of a ship by hydrocyanic acid gas, to be conducted by the United States Public Health Service, is authorized under the following conditions:

(a) Where the rules of the Public Health Service require cyanide fumigation by the United States Public Health Service before docking at a United States port.

(b) Where, in the opinion of the commanding officer, the rodent population of the ship may not reasonably be exterminated by trapping, and the facilities and personnel of the United States Public Health Service are available to conduct such fumigation.

2. The cost of the materials used by the Public Health Service for fumigating naval vessels will be borne by the Navy Department.

### 36-24. CARBOXIDE GAS FUMIGATION

1. The only fumigant authorized for shipboard use by naval personnel is carboxide gas. When used in the prescribed concentrations, with the ship properly sealed, it is an effective insecticide and rodenticide, although it is of such low toxicity that it may be applied aboard ship by naval personnel without undue hazard, with a minimum of interference with ship's routine, and without interfering with the scheduled operation of the ship. Fumigation by carboxide gas is authorized under the following conditions:

(a) Where, in the opinion of the commanding officer, deratization is urgently needed in ports where United States Public Health Service facilities and personnel are not available for conducting hydrocyanic acid gas fumigation.

(b) Where required for control of insects in foodstuffs, as outlined in paragraph 36-22.

### 36-25. CARBOXIDE GAS—SOURCE OF SUPPLY

Carboxide gas shall not be carried on board naval vessels as a part of regular allowance equipment. When required, it should be obtained by requisition on the nearest naval shipyard or station. Need for the material should be anticipated as far in advance of actual use as possible in order that the supply yards or stations may acquire the carboxide by the time required. Vessels on the west coast

should obtain it from the Mare Island Naval Shipyard; those in the Asiatic, and at Pearl Harbor, from the Pearl Harbor Naval Shipyard, which, in turn, should obtain it from the Mare Island Naval Shipyard. Vessels on the Atlantic coast may obtain it from the New York Naval Shipyard. Those in the Canal Zone may obtain it from the submarine base at Coco Solo which, in turn, should order it through the New York Naval Shipyard.

### 36-26. CARBOXIDE GAS CONTAINERS

The carboxide gas is delivered in steel cylinders of 30 pounds and 60 pounds capacity, respectively. In ordering, consideration should be given to the capacity of cylinders which can be most advantageously and economically utilized in the spaces to be fumigated.

### 36-27. COST OF CARBOXIDE GAS

The cost of the carboxide, when obtained, will be chargeable to ships' regular quarterly allotments. The following prices which have been quoted for this material may be of assistance to ships in calculating the cost of contemplated fumigation.

	60-pound cylinders per pound	30-pound cylinders per pound
F. A. S.	\$0.19	\$0.225
Panama C. I. F. Balboa	.245	.305
Panama C. I. F. Cristobal	.225	.28
Hawaiian Islands C. I. F. Honolulu (min. B/L \$5)	.225	.28
Mare Island Naval Shipyard—Delivered	.19	.24
New York Naval Shipyard—Delivered	.19	.22

### 36-28. RENTAL OF CARBOXIDE GAS CYLINDERS

Free rental of cylinders is allowed by the manufacturer of carboxide gas for 90 days except in cases of shipment to ports outside the United States. In the latter cases the free rental is for 6 months from the date of shipment by the manufacturer. Vessels obtaining this material should, accordingly, insure the prompt return of empty cylinders to the source from which they were obtained.

### 36-29. GENERAL DATA ON CARBOXIDE GAS

(1) Composition and physical properties: 10 percent of ethylene oxide and 90 percent of carbon dioxide, both components being 1.5 times as heavy as air. The ethylene oxide is the insecticidal fraction, the carbon dioxide rendering the mixture non-inflammable. The carbon dioxide also markedly accelerates the respiration of the insects and hence renders the ethylene oxide more effective by increasing the speed of its absorption by the insect. The pressure of a full cylinder is 725 pounds per square inch at 70° F., the mixture issuing as a liquid to a fine mist and completely vaporizing within a few minutes. The gas has a faint but distinct etherlike odor easily recognized in the concentration set up



for fumigation and is noninjurious to clothing, gold braid, furniture, or food products.

(2) Concentration for insects: 6 pounds per 1,000 cubic feet for an exposure period of 3 hours, based on the gross cubical contents.

(3) Hazard for man: The hazard in the concentration set up for fumigation is comparatively slight as compared with hydrocyanic acid gas, the toxicity as estimated from animal experiments being only about one-fiftieth of that for hydrocyanic acid gas. There is, however, risk of headache, nausea, and vomiting if personnel violate the simple precautions outlined hereunder in regard to the entering of spaces inadequately aerated following fumigation.

(4) Closure of ships' spaces: Closure should be as airtight as possible in order to reduce leakage of carboxide to a minimum. This should be susceptible of quick accomplishment for watertight compartments.

(a) Ventilating system (supply and exhaust): Watertight covers where provided should be closed to isolate the space being fumigated. Otherwise, the dampers of all terminals must be closed and the louvers plugged with damp rags or waste.

(b) Special measure: Commercial masking tape should be utilized for the sealing of door seams and various cracks and crevices. It adheres effectively and leaves no residue on removal. Masking tape should be equivalent to Navy Department Specification 53T-6. It should be obtained in rolls 2 inches wide and 60 yards in length. The quantity needed will naturally be dependent on the conditions encountered. An average estimate would be one roll of masking tape per 60 pounds of carboxide required. Wrapping paper coated with engine grease or vaseline and sealed at the edges with masking tape is satisfactory for the closure of larger openings such as door louvers, the grillwork of staterooms, and food-carrier openings. Masking tape may be replaced in an emergency by strips of ordinary paper and starch paste, but the application is time-consuming and requires extensive cleaning to remove the material.

(5) Diffusion: Proper diffusion of the fumigant throughout the space or spaces is essential. This will be accomplished by the operation of ordinary bracket fans alone, or combined with portable ventilating sets.

(6) Open-flame heaters or exposed-element electric heaters should not be used in areas being fumigated. In the presence of relatively high temperature, such as may be locally produced by such devices, the ethylene oxide content of carboxide may break down chemically, lose its fumigating properties, and create a condition of inflammability not existent in the original fumigant. This hazard is not involved in the use of electrical circulating fans or portable ventilating sets to promote diffusion of the fumigant throughout the area.

(7) Special carboxide vaporizing nozzles should be used whenever they can be obtained. The carboxide gas may be discharged through the control valves supplied with the gas cylinder when it is desired to proceed with the fumigation and vaporizing nozzles are not available. Under no circumstances should rubber tubing or rubber hose be used with carboxide. Any added connections must be of metal and suitable for working pressures of 800 pounds per square inch.

#### 36-30. INSTRUCTIONS FOR USE OF CARBOXIDE GAS

(1) Preparation for fumigation:

(a) Penetration: Open wide all locker doors, furniture drawers, file cases, etc., and remove covers from mattresses and pillows in order to facilitate maximum access of the fumigant. For the same reason, clothing stowed in drawers and lockers should not be left tightly packed during fumigation.

(b) Ventilating system: Stop and seal as above indicated.

(c) All openings sealed: Seal any openings which might permit gas to escape. Utilize masking tape or a combination of greased paper and masking tape for magazine vents, voice tubes, radio leads, enunciator chain leads, nonwatertight doors, natural ventilators, etc. Close all drains in heads and bathrooms. Dog down all watertight doors and air ports.

(d) Diffusion: Start all bracket fans in space or spaces to be fumigated. If desired to further facilitate diffusion, also utilize portable ventilating sets so arranged as to make suction from areas tending to contain dead air. This arrangement will also facilitate aeration following fumigation.

(e) Handling of carboxide cylinders: Determine the cubical content of the space or spaces to be fumigated. Calculate the weight of carboxide required on the basis of 6 pounds per 1,000 cubic feet. There is no objection to exceeding this concentration of the fumigant except the additional cost and greater time required for aeration. Place the cylinders, and so direct the nozzle, as to effect the maximum concentration of the gas at the beginning in the area known to be infested. Carboxide may stain fabrics or painted surfaces if projected directly on them. Accordingly, when being discharged, the cylinders should be so located and secured as to insure that the carboxide does not directly strike any fitting or structure within 5 feet of the gas outlet. Securely lash all cylinders in the upright position as the violent discharge of the contents tends to unbalance the containers. Cylinders must be grounded before discharging gas in order to avoid static sparks. In case the cylinder is standing on linoleum or other insulating deck covering, grounding may be effected through wire lashing to a bulkhead or to metal furniture which in turn is grounded to some metal structure of the ship. Make certain that all personnel in the area are accounted for. Test all cylinder valves in advance in order to be certain that there is no resistance to opening by hand. In some cases a wrench may be necessary.



When all preparation is complete and all openings to the spaces are closed except the exit, open wide the valves of the cylinders successively, beginning with the unit farthest from the point of exit and with the nozzle directed away from the operator.

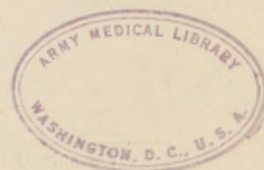
(2) Aeration after fumigation: Open the area fumigated at the end of 3 hours. Detail personnel wearing oxygen rescue breathing apparatus to open all air ports or other connections to the outside air and reestablish exhaust ventilation of the space which was fumigated. If the quantity of mechanical supply ventilation of the space is less than the mechanical exhaust ventilation, the supply ventilation may also be operated. Where permanent mechanical exhaust ventilation is not provided for the space, portable ventilating fans should be used for exhausting the space and the mechanical supply ventilation should not be operated. Maintain fans and portable ventilating sets in operation during the period of aeration. The time for adequate aeration will necessarily vary according to the status of ventilation, both natural or artificial, of the various parts of the

area fumigated. It will ordinarily be safe for personnel to enter for their normal activities 2 hours after full ventilation has been in progress. This period, however, should be determined by the officer in charge of the fumigation in conjunction with the medical officer. Particular care should be taken to clear spaces containing dead-air pockets where the odor of carboxide tends to persist. Storerooms or other poorly ventilated spaces should not be entered until the following day.

(3) Precautions for personnel:

(a) Working party: Members of the working party detailed to open carboxide cylinders, or to handle details connected with clearing of the area of gas after fumigation, shall wear oxygen rescue breathing apparatus. There is no risk of serious symptoms but this precaution will protect personnel against a possible attack of headache, nausea, and vomiting.

(b) General personnel: The personnel in general will not be permitted to resume their normal activities in the space or spaces following fumigation until so authorized by the fumigating authority.





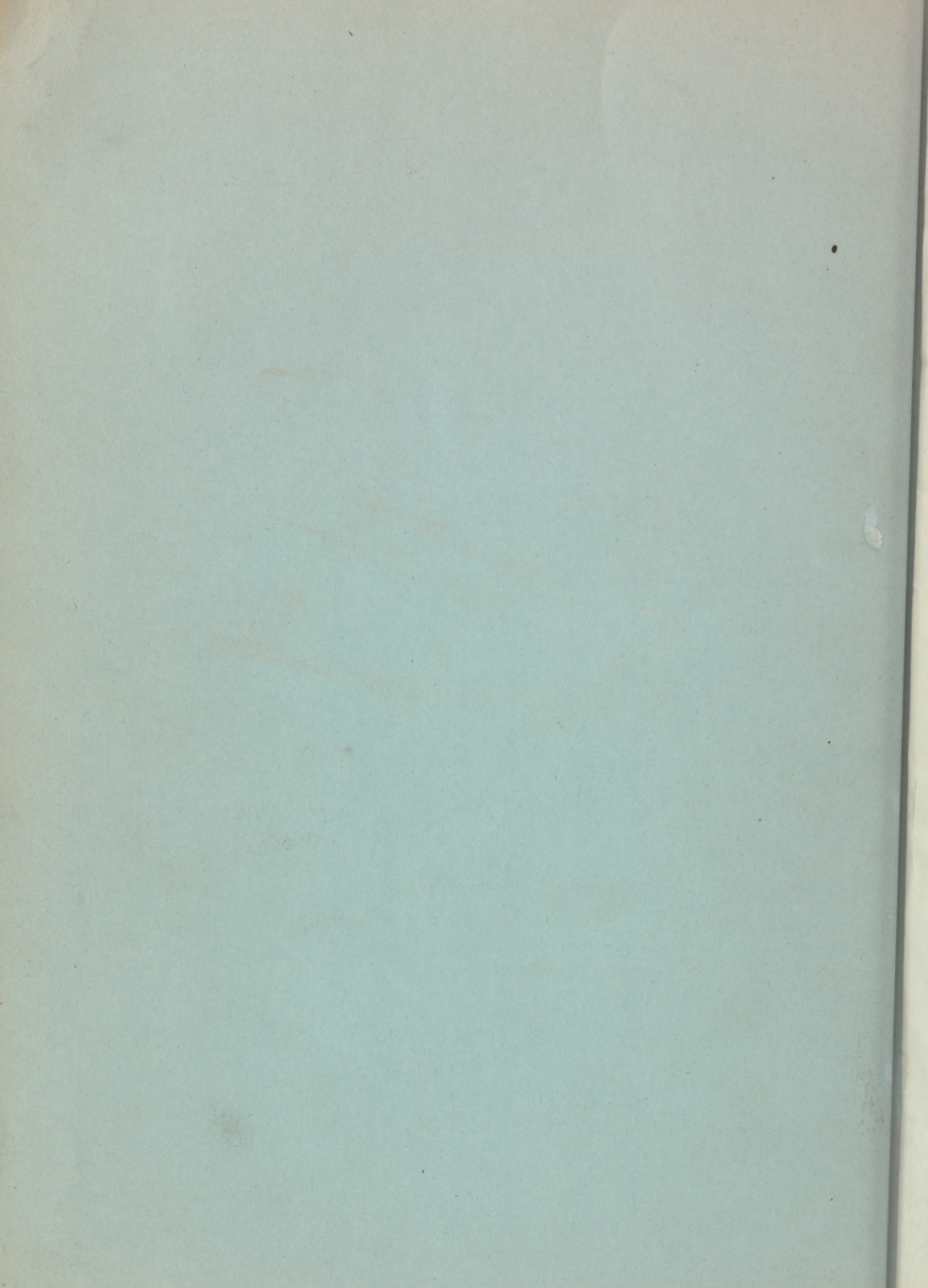
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