the tower; it is heated by steam in winter and cooled in summer by passing over ice; heating, cooling, and distributing take place in the basement. One fan at the foot of the tower forces the air into the audience hall, another on the roof exhausts it. The doors and windows are kept closed. The air is introduced by pipes running under the risers; an opening in the riser at each seat discharges a forward current with a velocity of two and one-half feet per second; other jets enter at the front of the footlights and below the balconies the exits are chiefly under the balconies, so that there is a general movement away from the stage. For large buildings, the "Wing disc fan" (Fig. 2727) is usually employed; a four foot fan using one-horse power delivers about 500,000 cubic feet of air per hour, while the larger sizes of the "Blackman wheel," according to Munson, are said to give about 12,000 cubic feet of air per minute (Fig. 2728).

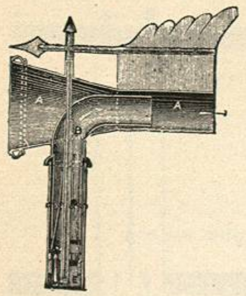

Fig. 2724.—Banner's Rotating Exhaust Ventilator. (Munson.)

Hydraulic ventilators are extensively used during the summer months in Germany; they consist of U-shaped pipes containing spray nozzles under high pressure; the air is sucked in and propelled by the falling spray, the water collecting at the bottom and being discharged by a drain pipe. According to the degree of temperature of the water, the air may also be cooled by this method (Fig. 2629).

Fig. 2725.—Star Ventilator.

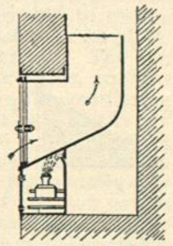

Fig. 2726.—Foul-air Outlet.

General Rules to be Observed in Ventilation.—1. The object of ventilation being to improve the air of the house, we should be sure of the purity of the incoming air. It should not be brought through underground ducts, nor from any point likely to be contaminated by sewer air or other noxious gases. The in-

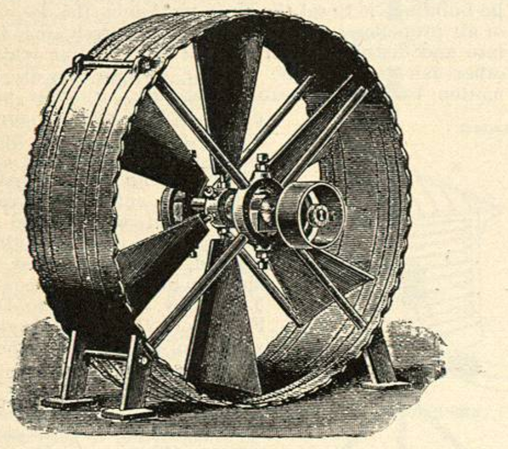

Fig. 2727.—Wing Disc Fan.

dication is plainly to select the safest spot for inlets; the inlets should be provided with valves to regulate the amount and protected with fine wire gauze or Hessian jute to exclude vermin and dust. Whenever practicable the air should not only be filtered, but also washed by means of a fine spray in its passage through the inlet. If the fresh air is too cold, it should preferably be warmed before entering the apartments by means of ventilating stoves or grates, or a central system of heating by furnace, steam, or hot water.

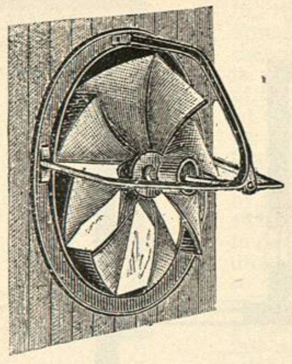

Fig. 2728.—Blackmann's Wheel.

2. The superficial area of outlets should be at least as large as that of the inlets, and in order to insure renovation of air with the least amount of draught, the inlet and outlet openings should not be placed directly opposite but diagonal from each other. It is desirable to place the inlets about the middle height of the rooms and the outlets near the ceilings; they should be supplied with registers to regulate the amount.

3. Since every adult requires 3,000 cubic feet of fresh air, it must be our aim to see that this amount is supplied without discomfort to the occupants. The air of a room cannot be changed oftener than three times in one hour in winter without causing a disagreeable draught; hence every occupant should have a cubic air space of 1,000 feet. Finally this air space must not be furnished in height at the expense of superficial or floor space, for the reason that organic matters are not equally diffused but tend to accumulate in the lower strata; consequently excessive height (*i.e.*, over twelve feet) does not mean a corresponding dilution. In spite of overwhelming clinical evidence, the question of proper air and floor space in prisons, lodging-houses, barracks, and even hospitals has not been practically settled, and the standard adopted is fa- below the amount required.

In conclusion, it should be distinctly understood that no amount of artificial ventilation can render thorough and frequent house-cleaning unnecessary, or the precautions for the exclusion of contaminated air superfluous, nor can ventilation in winter be maintained without the expenditure of considerable fuel.

Heating.—The necessity for artificial heat whenever the temperature falls below 70° F., notwithstanding the fact that a healthy adult gives off hourly 88 heat units, is fully recognized, and hygiene requires that this artificial heat should be supplied as uniformly as possible, and that the air of habitations, instead of being vitiated by the products of combustion, should be improved by the heating apparatus.

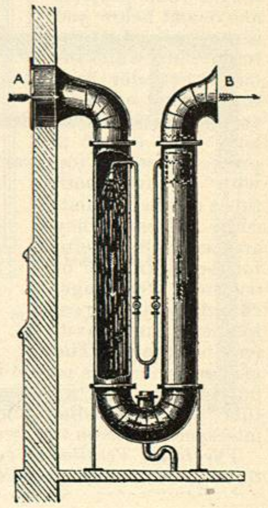

Fig. 2729.—Water Spray Ventilator. (Munson.)

Fuel.—For this purpose materials containing carbon and hydrogen, 1 gm. of which is capable of evolving during combustion respectively 8,080 and 34,462 small calories, are used. Putzey's estimates of the heating value of various kinds of fuel are as follows:

Fuel.	Fuel value of one kilogram.
Dry wood	3,600 calories.
Lignite	4,180 "
Coke	6,000 "
Charcoal	7,000 "
Bituminous coal	7,500 "
Anthracite	8,000 "
Petroleum	17,176 "
Illuminating gas per cubic metre	7,700 "

Of the foregoing fuels, white ash, Lehigh anthracite coal, and gas unquestionably permit of the most complete and ready oxidation of the carbon and hydrogen, which elements supply the heat.

The products of combustion are chiefly carbonic acid and water, although sulphurous vapors and arsenical fumes may be evolved in the combustion of mineral coal. If the amount of oxygen is insufficient for free combustion carbon monoxide, fine particles of carbon in the form of soot, tarry matters, and carburetted hydrogen also escape. The smoke under such circumstances is therefore a mixture of C, CO, CO_2, H_2O, C_2H_2 and may also contain sulphurous and arsenical vapors.

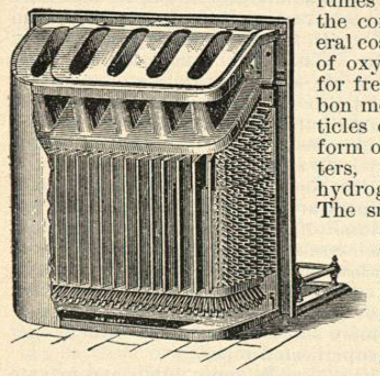

Fig. 2730.—Jackson's Ventilating Grate, Back View. The outer casing is cut away to show space and surface for warming the incoming air.

Rooms may be warmed separately by stoves or fireplaces; this is called *local heating* in contradistinction to the system of *central heating* in which the heat is supplied to a number of rooms or the entire building from a central plant. The latter system offers so many advantages that it is rapidly superseding every other method, at least in cities. The majority of houses in rural districts, however, are still warmed by open fireplaces and stoves. Fireplaces are niches in the chimney supplied with grates in which combustion may be maintained and the products are rapidly carried off through the chimney. The room in this instance is warmed by *radiant heat*, which means the passage of heat from warm bodies to cold ones without raising the temperature of the intervening air directly; the latter is warmed by convection from heated objects. A uniform temperature cannot be maintained by the exclusive use of an open grate, and though a most excellent ventilating apparatus, it is too powerful to be wholesome, and is moreover quite wasteful, as five-eighths of the heat generated escapes up the chimney. The latter objection has been in a measure overcome by controlling the chimney current by a damper, and by a proper construction of the grate and fire-back. For this purpose the width of the grate at the back should be about one-third the width in front facing the room; the side walls of the fireplace should join the back at an angle of 45°, so as to throw as many heat rays into the room as possible, and for similar reasons the whole fireplace should be brought well forward into the room. To minimize these defects, an attempt has been made to surround the back and sides with a space through which air can pass and be warmed by the heat that would be otherwise wasted. An opening below admits fresh air into the chamber where it is warmed and escapes through an opening into the room above the mantle. The Galton, Jackson, and Joly ventilating grates are all constructed on this principle and are therefore a combination of hot air and fireplace heating (Fig. 2730).

Stoves.—There are an endless variety of stoves in which either wood, coal, gas, or petroleum is burned, and in which from seventy-five to eighty per cent. of the fuel is utilized. The great distinction between these and open fireplaces is, that the air which comes in contact with the heated surface is warmed, expands and rises, and its place is taken by a cold air; the currents of warm air circulate through the room and thus every part is equally heated. It is essentially heating by convection, although a very hot stove also supplies radiant heat. Stoves are made of wrought or cast iron, terra-cotta, porcelain, and soapstone; some are ordinary closed stoves, while in others provisions are made for the admission of fresh air from without, which is made to circulate through the stove without coming in contact with the products of combustion, and after being thus heated passes into the same room or the room above, as in our lathrobes, ventilating grates, or the "Cortland Howe" ventilating stove (Fig. 2731). The principle of introducing fresh air can be applied by running a fresh-air inlet from the outer air to near the stove and surrounding the latter with a jacket of sheet iron. The inlet and corresponding outlets should be provided with registers. This is a very simple and effective method of heating and ventilating rural school-houses, etc.

Since gas, both natural and artificial, and coal oil are being extensively used in this country for both heating and cooking purposes, it may be stated on the authority of Notter and Firth that when the combustion is complete and the ventilation is sufficient for the ordinary effects of respiration, their use is not fraught with danger, especially when the more improved patterns are used; but the larger oil stoves or gas stoves which burn more than five feet of gas per hour should be provided with a flue to carry the products of combustion to the outer air. The ordinary gas logs set in fireplaces or the "Backus portable steam radiator" for use with gas should be preferred.

Heating by electricity possesses many hygienic advantages, but the excessive cost has so far prevented its general use.

Central Heating (Furnace).—A very common way to heat a modern dwelling is by the use of a hot-air furnace. In such a case a furnace of wrought or cast iron, brick or

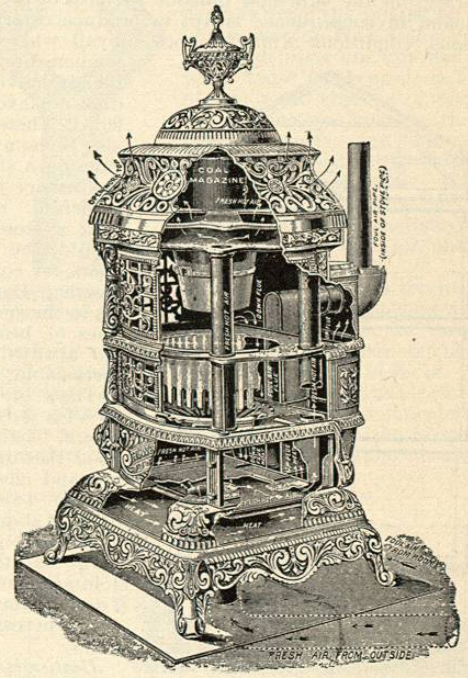

Fig. 2731.—Cortland Howe Ventilating Stove.

soapstone is placed in the basement; the fresh air is admitted from a pure source into the air chamber of the furnace where it is heated and conducted in suitable-sized flues to the different rooms and stories of the house. According to Mr. Edward S. Philbrick ("Man. of Pract.

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Hygiene," Parkes, vol. ii., p. 466) a house of more than three large rooms on the floor, however, with one or two stories of rooms above, cannot be properly heated by only one furnace, as it is almost impossible to conduct heated air more than six feet in a horizontal direction from the furnace. The combination of a hot-air furnace and open fireplaces is believed to be a very sanitary way of heating a house, because provision is thus made for both inlets and outlets; the latter are often neglected. An open fireplace is very useful in drawing the furnace air down to its own level, even when there is no fire actually burning in it. All this is important, for apart from the fact that outlets should exist for the extraction of foul air, a windward room cannot be warmed because the furnace air refuses to enter it, and the remedy for this is the open fireplace, or the opening of a chimney flue in the room. Flues from furnaces supplying different rooms sometimes draw against each other, especially when the supply from below is not sufficient for all, either because the fresh-air inlet to the furnace is too small or because after it has been closed in a high wind some one has neglected to open it (Lincoln).

The objection to cast-iron furnaces and stoves is that carbon monoxide is believed to escape through invisible fissures in the plates and joints, while the heaters are red hot; hence they should be lined with fire clay; this precaution may not be necessary for the escape of CO, but it will improve at least the quality of the heat. Soapstone furnaces are highly praised for the quality of the air. Since all heaters are liable to render the air too hot and dry, they should be provided with evaporating pans, or, what is even preferable, a larger heater should be chosen which will not have to be raised to red heat and at the same time furnishes a larger volume of warmed air. If the air is superheated it acquires a peculiar odor, probably due to charring of organic dust; it also becomes very dry and irritating owing to the rapid evaporation of moisture from the skin and mucous surfaces of the inmates and in consequence is apt to produce catarrhal affections, conditions which do not prevail when the temperature of the air delivered does not exceed 90°. There is also economy in running a stove or furnace at a moderate rate, and a reserve should be on hand for colder weather. Dampers in the smoke flues of heaters are always objectionable; the joints of the draft doors should be so good that opening and closing of the lower door or slides is sufficient, but as long as these joints are imperfect, dampers are a necessary evil.

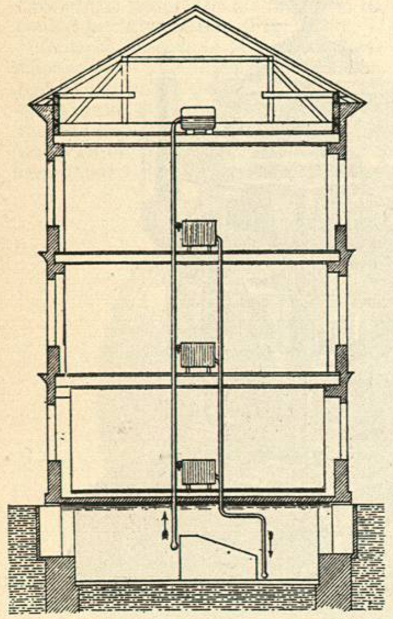
FIG. 2732.—Diagram of Low-Pressure Hot-Water System. (Munson.)

Heating by Hot Water is now extensively employed in modern homes and even larger buildings and while more expensive than the first cost of hot-air furnaces and a steam-heating plant, the advantages are economy in fuel and repairs; the temperature is more agreeable and the heat can be conducted to any desired point. In the *low-pressure system* large pipes, generally four inches in diameter, are connected with a boiler so as to provide a complete circulation. The water after being heated circulates through the pipes and radiators, parts with more or less of its heat to the air, *i.e.*, heating by convection, and returns to the boiler. At the highest point of the system an expansion tank is placed, and a small escape pipe is carried into the outer air to give vent to steam and hot air. The water rarely ever attains a higher temperature at any part of the system than 200° F. (Fig. 2732).

In the *high-pressure system* the pipes are smaller, about one inch in diameter, but sufficiently strong to withstand the pressure incident to a very high temperature, as from one-tenth to one-sixteenth of the coils are exposed directly to the heat of the fire. The water being completely enclosed from the outer air, attains usually a temperature of 300° F. and circulates more rapidly; provision is made for expansion by larger pipes at the top of the system. With the low-pressure system about twelve feet of radiating surface for every 1,000 cubic feet are required to raise the temperature of the room to 65° F. at zero weather, while with the high-pressure system eight or nine feet are sufficient. The volume of water in the high-pressure system is very much less and is heated therefore more quickly than in the low-pressure system, but it will also cool more quickly, and on the whole the advantages are decidedly in favor of the low-pressure system, because the temperature is more uniform and there is no danger from explosions or superheated pipes.

Steam Heating is employed in many public and private dwellings and the waste steam of locomotives is utilized in the warming of cars, ships, and factories. The methods have been perfected and the danger from explosions reduced to a minimum; nevertheless steam plants, as well as other central heating apparatuses, require careful planning and intelligent supervision. Steam heat, like furnace heat, is apt to be excessive in mild weather, but the temperature can be regulated by arranging multiple coils or radiators, which can be shut off in sections. In every case the calibre of the radiator should be larger than the supply pipes so as to favor condensation and consequent liberation of latent heat. Provisions must also be made for the rapid return of the condensed vapor to the boiler by means of return pipes, since any obstruction to the flow of the return steam interferes with a free and rapid circulation and causes not only defective heating but also a most disagreeable thumping noise.

In connection with either hot water or steam heating, we recognize three methods: (1st) the direct; (2d) the indirect; and (3d) the direct-indirect. In the direct system the radiators are placed in the room without any special provisions for ventilation; in the indirect system, the coils or radiators are placed in a suitable chamber in the basement into which fresh air is admitted and from which the heated air is distributed to the different rooms by suitable inlets and outlets. This plan answers very well for ordinary dwellings, but for larger buildings arrangements must be made to force the heated air where wanted, and this is accomplished by the *exhaust system*, or the *plenum system*. In the former the air is exhausted by suction and the pressure of the atmosphere is relied upon to replenish the fresh air, while in the plenum system the air is forced into the room by special fans, and is preferable because the purity and volume of the air can be regulated in the manner already referred to under Ventilation. In the *direct-indirect* system the radiators are placed under the windows and the fresh air is admitted from behind them and is warmed by its passage over the radiators. The fresh-air inlets are controlled by a key in the room connected with a register outside in order to regulate the amount of fresh air, while the foul air is discharged by suitable outlets. The air in steam- and hot-water heated apartments may also become excessively dry and evaporating pans are almost as essential as with furnace heat. With automatic thermoregulators, it is possible to maintain a uniform temperature, and on the whole we may conclude that the indirect and direct-indirect systems—

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combining, as they do, a central system of heating with proper ventilation—are the most sanitary. The use of steam gives perhaps more satisfactory results in cold climates than the hot water, but either method is preferable to hot-air furnaces.

Lighting.—Apart from the hygienic importance of sunlight on metabolism and its destructive effect on germ life, every room, whether used for dwellings, workshops, schools, etc., should be so well lighted by windows that the eyes need not be strained even on a cloudy day.

Natural Lighting.—The area of windows exclusive of sash frames should be at least one-sixth or preferably one-fifth of the floor space, and in order that the light may penetrate the deeper portions of the room, the windows should almost reach to the ceiling. After providing the windows we should, of course, not shut out ninety per cent. of the light by blinds and draperies; but if the light is too glaring it may be softened by white, cream, or light gray shades; the color of the window panes should always be perfectly transparent; plate glass possesses the advantage of warmth and durability. The difficulty of securing a sufficient amount of daylight in buildings located on narrow streets surrounded by tall buildings has been partly overcome by glass building blocks $8 \times 6 \times 2\frac{1}{2}$ inches, with an air chamber in the centre, used instead of brick or stone in connection with steel frame construction, but more particularly by the introduction of prisms, which refract and diffuse the light throughout a room that would otherwise be illuminated but partially or not at all.

Artificial light, no matter how obtained, differs from daylight in this, that it does not furnish a pure white light; the prevailing rays are red, yellow, or violet, and the effects of a yellowish-red or violet-blue are produced. Whatever difference of opinion there may be as to the color best suited to our eyes, we know that our vision is most perfect under the influence of a white light, and this ought to be a good criterion. One of the disadvantages of all low-power illuminants is that the light is never as bright as daylight, involving therefore closer application of the eyes and consequent strain of the muscles of the eyeball. These remarks are hardly applicable to the electric arc-light and the Welsbach gas-burner, the rays of which, like the direct solar rays, may indeed be so glaring as to cause undue irritation of the retina. Another harmful effect of artificial illumination is the unsteady or flickering character especially seen in the electric arc-light, and which on account of the abrupt changes is likely to irritate the retina; another disadvantage is that the ordinary illuminants, except the electric light, tend to vitiate the air by the products of combustion and also affect the temperature and humidity of the air by the heat evolved. The requirements of a hygienic light are that it should be as near as possible the color of sunlight, sufficiently ample, but not too glaring; it should be steady and, instead of deteriorating the air, it should as far as practicable be utilized to improve the air; nor should the heat evolved be sufficiently intense to be a source of discomfort to the inmates in warm weather.

From this table we conclude that the electric arc-light is the most suitable for lighting of streets and squares, the electric incandescent light is best suited for public and private habitations, including also steamers, powder works, and mines. It is in every way superior to gas and other illuminants, because there is no danger from fire, there are no products of combustion, hence no pollution of the air, nor are the temperature and humidity of the rooms affected to any perceptible extent. These advantages over gas are of special importance to the inmates of buildings where the question of fresh air and temperature play an important rôle; hence we can readily appreciate that banks and other institutions find it profitable to install electric lighting and save time and money by the prevention of sickness among their employees. Next to electric light, gas, especially in connection with a Welsbach or Siemens burner, offers the next best choice; in the absence of either, kerosene with a high flashing point should be preferred over other illuminants. The flashing point of refined kerosene is defined as the temperature at which a sample of the oil commences to give off sensible quantities of inflammable vapor; it should not be less than 100° F. and a higher temperature is preferable. Explosions may occur in lamps when from any cause the vapor over the oil in the reservoir is lighted by a spark, as for instance when the wick is extinguished by blowing over the chimney and is then depressed in a smouldering condition, or when the chimney of the lamp is broken. The Duplex and Rochester burners and many other safety lamps have reduced these dangers to a minimum. The dangers from the inhalation of carbon monoxide from leaky gas fixtures and pipes are especially great when water gas is used, on account of the total absence of odor. Of the various gas burners, the Welsbach, Siemens, and the argand burner enclosed with a chimney give the best results. Wherever practicable, provisions should be made to carry the products of combustion to the outer air, and thereby aid in ventilation.

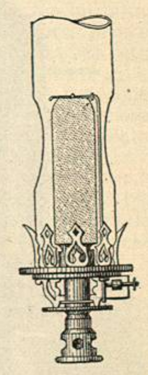
FIG. 2733.—Welsbach Burner.

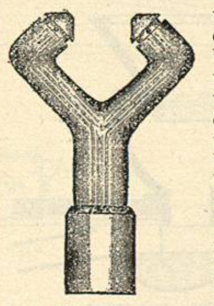
FIG. 2734.—Burner for Acetylene Gas.

Acetylene gas has recently come into deserved prominence, and as it can be generated for individual households at a comparative slight expense, and has many excellent qualities, it is likely to grow in favor. It is a colorless gas (C_2H_2) with a characteristic unpleasant odor, and is generated by the action of water on calcium carbide in a special apparatus, suited to the needs of the respective household or building. Munson states that

SUMMARY OF THE MOST IMPORTANT CHARACTERISTICS OF ILLUMINATING AGENTS.

Illuminants.	Quantity consumed.	Color.	Candle power.	Oxygen removed. Cubic feet.	CO_2 produced.	Moisture produced. Cubic feet.	Heat calories produced.	Vitiation equal to adult.
Tallow candles	2,200 grains.	Red yellow	16	10.7	7.3	8.2	1,400	12.0
Sperm candles	1,740 "	"	16	9.6	6.5	6.5	1,137	11.0
Paraffin oil lamp	992 "	"	16	6.2	4.5	3.5	1,030	7.5
Kerosene oil lamp	909 "	Light red yellow	16	5.9	4.1	3.3	1,030	7.0
Coal gas, No. 5 batwing burner	5.5 cubic feet	" "	16	6.5	2.8	7.3	1,194	5.0
Coal gas, Argand burner	4.8 "	" "	16	5.8	2.6	6.4	1,240	4.3
Coal gas, Siemens' regular burner	3.2 "	Yellowish-white	32	3.6	1.7	4.2	700	2.8
Coal gas, Welsbach	3.5 "	White	50	4.1	1.8	4.7	763	3.0
Acetylene	1.0 "	"	50	....	2.0	....	....	3-6
Electric incandescent light	0.3 "	"	16	0.0	0.0	0.0	37	0.0
Electric arc-light	....	Blue violet	100	....	0.0004	.	....	....

"a generator capable of thoroughly lighting a company barrack or post hospital need not be greater in bulk than a hogshead, while one capable of illuminating a field hospital of one hundred beds is not larger than a pork barrel." The gas requires a special tip and combustion is usually complete (Figs. 2734 and 2735).

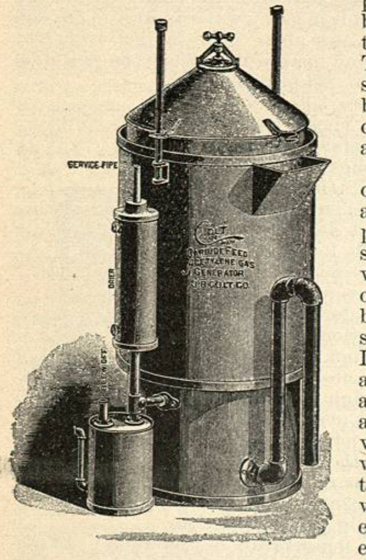

Fig. 2735.—Large Size Acetylene Generator. (Munson.)

Water Supply.—In cities furnished with a general water supply, every floor should be provided with water taps, not only for convenience, but also for greater safety in case of fire. In isolated houses and villages without a general supply or a good spring in the vicinity, our choice will be between artesian, cistern, and well water. On general principles preference should be given to artesian water. (See article on *Water.*)

House Drainage.—The object of the sanitarian is to remove as rapidly as possible all excreta and refuse from habitations, so that the air, water, and soil shall not be made impure. In any event the accumulation must in no case extend so far as to render putrefactive changes evident to our sense of smell. The various methods for the disposal of sewage will be discussed in a separate article, and for the present suffice it to say that the most sanitary disposal of the flow from the water-closets and house drains is a well-devised system of sewerage, which will convey the flow on to farm lands or into the sea, but not into watercourses used for drinking purposes. Since this system begins in the habitations, we shall point out the requisites for proper house drainage, which consist of:

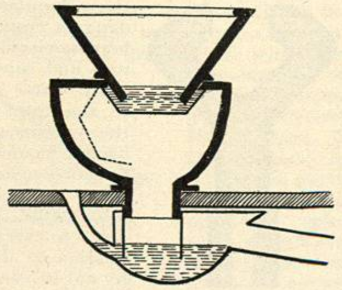

Fig. 2736.—Pan Closet.

1. Water-closets and urinals, wash basins, bath and laundry tubs, and kitchen and slop sinks;
2. A perpendicular pipe known as the soil pipe with which the foregoing fixtures are connected; and
3. The house drain, which is a nearly horizontal pipe, and connects the system with the sewer or cesspool.

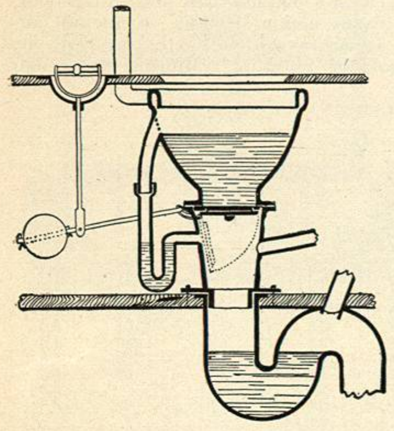

Fig. 2737.—Valve Closet.

Water-closets consist of an apparatus for the reception of excreta connected with the soil pipe by means of a suitable trap, and in which water is used to dilute and carry away the excrement deposited therein. They are classified under two heads, viz.: those in which there is no movable apparatus for retaining water in the bowl, and second, those which are supplied with a movable apparatus. Under the first head are included hopper, washdown and wash-out closets, under the second, pan-valve and plunger closets. Space will not permit me to enter into a detailed description of the various patterns, except to say that the pan, valve, and plunger closets (Figs. 2736, 2737, and 2738) are objectionable and should not be tolerated. Among the best forms are the short hopper closets, with a trap which opens into the soil pipe above the floor. This brings the water seal well up in the hopper and reduces to a minimum the surface likely to be fouled above the trap-water. So-called "wash-down" closets are modications of the short-hopper; of these the "Deluge," "Dececo," and the "Century" have given the most satisfactory results (Figs. 2739, 2740, and 2741). All of these fixtures are designed to give a quick and powerful flush of five or six gallons of water from a tank, the siphon of which is put into action by pulling a chain. Where the closet is to be used by servants, children, and others likely to neglect the flushing, the water supply should be made automatic and metred by a waste-saving apparatus. The

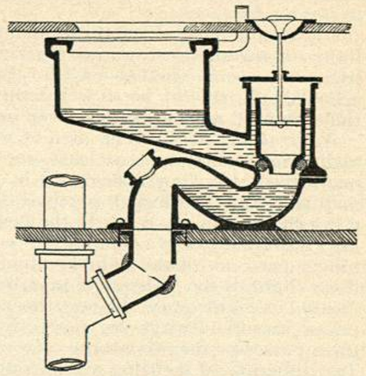

Fig. 2738.—Plunger Closet.

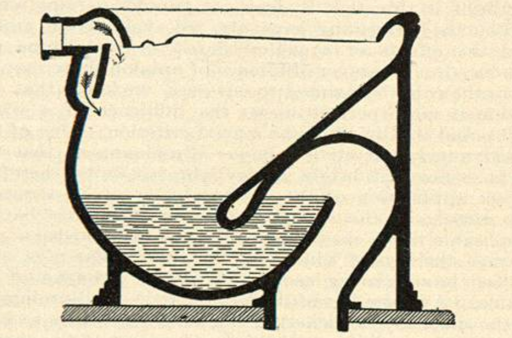

Fig. 2739.—Deluge Closet with Recessed Back. (Munson.)

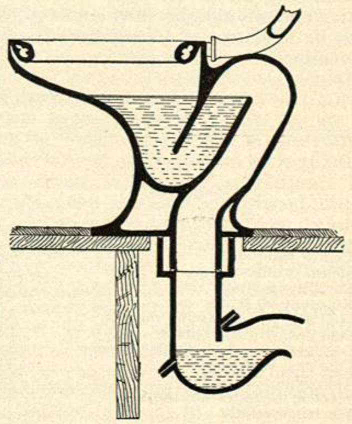

Fig. 2740.—Dececo Closet.

weight of the person on the seat is thus made to lift the valve in the bottom of the tank and when the weight is removed this valve closes and the lower one opens, discharging an ample and definite quantity of water with a sudden dash, which expels all the contents of the hopper below. For public buildings, copious flushes discharged at regular intervals from automatic flush tanks like the "Rogers-Field" are to be preferred. No system should be tolerated which provides for the flushing of the hoppers by faucets, for even if allowed to run for half the time with the consequent waste of water, it does not flush the system like the sudden dash of five or six gallons of water.

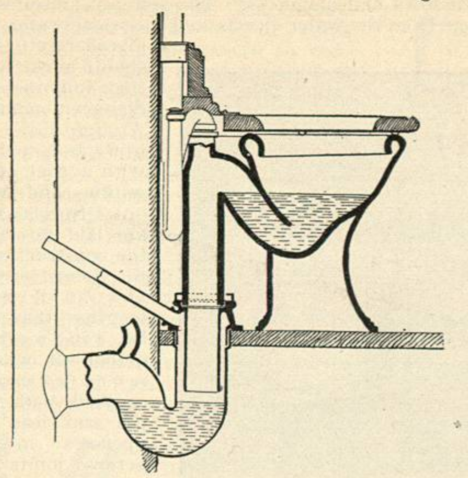

Fig. 2741.—Century "Siphon-jet Closet." (Munson.)

Water-closets whenever practicable should be located in a separate room from the bath-room, and preferably in a special projection connected with the house by a well-ventilated lobby; the closet should be provided with a window and other outlets, so that the air may find a ready exit without contaminating the air of adjoining rooms. The exhaust flue already referred to (Fig. 2726) and heated by either a gas jet or lamp is especially indicated in rooms used for water-closets. Each floor of the house, if great convenience is desired, should have such a room and an adjoining room large enough for the bathtub, lavatories, slop sinks, etc. (See plans on page 756.)

Simplicity of the drainage system is of the utmost importance; hence all the fixtures necessary for the comfort of the inmates of the house should be placed in close proximity to the soil pipe, drained and trapped separately into the soil pipe. An error frequently made is to connect a wash bowl waste with a water-closet trap several feet distant by a pipe under the floor, difficult of access and so nearly horizontal as to insure its being soon filled with a deposit of slimy filth. This, like the scattering of fixtures all over the house, is very objectionable. A well-planned, moderate-sized house will show all the bath-rooms, water-closets, pantry, kitchen and laundry fixtures directly above one another and in close proximity to the soil pipe; that is to say, the rooms used for servants' bath-room and laundry in the basement should correspond with the kitchen and pantry on the first floor, and the toilet rooms and water-closets on the upper floors. (See the diagram shown in Fig. 2742.) All the plumbing should be exposed, and since the introduction of nickel-plated pipes the various fixtures present a very attractive appearance. Copper-lined wooden bathtubs and encased wash bowls and water-closets have given way to open elegant and durable fixtures of porcelain, enameled iron or marble, and the ordinary water-closet with hinged seat can be used for a urinal. The bathrooms and other rooms containing plumbing should have an impermeable floor, such as the "granito" floor already referred to, while tile or adamant walls are also desirable.

Urinals should always be of some non-corrosive material, such as china, stoneware, or slate; public urinals should be provided with automatic flushing tanks or a "flush-down spray" (Fig. 2744) and an impermeable floor sloping toward a gutter which discharges into a siphon trap connected with the soil pipe.

Kitchen, pantry, slop sinks, and laundry tubs are usually made of earthenware, porcelain, slate, soapstone, or galvanized iron with or without enamel, and are protected with a strainer to keep the large foreign bodies from obstructing the pipes. Whenever the kitchen and

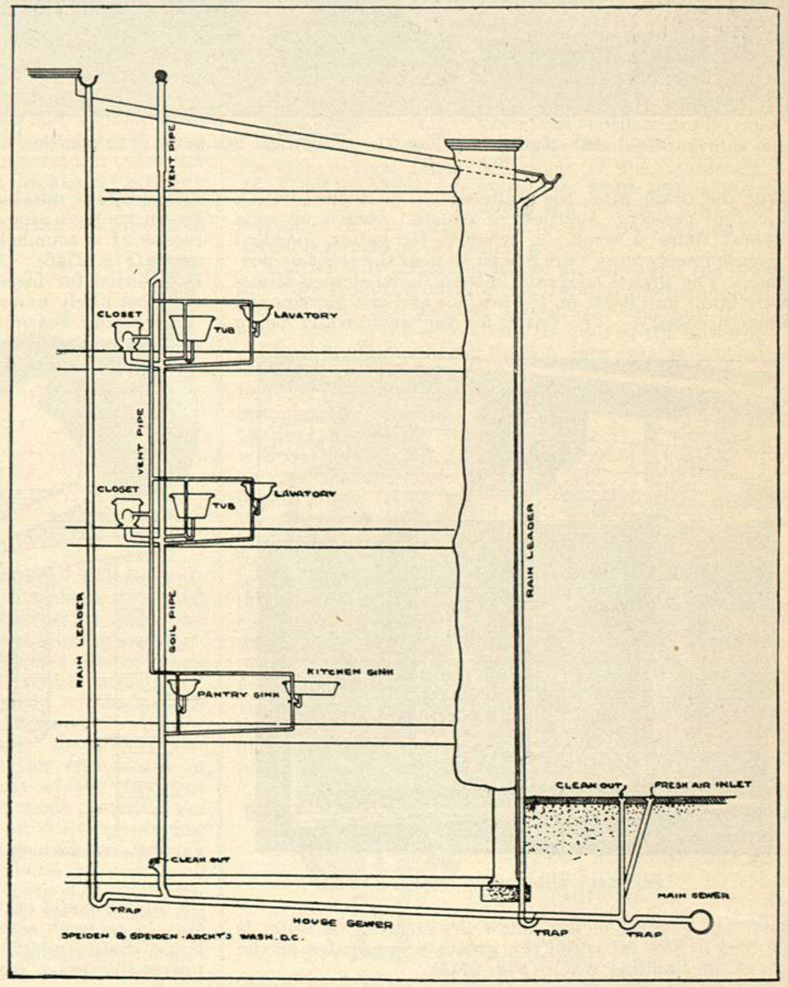

Fig. 2742.—Diagram Illustrating Sewage Plumbing of a House.