Bulletin 87

DEPARTMENT OF THE INTERIOR

FRANKLIN K. LANE, SECRETARY

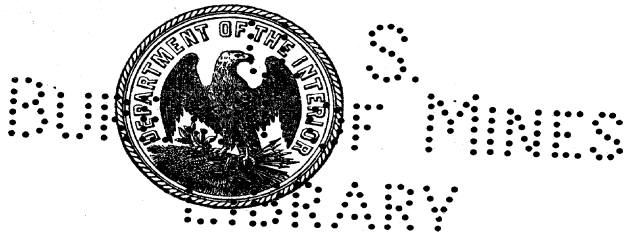
BUREAU OF MINES

VAN. H. MANNING, DIRECTOR

HOUSES FOR MINING TOWNS

BY

JOSEPH H. WHITE



WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

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Second edition. June, 1916.
First edition issued in October, 1914.

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PREFACE.

The organic act establishing the Bureau of Mines prescribes, among other provisions, the following:

> That it shall be the province and duty of the Bureau of Mines * * * to conduct inquiries * * * concerning mining * * * with a view to improving health conditions and increasing safety, efficiency * * *. That the director of said bureau shall prepare and publish * * * reports * * * concerning * * * the improvement of conditions, methods, and equipment, with special reference to health, safety * * *.

Although the actual loss due to an insanitary environment may not be as readily measurable as other losses, it is nevertheless real, and inquiries concerning improvements that go to shield the miner and his family from unnecessary sickness or discomfort plainly lie within the scope of the bureau's duties.

The author of this bulletin has visited the plants of many of the important mining corporations that control their own towns and carry on sanitary and welfare work. Much of the information contained in this bulletin is based on those visits, and too much credit can not be given to the mining officials for their friendly and helpful attitude toward his inquiries. This information has been supplemented by the observations of the mining engineers of the bureau and by data obtained by correspondence and from publications.

The bureau is indebted, for examination and criticism of the manuscript, to Morris Knowles, consulting sanitary engineer; Francis Feehan, Pennsylvania department of labor and industry; and J. B. Kuntz, architect.

JOSEPH A. HOLMES.

HOUSES FOR MINING TOWNS.

By JOSEPH H. WHITE.

INTRODUCTION.

In its investigations looking to the improvement of health conditions and the increase of efficiency in the mining industry, the Bureau of Mines, in cooperation with the Bureau of Public Health, is studying sanitary conditions in and about mines with the intent of pointing out how those conditions that are a menace to the health of the miner may be most efficiently removed or remedied. An outline of sanitary betterment work at mining villages in the Birmingham district of Alabama has already been published by the bureau,[a] and in this bulletin are presented suggestions on the planning of mining towns and the construction of miners' houses. The bulletin does not pretend to be a treatise on the so-called "housing problem," and mentions sociologic issues only incidentally.

It is assumed that the influence of proper shelter on health is understood and that not a lack of appreciation so much as a lack of knowledge of the best remedies is responsible for many of the undesirable conditions that exist at mining towns. The purpose of this bulletin is to supply facts on the building of well-lighted, well-ventilated, warm, attractive, and economical houses for miners, these houses being assumed to be units of an industrial village or town the building and management of which are under the control of a corporation, so that special conditions hold which do not apply to houses built and owned by individual miners.

From this it is not to be inferred that the company-controlled town is the best system or the only one in vogue. The discussion of this side of the subject in all its phases is too involved to be included in this paper. One element in favor of the company-controlled town is its possible immediate responsiveness. Hence this assumption. Also the assumption is made that a new isolated town is being built, and hence the selection of the site, the arrangement of the streets, and the situation of the houses are discussed before the house itself is treated, for one of the most important factors in obtaining an

[a] Woodbridge, D. E., Sanitation at mining villages in the Birmingham district, Ala. 1913. 27 pp.

economical sanitary house is a well-selected town site. Many of the suggestions, however, may be applied in improving conditions in existing towns, in building new houses in old towns, or in repairing old houses. Emphasis must be laid on the fact that as a rule a mining village has a shorter life than a manufacturing town.

Economy is emphasized frequently because the discussion is predicated upon the assumption that the miner himself is to pay for all that he gets. House rent will doubtless be expected to bring in a reasonable return on all money invested in streets, sidewalks, water supply, sewer system, and houses; in other words, the town is to be run on a business and not on a paternal or charitable basis. "Fair and reasonable" precludes, of course, the idea of excessive returns. Some companies do not consider it good policy to realize as high a rate of interest as an independent realty company would be warranted in realizing. Under some circumstances part of the town improvements might be charged as "expense of the industry," that is, to the consumer.

The isolation of a mining town introduces a unique responsibility. As the miners are practically obliged to rent the company houses, the officials of the company ought to scrutinize all expenditures involved so that house rent may be reduced to a minimum. In a way the town builders are placed in the position of trustees. They determine, within certain limits, what proportion of a man's wages shall be spent on house rent. This consideration should restrain fanciful and unnecessarily expensive building; the other extreme should likewise be avoided. True economy should be distinguished from cheapness. Ugly, insanitary, uncomfortable shacks should not be built even if, because of their cheapness, there is a demand for them from tenants. The obligation of the industry to society as a whole as well as to the tenant ought to forbid this. A cheerful, strong, healthy, virile race will not rise out of the filth and squalor of cheap hovels. An insanitary environment often does its damage slowly and silently; vitiated air does not, like mine gas, announce its deadly work by an explosion. As Talbot[a] says:

> Health depends in part on freedom from infection. The probability of obtaining that freedom will be greatly increased by maintaining the body at a high state of vigor, or "vitality," as it is popularly called. This implies the promotion of all agencies which have to do with the physical well-being as well as with the control of sources of infection.

Many men realize that in building houses for their workmen they are invested with a peculiar responsibility that must be wielded wisely, and in large developments they call into consultation the landscape architect, the sanitary engineer, and the building architect, as well as the mining engineer.

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[a] Talbot, Marion, House sanitation, 1913, p. 8.

TOWN SITE AND ARRANGEMENT OF TOWN.

IMPORTANCE OF TOWN SITE.

The general practice in the past has been to build the miners' houses near the mines, and in selecting a site for a mining plant the desirability of the locality for town building received slight consideration. So long as crude, ugly, insanitary mining "patches" or "camps" (see Pl. I, *A*) prevailed this course of procedure went unchallenged, but the rise of the modern mining town necessitated changes, and to-day the policy is to consider the town site in connection with and as an important factor in the situation of the mine plant. Moreover, if the mine plant must be built in a place that is undesirable for a town site it is no longer considered essential to build the town close to the plant.

ADVANTAGES OF ESTABLISHING TOWN NEAR PLANT.

Numerous elements affect the desirability of a town site, and local conditions will modify the choice in each case; nevertheless, there are certain general considerations that apply in making the selection. In the first place, some of the advantages gained by building the town adjoining the plant will be considered. Perhaps the most important of these advantages is that the miners may live near their work, wherefore they do not have to get up so early in the morning and in returning home at night do not have to walk so far in their damp working clothes, perhaps in the cold or wet. It should be kept in mind that a miner may have to walk a considerable distance, sometimes over a mile, before reaching the surface.

At mines where the company owns the store and where wages are advanced before pay day it is convenient for the women and children to have the house, the time office, and the store close together.

There is an advantage in having the houses near in time of breakdown or disaster, and men holding responsible positions such as those of mine foreman, fire boss, or watchman, should be within call at all times.

Building the town and the plant at one place simplifies the shipment and hauling of building material and reduces the cost of supervision. The proximity of the houses to the power plant is to be considered in connection with heating, lighting, and fire protection. In some cases it may be of advantage to have all surface rights contiguous in order to avoid litigation about roads, power-transmission lines, or water pipes.

These are important considerations, but the tendency has been to overestimate their significance; besides, new mining methods make many of them less important now than formerly. For instance, shifts are shorter than they were; underground transportation of

men to their working places is more developed; wash and change houses are being erected so that the men may leave their damp working clothes at the mine; more frequent pay days are coming into vogue, and company stores are not as common as they were.

POSSIBLE ADVANTAGES OF BUILDING TOWN SOME DISTANCE FROM PLANT.

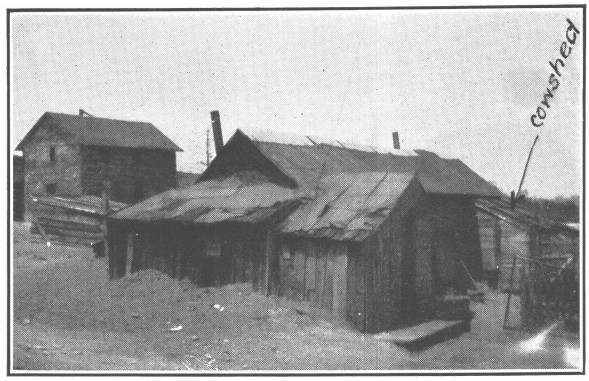
If latitude is allowed in the search for a town site, a larger plat of gently sloping land may be found which will offer many advantages. The town may be laid out contiguously rather than in separated clusters of houses as is frequently done. The cost of streets and surface drainage systems may be lessened by the ground being less rough, and unsightly hillside houses with expensive foundations may be avoided. Single houses may be erected with large yards, insuring sunshine, good air, and fire protection. Fertile soil may be found, making possible kitchen gardens with their multifold benefits. A large plat of land may be available for truck gardens, chicken farms, or pasturage, all of which will help to reduce the cost of living and offset the difficulties incident to the irregularity of mining.

Latitude in the choice of a site may allow the utilization of a lake, a river, or a spring, which may simplify the drinking-water-supply problem (see Pl. I, *B*), or may prove an asset as a source of healthful recreation. Athletic fields, picnic grounds, and wooded areas may be possible.

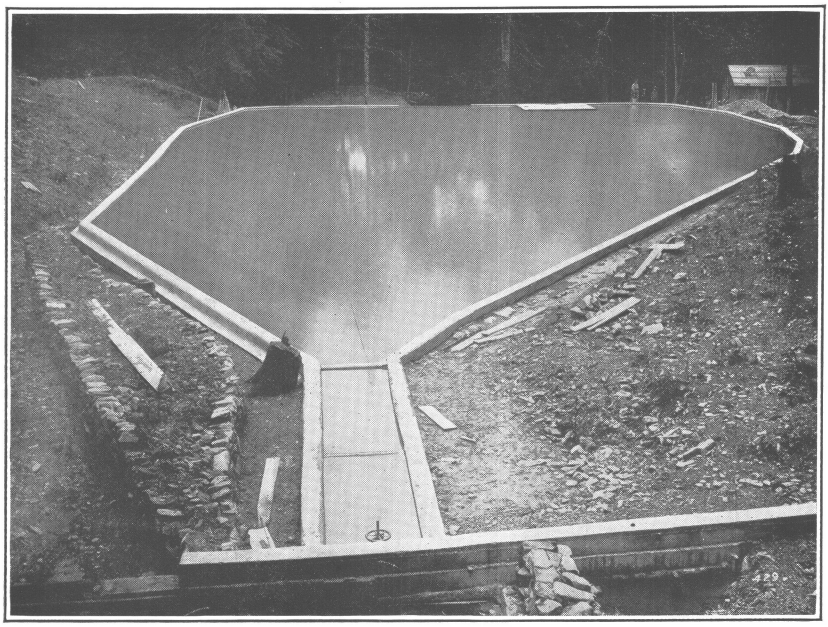
By building the town at a distance from the mines many of the dangers, nuisances, and necessarily unsightly features incident to mining may be avoided. The dangers and delays due to railroad crossings will be minimized; and in the case of a coal-mining town the noise, smoke, and dust from the tipple, breaker, coke ovens, washery, and boiler plants will be avoided, and "slate" dumps and culm heaps will not be before one's eyes year in and year out.

The maximum permissible distance between town site and mine will depend largely on the proximity to a railroad or an interurban electric system. If the men have to walk to their work the character of the roads and short-cut foot paths is important. A little money invested in footbridges, steps, and clearing away obstructions may greatly improve conditions. The long distances many men are willing to walk to work, in order to obtain the advantage of owning and living in their own homes, proves that nearness to work may be offset by other factors.

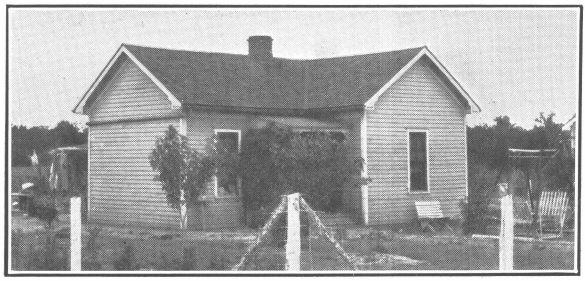
In the above discussion the opening of a single mine whose operation required 200 or 300 houses was under consideration. Another case arises when the mineral development requires or ultimately will require a large number of openings a mile or so apart, as in drift mines. Suppose 50 to 100 homes are needed for each



A. OLD-STYLE, CHEAPLY CONSTRUCTED, AND NEGLECTED COMPANY HOUSE.



B. DRINKING-WATER RESERVOIR IN PROCESS OF CONSTRUCTION AT JENKINS, KY.



C. THREE-ROOM MINER'S COTTAGE AT DEWMAINE, ILL.

opening, with a total of 800 or 1,000 houses in all. The desirability of assembling these at one place and building one large modern town (fig. 1) is worthy of careful study. The magnitude of such a town would warrant such features as an efficient traction system, a suitable water supply, a sewer system, paved streets and sidewalks, a lighting system, better sanitary laws and regulations, garbage collection and disposal by incineration, salvages realizable by utilization of wastes, bigger stores, better schools, hospitals and cemeteries, a playground, amusement halls, a dancing pavilion, a theater, and more varied means of entertainment; in short, the advantages of a highly organized city as compared with those of a village; and

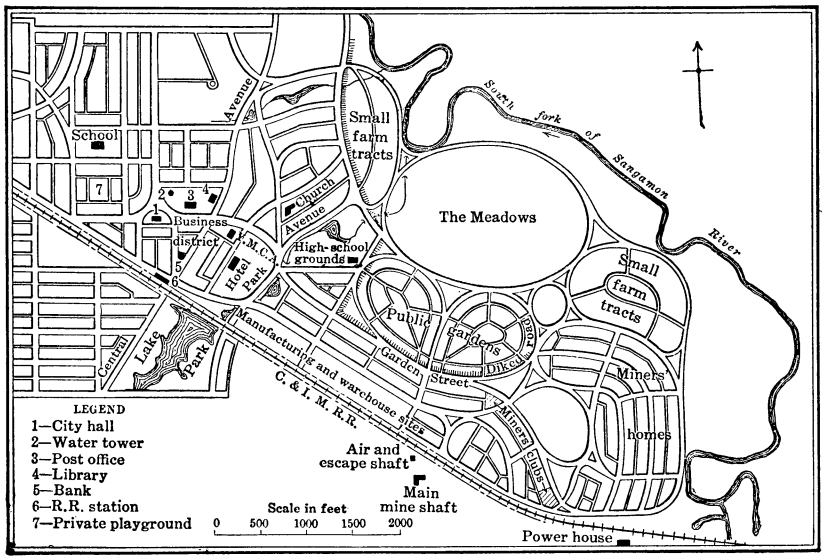


FIGURE 1.—Map of model mining town in Illinois.

as the company controls the construction of the town, if not the management, many city evils may be forestalled.

NECESSITY OF A MAP.

After the site for the town has been determined the layout of the streets and alleys and the size and arrangement of lots must be considered. For this reason a topographic map of the site should be made showing contour lines at not more than 5-foot intervals, if possible, all watercourses with high and low water levels, wet places, soil conditions, the name and diameter of all large or sightly trees, Government section lines, and similar information. With the aid of such a map a number of arrangements may be investigated and their relative costs and advantages may be compared, and when field inspections are made a more vivid and comprehensive mental picture

can be formed. The advantages derived from having a map of this kind will well repay the cost of making it.

STREETS, GUTTERS, SIDEWALKS, AND ALLEYS.

STREET SYSTEMS.

Even on a level area the rectangular street system is not adopted as much as formerly because of the many pleasing effects obtainable

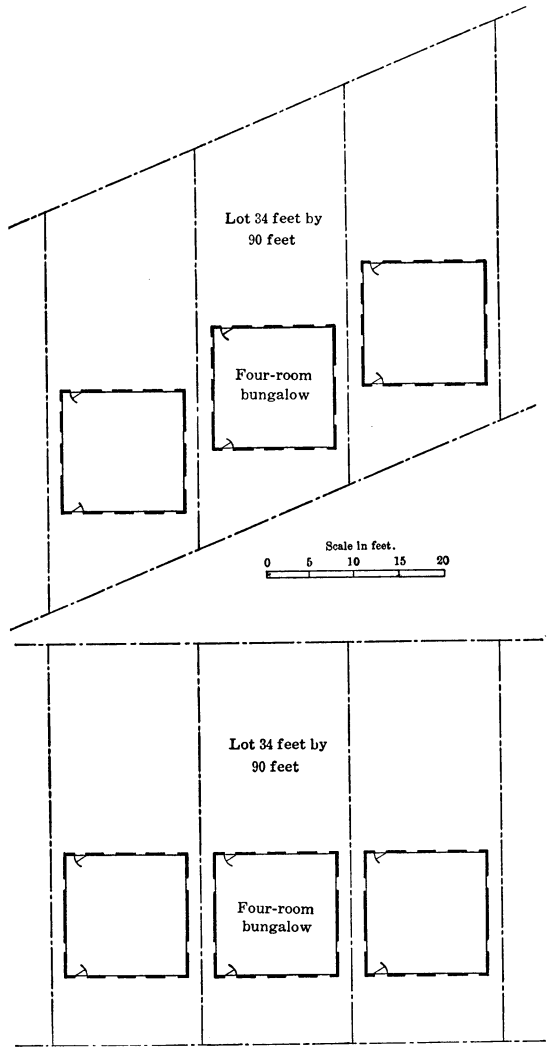


FIGURE 2.—Diagram showing advantage of diagonal street for closely grouped cottages. Houses arranged as in upper view have more air, light, and sunshine, and better outlook than those arranged as in lower view.

with winding streets. Winding streets permit a larger number of houses to take advantage of such natural features as favorable

exposures and prevailing winds, and a greater variety of viewpoints is attainable, especially on the concave side of curves. Numerous parks and grass plats may be developed. On a hilly site contour streets are, in addition to these advantages, most economical; easy grades may be obtained with less cut and fill; culverts, bridges, surface drainage, and sewer systems will cost less. With this system the lot will slope toward the street, so that the ground line of the front of the house will be level, which greatly improves appearances.

In some cases it may be necessary to crowd cottages closely. In such, more sunshine, better ventilation, and a better outlook will be afforded if the houses are offset by means of a diagonal street than if the regular perpendicular street system be followed (see fig. 2).

In some localities the street system of the proposed town may have to be coordinated with the public-land system of roads, in which case some streets must run north and south. In the main business part of the town practical purposes may be better served by straight streets.

WIDTH OF STREETS.

In the average mining town the vehicular traffic in the residential district is not heavy, so that a narrow well-surfaced street, with an effective gutter and paved sidewalk, provided the building line is well back from the street, suits conditions better than wide streets and poor sidewalks. As a fire-protective measure streets have been made very wide in some mining villages; hence it is evident that the water-supply system will affect the width of the streets.

NAMING OF STREETS.

The streets should be named not only on the maps in the engineer's office but by signboards in prominent places. This is a thoughtful improvement and costs very little. It goes without saying that the town should not be designated by a numeral in correspondence or referred to in conversations as a "camp" or "patch."

CONSTRUCTION OF SIDEWALKS AND GUTTERS.

The following directions are often followed for making cement sidewalks. The ground is leveled off about 10 inches below the finished grade, and if necessary is well settled by ramming. A 5-inch foundation of coarse gravel, broken stone, or coal ashes is placed and rolled. A 3-inch layer of concrete, made from one part cement, two parts sand, and three parts stone and mixed dry, is laid on this foundation and covered with a 1-inch surface coat made of one part cement and one part sand. The sidewalk should drain toward the gutter, with a slope of 1 in 10, and should have expansion joints every 5 or 6 feet.

Well-paved sidewalks are recommended for comfort and cleanliness. They do not have to be as wide as city sidewalks. There is perhaps more comfort in using a well-paved sidewalk 2½ or 3 feet wide than one of much greater width less carefully built.

In case there is no underground sewer system the street gutters should be designed with a view to removing house wastes, such as kitchen slops and wash water, as well as surface drainage. For this reason they should be made of concrete, box shaped, and smooth surfaced with rounded corners.

ALLEYS.

Alleys, preferably narrow ones, should be provided, as they make a lot more private and are convenient. In a well-administered model town none of the notorious evils of the alley need be allowed to develop.

Some town planners disapprove of alleys because the expense of fences is increased, more paving is required, and the alley is apt to become unsightly.[a]

DIMENSIONS OF HOUSE LOTS.

Where there is plenty of suitable land each cottage should have a large yard. It is generally better to apportion this area by depth rather than frontage, in order to reduce the cost per lot for street improvements. However, the houses should not be crowded together; there should be sufficient distance between them to insure good light, ventilation, privacy, and fire protection. This distance depends to some extent upon the height of the house. One-story houses may be spaced closer, if necessary, than two-story houses, and conditions may be relieved somewhat by alternating one and two story houses.

SITUATION OF HOUSE ON LOT.

Better lighting often may be effected by varying the distance between the front of the house and the street line, in which case two-story houses should be set farther back than one-story houses for the purpose of equalizing the street view. Similarly it is a good plan not to build the houses on the two sides of the street directly opposite one another. If the houses are staggered, better circulation of air and more interesting outlooks will be furnished. (See fig. 4.)

If there are to be no front fences and if the houses are practically on the street level a greater distance between the street and the house is necessary than if the reverse be true. Most advantage may be taken of a necessarily small distance by laying the sidewalk adjacent

[a] See remarks of Morris Knowles, The Proceedings of the Third National Conference on Housing, Dec. 3, 4, and 5, 1913, p. 111.

to the gutter rather than by having a 6 or 8 foot grass plat between the gutter and the sidewalk, as may be justified under different circumstances.

HILLSIDE HOUSES.

On many sites the grading of house lots is so expensive that some houses must be built on sloping lots. Every economical method of relieving the unsightliness of these hillside houses should be employed. As has been pointed out contour streets improve conditions somewhat because the ground line on the exposed side of the house is level. Excessively steep lots should not be used, as the cost of foundations, steps, and building is too great and the house is not satisfactory to live in. With the idea of utilizing such lots, one company attempted to develop a cheap five-room house in which the front and the back contained a different number of stories; on the high side of the street the house had three stories in front and two in the back; whereas on the low side the arrangement was reversed. The construction of these houses proved very expensive and was discontinued.

The houses on the low side of the street should be brought up to the level of the street grade, if possible. This can be done by shifting the retaining wall, which is so often placed on the property line, back to the house line. Houses on steep lots should be shallow, as this greatly reduces the appearance of the inequality in height between the front and back of the house. Two-story houses on the low side of the street will equalize appearances (see fig. 3). The appearance of the houses on the high side of the street may be improved by placing the veranda on the side rather than on the front, thereby reducing the depth of the building, or by changing the direction of approach of the front steps. Figure 4 shows a suggested arrangement of houses and lots.

TYPES OF HOUSES.

MATERIAL OF CONSTRUCTION.

The material from which the houses are built depends largely on local conditions. The availability of the material, whether it be lumber, brick, stone, or cement, is important because of its bearing on cost. The estimated life of the town determines how much stress should be laid on the durability of the building material. Climatic conditions may determine the selection of a cold-resistant or heat-resistant material and the form of construction to be used. The prevalence of high winds, earthquakes, rain, and atmospheric humidity must be considered. The spacing of the houses, one from the other, the cost of fire protection, the fire hazard, and the insurance rates influence the choice of building material.

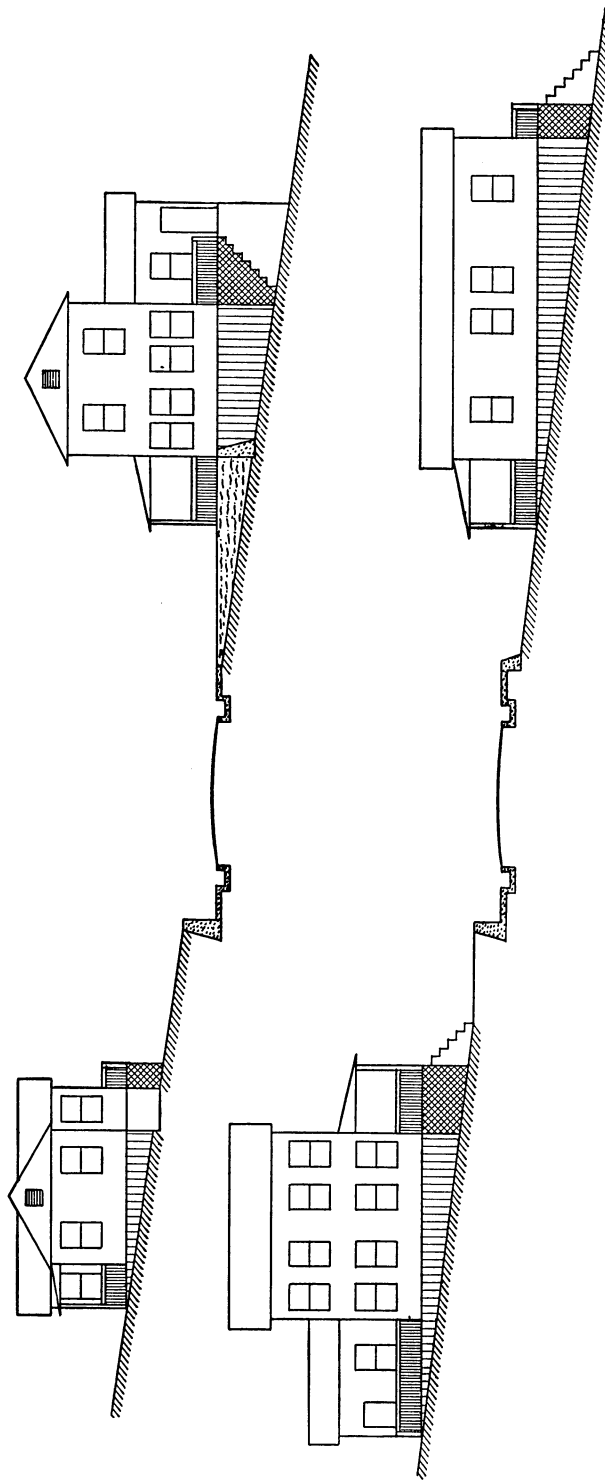


FIGURE 3.—Right and wrong methods of arranging hillside houses. Upper view shows correct arrangement, with one-story house on high side of street.

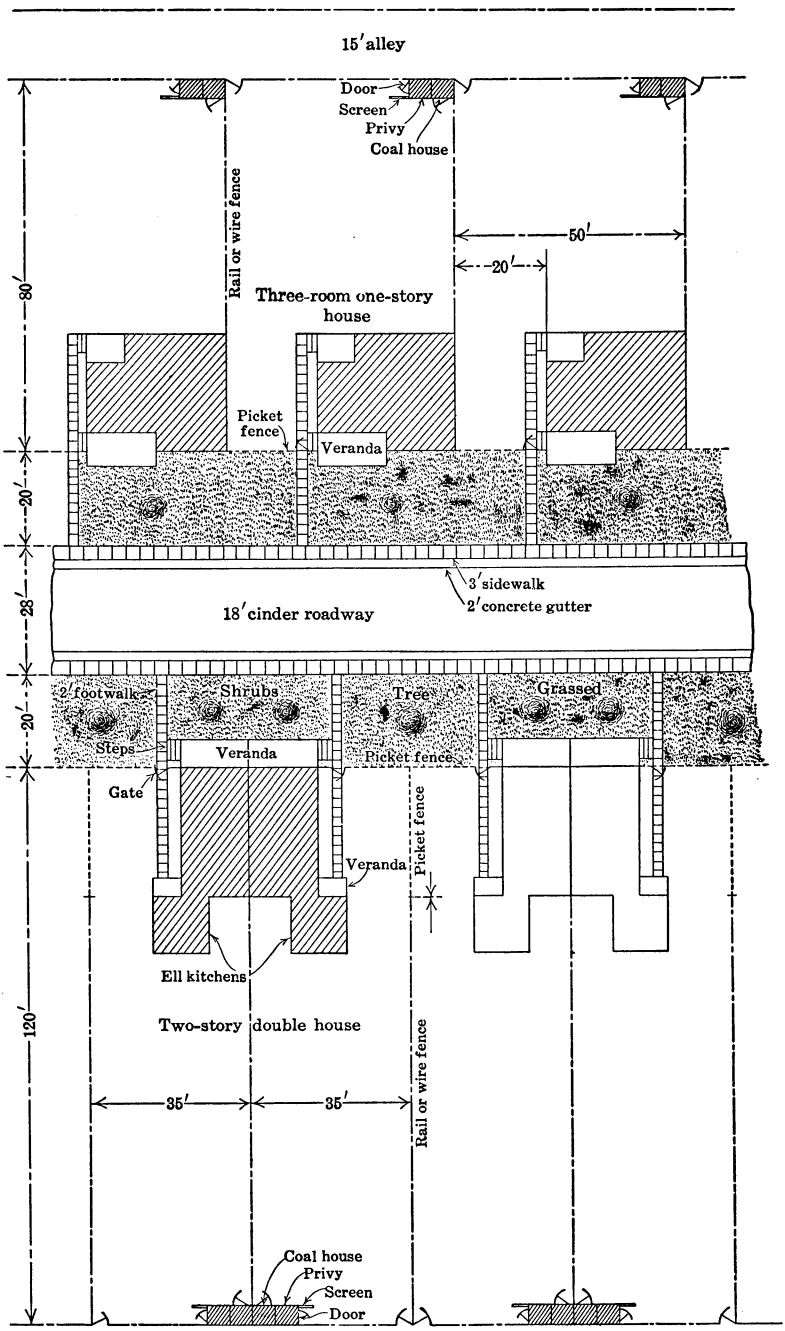


FIGURE 4.—Suggested arrangement for houses and lots: Picket fence in front, rail or wire fence along sides and in rear, footwalks along side of house, houses not directly opposite one another.

MASONRY HOUSES.

Various types of masonry houses are being erected at towns connected with mining and metallurgical industries. Under special circumstances brick and stone (generally sandstone found on site and easily quarried) houses have been erected for the use of miners. Recently some attractive homes have been made from poured concrete (Pl. II). These are very durable, fireproof, and, to a large extent, vermin proof.

Unless some precautions are taken houses built with solid masonry walls will be damp and moisture will condense on the inside. Brick walls are generally built with an air space in the interior to prevent this. Sometimes an insulating medium is placed back of the plaster. Forms for making concrete blocks or artificial stone are usually made so that there will be an air space in the stone. Special machines are on the market whereby a hollow concrete wall may be poured. Hollow tiles are now also being used for finished exterior walls. These have been used for some time on interior nonload-bearing walls.

The idea in all of these types is to establish an insulated air space (similar to a thermos bottle) between the outside and inside wall surfaces, so as to prevent dampness and make the rooms warmer in winter and cooler in summer.

ADVANTAGES OF FRAME HOUSES.

Generally, the frame house is best adapted to mining villages. More variety of design can be attained in a frame house, and it lends itself to more economical decorative features, although, of course, health and comfort are to take precedence over beauty. Another desirable feature of the frame house is the ease with which it can be enlarged. In designing small houses possibilities for future extension should be provided; many a miner becomes strongly attached to his house or some feature of the local environment, and if his house can be enlarged to meet new demands he is often more contented. As regards color, the variety that may be attained by different combinations of colors in the painting, and the need of periodic painting with its cleansing and renovating effects may be regarded as an advantage of the frame house.

ADVANTAGE OF VARIETY IN DESIGN.

In building on a lot it is desirable to have plans of a variety of houses available in order that the house may be best adapted to the lot on which it is placed. Variety of design not only has a utilitarian purpose, but improves the appearance of the entire town. There is also an economic reason which pleads strongly for

MULTIPLE-TENEMENT DWELLING OF CONCRETE CONSTRUCTION. FIVE ROOMS EACH; ALL MODERN CONVENIENCES. GARY, IND.

variety in houses; namely, differences in rents. The decision as to what proportion of his income a miner should spend on house rent is determined by a number of considerations. Racial characteristics, size of family, domestic habits, social and educational aspirations, past obligations, all affect the question. Each case can best be settled by each individual family, and means of meeting different desires should be provided within certain limitations.

PROPORTION OF TYPES.

After the variety in style of the houses for a new mining town has been determined, the next question that arises is the number of three, four, five, or six room houses that shall be built, and how many houses shall have single, double, or multiple tenements. This question can be decided only after carefully collected statistics have been interpreted with sound judgment. Local investigations must be made; the character of labor must be predicted; the percentages of married and unmarried men on neighboring pay rolls should be ascertained; and the sizes of miners' families should be recorded. Observation indicates that miners' houses in the past have been built entirely too small. In correcting this defect incongruous additions have been built, which probably gave rise to the term "mining patch."

TWO-STORY HOUSE.

As the number of rooms in a one-story house increases, the number of exposed sides to each room decreases. In a one-room house the room would have four sides completely exposed; in a two-room house each room would have three sides; and in a four-room house two sides exposed; and when a fifth room is added only one side of it may be exposed. Therefore, when the rooms reach a certain number it becomes advisable to build two-story houses, not only for improved lighting effects, but also because it cheapens the proportionate cost of foundation, roof, and of land occupied.

A two-story brick cottage is shown in Plate III, *A*. The plan of the house is shown in figure 5.

DOUBLE-TENEMENT HOUSES.

Double-tenement houses have in the past been used to a large extent in mining towns, especially in northern climates, where expensive cellars are required. It is generally necessary to make double-tenement houses two stories high. Each tenement should be made as private as possible. Separate front porches are highly desirable. The yards should be fenced off and individual privies and coal sheds built. Tenements should be side by side and not one over the other.

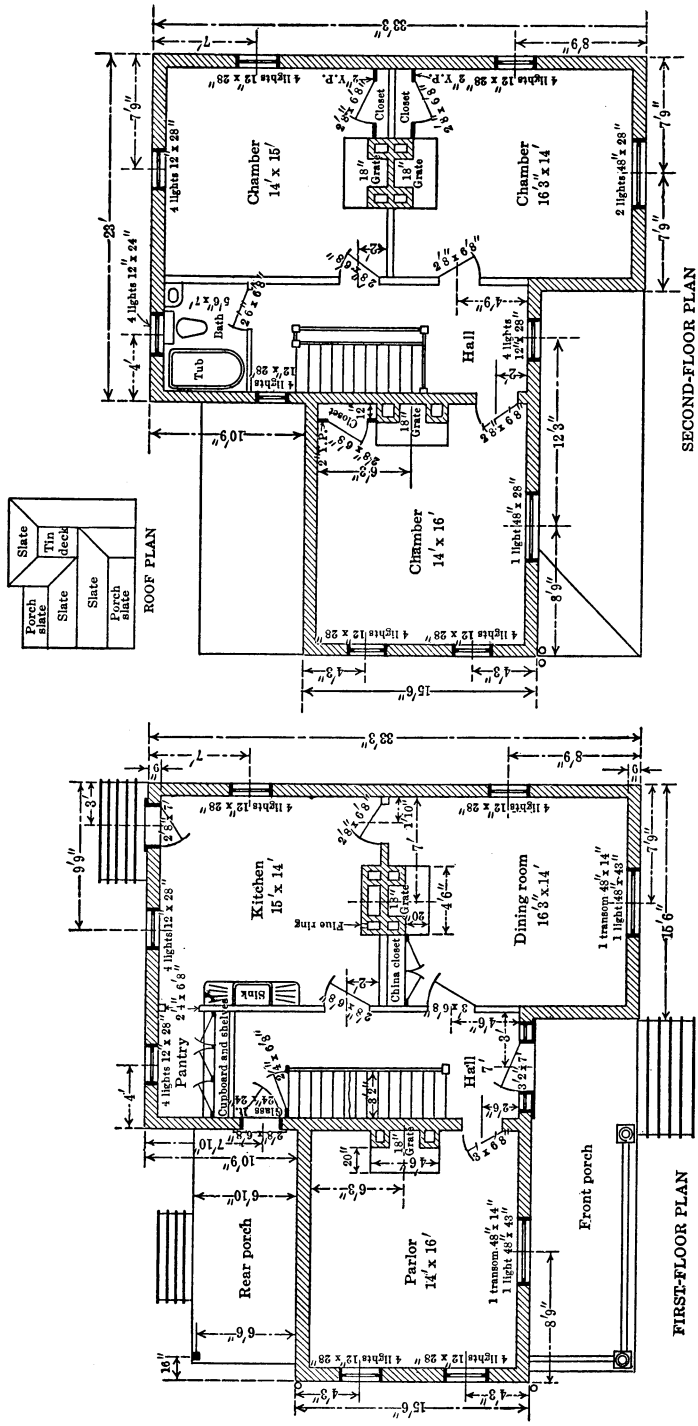
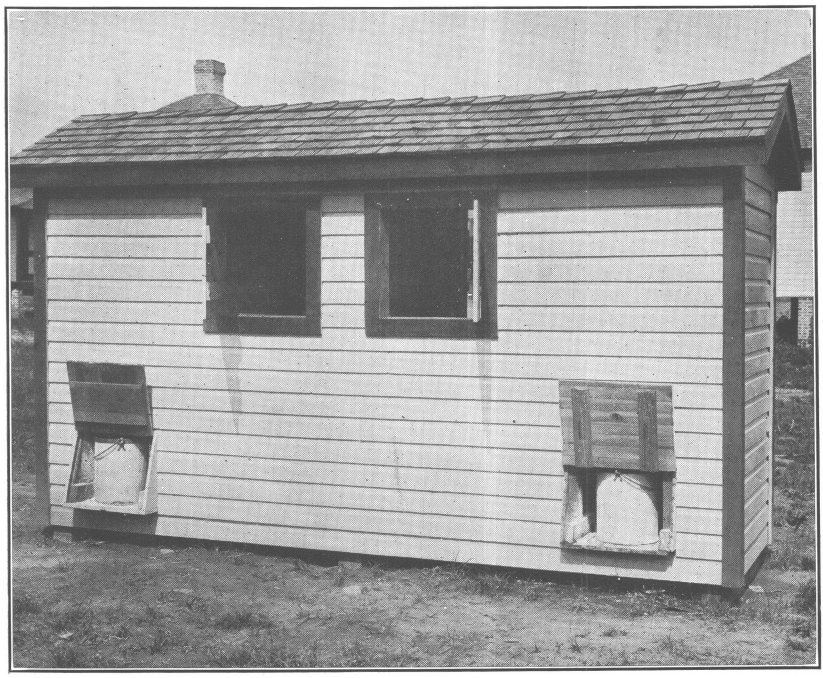


FIGURE 5.—Floor plans of two-story brick house.

A. MINER'S BRICK HOUSE AT MARIANNA, PA.



B. REAR VIEW OF COMBINATION COAL BINS AND PRIVIES FOR TWO DWELLINGS. THE LOWER DOORS ARE SET AT AN ANGLE SO AS TO CLOSE TIGHTLY.

MULTIPLE-TENEMENT BLOCKS.

A multiple-tenement block may be a building two or two and one-half stories high, extending along the street front so that 6 to 10 homes are under the one roof. This type of dwelling is economical because of the saving in side walls and may be necessary where land frontage is scarce. The critical consideration in its adoption is climatic conditions. In a cold climate the practice of building a number of two-story houses of identical design with narrow passageways (4 or 5 feet) between the houses is undesirable. Little sunlight reaches the rooms on these blocked sides; in fact these sides are generally windowless. It would be better to combine these houses and omit the narrow passage entirely and enlarge the window areas in front and back. The tenement block should never be built more than two rooms in depth, except, perhaps, for the extension of a kitchen ell in the rear. Tenement blocks should be built preferably on a street that runs north and south, so that the exposed side of the rooms will have the advantage of as much sunlight as possible. The cutting off of the convenient entrance to the back door is not a serious objection. The combining of eight of these houses may permit the blocks to be separated by an interval 30 feet or more wide, thus furnishing two tenements in every eight with plenty of light and sunshine.

In warm climates, however, the important consideration is to get a cool, well-ventilated house, and individual houses, even though spaced closely, help this. Even if sunlight can not penetrate these narrow passageways, windows should be placed therein for ventilating purposes. Privacy may be attained by not placing windows directly opposite each other or by using ground or other translucent glass.

ORIENTATION.

The direction in which the house faces is important in self-contained houses as well as in multiple-tenement dwellings. Every effort should be made to have the living rooms that are most used on the south and east sides. The north and west sides are more cheerless in winter and more uncomfortable on warm summer evenings. The halls, stairways, and less used rooms should be on these less desirable sides.

KITCHENS.

In some places it was a common practice in the past to build the kitchen entirely separate from the rest of the house. It is not believed the best conditions result from separating the kitchen and the house; ultimately the intervening space is roofed over, then one side

will be closed, and finally the kitchen becomes a part of the main building.

The kitchen in a miner's house should be made much larger than has been the practice in the past; in fact, the kitchen should be the largest and most pleasant room in the house. It is the center of all home activities. The miner's wife spends a large part of her life in the kitchen; it is used as the family dining room; the children play there and around the back door. Neighbors are entertained in the kitchen. In the absence of a washhouse, it is used as a bathroom. On cold winter nights the family circle is around the kitchen stove. These remarks apply notably to the smaller houses, in which the living room is often converted into a bedroom. Statistics as well as observations prove this. Of 2,371 miners' families investigated by the Immigration Commission[a] 43.5 per cent used all but one of the rooms in the house for sleeping purposes, and 41.1 per cent used all but two rooms for sleeping purposes. Of course, it would be desirable if every miner—in fact, every workingman—could have a dining room, a living room, and a parlor, in addition to his kitchen, but this is not always practicable under existing conditions.

WINDOWS, DOORS, AND ARTIFICIAL LIGHTING.

In this bulletin the discussion of windows, doors, artificial lighting and heating, and interior finish precedes the discussion of foundations, chimneys, framework, and roof. Although this order is illogical from the builders' point of view, it is the logical order as regards the health of the people who are to occupy the house. It is felt that many advantages have been abrogated because of a desire to conform to construction practices or through fear of violating fixed standards, such as placing windows with a view to symmetry rather than with regard to the interior arrangement or the lighting effect. It is desirable that the plan of the house should be developed from the room out and not from the foundation up.

WINDOWS.

MORE SUNLIGHT IN THE HOME.

The part played by sunlight and fresh air in insuring good health is often dwelt upon, but practical and specific methods of introducing a maximum of these into a cottage are seldom furnished. Because lighting and ventilating an individual house, as compared with a crowded city tenement, is simple, the tendency has been to slight this subject, with the result that the prevailing condition is far from perfect. The lightsomeness of a miner's cottage deserves special consideration. As the miner's occupation necessitates many

[a] Immigrants in industries: Reports of the Immigration Commission, 1910 (Senate Doc. No. 663), vol. 6, 1911, p. 134.

sunless hours, every effort should be made to bring as much sunshine into his home as possible and to reduce to a minimum the need of artificial light.

The explanation frequently given for not having more windows is that they would make the house more difficult to keep warm in cold weather. Climatic conditions should greatly influence one's judgment in this matter, and it must be remembered that warmth and comfort are essential as well as sunlight, but excuses should not be allowed to masquerade as reasons. A house can be well lighted and still be kept warm. Open foundations, single floors, unceiled rooms, leaky roofs, loose windows, and sagging doors are the chief reasons for cold, uncomfortable houses, and if larger windows will necessitate a correction of these defects, then they bring a double blessing.

CONTROLLED VERSUS ACCIDENTAL VENTILATION.

Some good from the above construction defects has been claimed because they were all that furnished many occupants with fresh air on account of their prejudice against opening windows. This claim is not supported by modern ventilating ideas. "Air-conditioning" is the latest word in ventilating parlance. It signifies that the amount of air furnished should depend upon whether the occupant is actively engaged in housework, or sitting quietly eating or reading, or is sleeping under warm bedclothes. "Controlled" ventilation by properly placed doors and easily opened windows is needed, and not "accidental" ventilation.

WINDOW AREA.

No hard and fast rule can be given for the proportion of wall area that should be used for window space. The climate, building material, interior finish, shape of room, number of sides exposed, and the use of the room all affect the proportion. One feature that may serve as a guide is the common inadequacy of window area in the past. Those mining companies that are changing the type of construction of their houses are especially cautioned. Some companies have recently built clapboarded and plastered houses and did not increase the window area from that used with old methods of construction, with the result that the rooms are very warm and close in summer.

POSITION, SPACING, AND SHAPE OF WINDOWS.

It will be of help to keep in mind the three distinct functions of a window, namely, air, light, and outlook; and the position of the window should be such that all these purposes are fulfilled to the best advantage. The arrangement of the furniture in the room

should be forecasted so that the windows may be placed with respect to the arrangement of the bed, bureau, tables, looking-glasses, etc. In placing bedroom windows it should be remembered that bedsteads are from 6 feet 6 inches to 6 feet 8 inches long and from 3 to 5 feet wide. If the room has two sides exposed, advantage should be taken of this feature and windows placed in both exposed sides. One of the fundamental considerations emphasized in designing a house is the necessity of having exposed sides for this very reason. In a balloon-frame house it is desirable to have the windows in the second story directly over those in the first story.

The shape of the opening is important, and in building a large number of houses the use of sashes not of standard sizes may be justifiable. A tall, narrow window is more effective than a short, wide one, and the opening should extend well up toward the ceiling. This permits the light to penetrate farther into the interior of the room and reduces the reservoir of stagnant air between the top of the window and the ceiling. It also allows greater wall space for furniture.

On all window casings a strip of sheet lead should be placed along the top on the outside. Otherwise water may leak in during rains and stain the curtains or shades.

GLAZING.

Ordinary window glass is made in two standard thicknesses, known as "single thick" and "double thick," the former being about one-sixteenth inch and the latter one-eighth inch thick. Although the latter costs a little more than the "single-thick" glass, it is much stronger and is a better insulator against the cold. Single-thick glass should never be used in panes larger than 24 by 24 inches.

Glass should be set with putty made from a mixture of pure linseed oil and whiting, to which one-tenth part of white-lead putty has been added. A liberal number of triangular zinc points should be used. Before the glass is set the sash bars should be painted with a linseed-oil paint so that the wood will not absorb the oil of the putty. If these directions are followed the putty will harden and cling tightly both to the glass and the wood and will last as long as the sash itself. Cheap commercial putty is sometimes made from marble dust and kerosene; this putty tends to curl away from the glass and fall off, thus permitting the rain water to lodge on the sash bars and rot them. Attention to details of glazing will greatly reduce the number of vexing window troubles.

NUMBER OF PANES IN SASH.

Sashes with six or eight panes of glass have been used to a large extent in the past in miners' houses. These permit the use of

"single-thick" glass and reduce the expense of replacing broken panes. They do, however, catch more dirt, are more difficult to clean, and obstruct the light more than windows with larger panes. The leakage of air is probably greater and cracked or broken panes are apt to remain unrepaired longer than with larger lights. A two-light sash makes a very desirable window for a dwelling.

EASILY OPERATED WINDOWS.

All windows should be double sash and each sash should slide up and down with such ease that a child can operate it. Opening a window that binds is very trying and the occupant may neglect to admit fresh air to a room if the windows are in such a condition that it requires a bar to open them and a prop to keep them open. Windows often bind on account of the settling of a house and remedies for this are discussed under the subject of "Foundations." Windows often become loose, rattle, and leak because of shrinkage. After a new house has been in use for some time all of the windows should be carefully gone over and these defects remedied.

The windows should be weighted so that both sashes can be raised or lowered to any desired height. Sash lifts should be applied to the bottom rail of the lower sash to afford a hold for the fingers in raising the sash. In old houses in which weight boxes have not been provided, side sash locks should be installed. These are attached to the side of the window and will hold the window open at any desired height. They are cheap, costing only 50 cents or a dollar a dozen.

BLINDS NOT NECESSARY.

Outside blinds, or shutters, are unnecessary for a miner's house. They are apt to get out of repair quickly. The frame may sag and get out of shape, the slats may drop out or get stuck. The fasteners may become broken or bent. Frequently the blind is then tied back with a string and is then seldom used for the purpose intended, or is permitted to become a plaything of the winds and slam back and forth, breaking glass and causing other damage.

SCREENING WINDOWS.

Flies and mosquitoes are undesirable, not only because they are nuisances, but because they spread disease. In mining towns the fly evil is especially menacing because of the open privies and other insanitary conditions that frequently exist. These bad conditions should be uprooted at the source, but as an additional safeguard fly screens are urgently advocated. Unfortunately, many of the framed screens on the market are ineffective and expensive. Cloth netting, when tacked on the outside casing, makes an effective screen when in

good condition, and on account of its cheapness may be renewed each summer. It is objectionable, however, because it is quickly torn or rotted. In communities where fly and mosquito disseminated diseases are prevalent many companies have encouraged the use of screens by selling them to the tenants at cost. Copper screening will perhaps prove cheapest in the end. It should have about 16 meshes to the inch.

DOORS.

DOORS AS INSTRUMENTS OF VENTILATION AND ILLUMINATION.

The illumination and ventilation of the house may be greatly improved by properly placing the doors. Advantage should be taken of these uses for doors in addition to their use as a means of entrance and exit. Frequently dark ends of rooms may be lighted by a glass-paneled door, ground glass being used where privacy is necessary. If the front door leads into a dark hallway the glass panel is almost essential.

Outside door frames should be recessed for attaching screen doors. Storm doors, of the same size as the screen doors, should be provided in cold climates for exterior doors which open directly into a living room. For a hall or vestibule the storm door is not so important. If the doors were stored in a company building when not in use, and were hung each season by a company carpenter, they would last much longer. This service would show the interest of the company in the comfort of its employees without carrying with it any semblance of paternalism.

The movement of air through the house can often be improved, thereby making the house much cooler in summer, by properly placing the doors relative to one another and to the windows. The use of transoms is advocated for the same reason. The transom may be used to advantage, especially in those bedrooms which have only one side exposed. Otherwise, when the door of such a room is closed at night, the room approximates a "hole in the wall," with such a slight movement of air that a comfortable and refreshing night's rest is impossible. A transom over the kitchen door will greatly help to remove the smoke incident to cooking and make the room more livable.

LOCATION OF DOORS.

The position of the furniture should be considered; the wall space can generally be used to better advantage in respect to this if the doors are placed near the ends rather than in the center of a wall. In a dwelling the outside doors usually swing in, and provision should always be made on the door frame for a screen door. In hanging interior doors the side on which the hinges are placed

and the room into which the door swings may vary with circumstances; it is not necessary to follow one system. Doors should not swing so that when left open the lighting from a window is blocked or the opening of another door is interfered with. Such a conflict often occurs with closet doors, and should be guarded against. Sometimes it may be of advantage not to hang the door.

HANGING THE DOOR.

Great care should be used in setting the door frame, for if this is out of plumb the door will not hang well. Some woods swell in damp weather and contract in hot weather, and continue to do this season after season, so that if the door should be planed off to fit in one season it will be too small to stay closed in the other. For this reason pine doors are best for common use, as pine shrinks less than most other woods, and when once dried has little tendency to absorb moisture again.

Strong hinges firmly secured with long screws should be used. All the hardware should be of plain design for ease in cleaning and for durability.

Stock doors are made $1\frac{1}{8}$ inches, $1\frac{3}{8}$ inches, and $1\frac{3}{4}$ inches thick. The $1\frac{1}{8}$-inch door may be used for closets, but all other interior doors should be $1\frac{3}{8}$ inches thick. Outside doors should be $1\frac{3}{4}$ inches thick. Stock doors usually vary between 2 and 3 feet in width and from 6 feet 6 inches to 7 feet in height.

CEILING VENTILATORS AND LOUVERS.

In addition to windows, doors, and transoms, ceiling ventilators and louvers are a help to ventilation. If the ventilator is placed in a closet, the ventilation can be controlled by opening or closing the closet door. An additional advantage is that the closet and clothes therein are kept fresh and wholesome. Openings in the ceiling are of no benefit as a means of ventilation unless louvers are placed in the eaves of the cottage. (See Pl. VIII.)

ARTIFICIAL ILLUMINATION.

In the artificial lighting of miners' cottages it is important to use a system that gives a well-diffused light, does not vitiate the atmosphere, and does not increase the fire hazard.

It has been estimated that an ordinary gas jet will consume as much air as two people and that a kerosene lamp will use as much as four people. When to these disadvantages are added the danger of leaking gas and the menace of the oil lamp in the presence of children, it is hoped that these methods will be abandoned.

In many mining towns the houses are lighted by electricity, and this system should be universally adopted. Electric bulbs do not

vitiate the atmosphere, and if the house wiring is properly done there is practically no danger from fire. Note position of electric lights shown in Plate VI.

FIREPLACES, STOVES, CHIMNEYS, AND FLUES.

WARMTH NECESSARY AS WELL AS AIR AND LIGHT.

In discussing the means of obtaining an abundance of air and light, the question of the warmth of the house forthwith intruded itself. Unfortunately, fresh air during certain seasons of the year is also cold air, and some artificial means must be adopted for warming it. It is believed by many that breathing the artificially heated, stale air of the house is responsible for many of the ills that afflict humanity, and the tendency seems to be to revert to the out-of-door life. This can be done conveniently during one's sleeping hours by means of a window tent, if a sleeping porch is not practical.

If care is used in the erection of a house, the problem of keeping the house warm will be greatly simplified; and throughout this paper emphasis is placed upon construction details for this reason.

FURNACES.

Few miners' houses have individual furnaces. Although no one will deny that this system is very convenient, it is felt that there are numerous more important improvements calling for attention. On account of the smallness of the miner's house, the necessity of building a cellar demanded by this arrangement, and the consequent increase in rent, the universal installation of such systems is not recommended.

FIREPLACES.

Fireplaces and stoves are the two methods usually adopted for heating the small cottages in mining towns. The fireplace is not as efficient as the stove for keeping the room at an even temperature, but it is valuable as a ventilating apparatus, as it removes the impure air and constantly renews the air in the room by suction through cracks in the walls and around the doors and windows.

A stout screen should be provided for the fireplace to prevent sparks flying into the room and to prevent accidental burns from the open fire. Children particularly are subject to such accidents.

CONSTRUCTION AROUND CHIMNEY.

If the chimney breast over the fireplace or mantel is to be furred out and finished with lath and plaster, only metal lath should be used. If the mantel is to be of wood, it should not project far enough to be blistered or ignited.

All floor timbers should be trimmed clear of the brickwork of the hearths and chimney, so as not to be in contact with it at any point. This is secured by header beams, carried in front of the fireplace and at least 20 inches from the chimney breast, supported by the trimmer beams, which enter the wall on each side of the chimney. These should not approach the side of the chimney closer than 4 inches. The intervening tail beams, as they are called, are mortised into the header. In this way the floor beams are free of contact with chimney flues. (See fig. 6.)

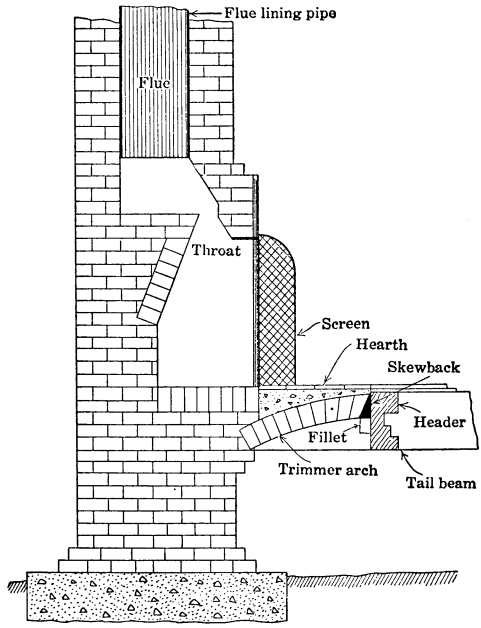


FIGURE 6.—Cross section of chimney, showing construction.

HEARTHS.

All hearths should preferably be laid on trimmer arches of brick or a reinforced concrete slab extending from the chimney breast to the header beam already described, so that the hearth shall not rest upon or near wooden beams in any case. The length of trimmer arches should not be less than the width of the chimney breasts, nor their width less than 20 inches, measured from the face of the chimney breast. (See fig. 6.)

STOVES.

The most effective place for a stove is near the cold or exposed side of the room, possibly between two windows, so that the chill may be removed from the cold air as it enters the room. This is on the same principle that radiators are placed underneath the windows. The

position of the chimney should be selected with this thought in mind, unless it is to be used by the stoves in two different rooms, in which case it must be in the partition between the rooms. The more efficient heating would hardly warrant the cost of an additional chimney.

It is desirable to have a short stove pipe, so the stove should be near the chimney. The stove should be placed far enough from the wall so that there is no possibility of blistering the paint, and a piece of sheet tin or galvanized iron should be provided for the stove to rest upon.

When a stove is used, the windows should be lowered slightly to insure an adequate supply of air.

The department of public instruction of the commonwealth of Virginia describes in one of its recent circulars[a] a method of heating country school rooms which might be adapted to cottages. It suggests that a ventilator be placed under the stove to permit the entrance of fresh air and that the stove be surrounded with a galvanized-iron or tin jacket so that the chill will be removed from the incoming fresh air.

CENTRAL HEATING PLANT.

In some instances it might prove economical to heat the houses from a central heating plant. This system deserves to be carefully studied, the important factors being the cheapness of power, the nearness of the houses to the plant, and the number of months during the year that heat is required.

CONSTRUCTION OF CHIMNEYS.

CHIMNEY FLUES.[b]

A chimney should not be built with the idea of using it as a heating device; to do so is dangerous, but should be so built as to conduct the smoke and heated gases directly into the open air. Defective flues are among the most frequent causes of fire.

All chimneys should be built from the ground up, and the foundations should extend below the frost line. The practice of supporting chimneys or flues on floor beams or wooden or iron brackets is hazardous. A small fire around the base may drop the flue and allow draft for the rapid spread of fire.

HEIGHT OF CHIMNEY.

All chimneys should be built to a point at least 3 feet above flat roofs and 2 feet above the ridge of gable roofs. Down drafts are

[a] Form X, No. 45.

[b] Most of the following recommendations have been adopted from a bulletin issued by the National Fire Protection Association.

frequently caused in chimneys in the L's of buildings, because the chimneys are not built sufficiently high. Air in motion has the peculiarity of clinging to surfaces over which it passes, and in following down the pitch of a roof, if the chimney flue is in the descending current, a down draft will be caused. Often down drafts may be prevented by covering the top of the chimney with a semicylindrical cap of brick, or similar device, having its axis at right angles with the direction of the downward current so that the chimney gases can issue from the ends of the cap.

SECTION THROUGH CHIMNEY.

A chimney should not be built with a wall less than 8 inches (two courses of brick) thick and cement mortar should be used up to the first floor and above the roof line. The walls of the chimney, from 12 inches above the roof to the top, may be only 4 inches thick if the bricks are carefully bonded together with cement or fireproof mortar. All chimneys should be large enough to give a separate flue for each fire, using fire-clay or terra-cotta linings at least 1 inch thick. Two connections to a single flue may result in fire from one connection communicating to the opening of the other, and thousands of fires are said to have originated in this manner. Where flue linings are not provided all joints on the inside should be struck smooth and projections of brick or mortar should not be allowed, nor should the inside of the flue be plastered.

INTERIOR AND EXTERIOR FINISH.

FLOORS.

Emphasis is laid on the necessity of making the floors of plastered houses less vibrant than was the practice when the houses were ceiled with wood. A number of companies are now plastering their houses, and unless the floor is well braced the plastering will crack, and an excellent sanitary improvement will be unjustly discredited. The floor joists should be spaced sufficiently close and should be stiffened by bridging to prevent vibration.

A house with cold floors is especially uncomfortable. It is earnestly recommended that the floors of all miners' houses be made of two layers of boards, and it is a good plan to place heavy paper between the layers. The lower layer may be made of rough boards of irregular width and three-fourths to seven-eighths of an inch thick, laid diagonally. The upper layer should be made of narrow boards, preferably matched, one-half to five-eighths of an inch thick, laid perpendicularly to the floor joists and blind-nailed to the joists only. If the two were laid in the same direction, the shrinkage of the wide boards underneath would tend to pull two or three of the

narrow finished boards together, thereby leaving open joints, corresponding roughly to the widths of the boards below.

The matched floor should be given a coat of filler paint and a finishing coat of floor stain or of varnish. If the floor is to be painted, the paint should contain a large proportion of hard oleoresinous varnish and should be heavily charged with dryer. Numerous hard, quick-drying paints, especially adapted for floors, are on the market. With a view to discouraging the nailing of carpets to the floor, which is an insanitary arrangement and is not necessary if the house be warmly built, a border should be painted around the edges of the floor.

PLASTERING.

Plastered houses are being built in a number of the new mining towns. Plaster makes a warm, clean, interior finish and is said to be less expensive than ceiling with wood. As a plastered house is warmer than one ceiled with wood, greater window area may be allowed and the house made more lightsome. If plaster is used, consistent construction should be followed in other respects. Attention is again called to the necessity of good foundations and rigid floors; otherwise big sheets of plaster may fall off and expensive repairs and unsightly walls result. Good material should be used and the laths should be laid one-fourth to three-eighths of an inch apart, so that the plaster will form a good clinch on the back of the laths. The laths on a wall should all be laid in the same direction; the shrinkage of laths that are placed at right angles to one another often causes plaster to crack.

PLASTER BOARDS.

Plaster boards of various compositions are used in place of lath and plaster. This construction is said to be cheaper, more resistant to fire, and to furnish better protection against extremes in weather.

PAPERING.

Although wall paper at first may furnish an artistic charm, it soon fades, becomes dirty, and gets torn, and makes anything but a pleasing appearance. Perhaps the danger of arsenic poisoning from the green coloring matter in wall paper has been overexaggerated, but this and other coloring may give off odors which are unpleasant if not dangerous. The flour paste which is used in hanging the paper will slowly putrefy, which helps to cause the musty smell characteristic of houses that have been closed for some time. This flour paste also furnishes food for vermin, and when these get concealed under the paper it is difficult to destroy them. With a view to preventing this, an insecticidal solution is sometimes mixed

with the paste. The fibrous pores of the wall paper may harbor germs if the house has been occupied by a person suffering from a contagious disease. Because of the expense of removing old paper when a room is repapered, the dirty, greasy paper is often covered over with the new paper, and this, of course, intensifies the evils heretofore mentioned.

If wall paper is to be used, a good way to insure proper hanging of the paper, one practiced by several companies, is to have the tenant furnish the paper and to have a representative of the company hang it. This is much better than the reverse arrangement, which is adopted at some places.

INTERIOR PAINTING AND KALSOMINING.

The substitutes for wall paper are painting, kalsomining, and tinting. New plaster does not take paint well, because of its alkaline character, and newly plastered walls are best allowed to remain unpainted for at least a year. Various and attractive tints may be applied whose charm and interest last much longer than many of the gaudy designs seen in cheap wall paper. Oftentimes figures may be stenciled around the border, which will improve appearance and add contrast.

INTERIOR WOODWORK.

All the interior woodwork, as baseboards, window and door frames, moldings, and stair rails, should be plain and without such ornamentation as flutings, ogee curves, beadings, and filigree designs. None of the woodwork should be installed until the plaster has dried. It is best to keep the woodwork out of the house while plastering, so that it will not absorb the moisture given off by the plaster. The ledges should be beveled and the intersections between floors and walls should be filleted with a triangular piece, instead of the quarter round that is used so extensively. Picture molding should not be used, but knobs should be screwed into the walls at places where pictures might be hung to good advantage. Attention to these little details will reduce the number of dust pockets and crevices, which are difficult to clean, and will lessen rather than increase the cost of the house.

MODEL FURNISHED HOUSE.

It is not desirable for the company to dictate the methods of furnishing houses. Even if conditions are not up to the desired standard of sanitary perfection the evils arising from interfering in the home might incur graver consequences. It is none the less true that some discreet method of showing good and bad interior arrangements would cause desirable information to be diffused in the mining town. Such information reaches the miner's house slowly

unless special efforts are made to disseminate it. The isolation and homogeneity of a mining population, the great number of non-English-speaking people, their recent advent into this country, the absence of libraries and lectures, and the scarcity of newspapers and magazines make some such effort desirable.

On this account, in addition to the regular educational channels, as the schools, some companies have employed visiting nurses and social workers whose duties are to render assistance along such lines as furnishing the house, cooking, modern methods of taking care of the baby, etc. In addition to special training and experience, great tact must be exercised by the person or persons employed in this work if permanent good is to be accomplished.

One progressive company has successfully and tactfully met this problem by setting aside a cottage and furnishing it in a clean, modest, up-to-date manner and throwing it open to the public for exhibition. The cost of each piece of furniture is plainly marked and the total cost of furnishing each room is conspicuously printed on a placard. This feature also thwarted another local evil, namely, the imposition of unscrupulous furniture dealers who sold furniture on the installment plan at exorbitant prices.

The educational feature of the exhibition house might be carried further to advantage. A placard on the bedstead might call attention to the position of the bed relative to the windows, another may explain that an iron bedstead is not broken so easily as a wooden one, affords better ventilation, and is more easily kept free of vermin. Attention should be called to the bedclothes and to the advantage of sleeping between sheets in order that heavy blankets will not have to be washed so frequently. The sleeping room should be free from unnecessary furniture, pictures, trinkets, drapings, canopies around the bed, fancy table coverings whereby a lamp might be upset by a child, mantel decorations, etc. There should be no carpet nailed on the floor and the windows should not have lace draperies. An appropriate placard could state that lace curtains, carpets, and draperies offer collecting places for dust and germs and make the living rooms less healthful. The windows should be screened, and the necessity of opening the window from the top and bottom should be suggested.

The above suggestions will serve to indicate how inroads may be made into local customs or fetishes without causing friction.

THE VERANDA.

IMPORTANCE OF THE VERANDA.

One of the most important health features of a house is the veranda. It is sometimes called a piazza, a porch, or a gallery, and is an invaluable asset in seasonable weather. No house should ever

be built without at least one veranda. The veranda also serves to add beauty and variety to the house.

FOUNDATIONS OF VERANDA.

The foundations of the veranda should be strong and stable. If piers are used they should be inclosed by latticework, especially those of the front veranda. A variety of designs may be used on the latticework; broad horizontal bars reduce the "up in the air" appearance of a high veranda, and vertical bars relieve the "squattiness" of a low one.

FLOOR OF VERANDA.

The veranda, especially the one in the rear, should be built with the thought that it is frequently to be used as a playroom for children and as an airing place for babies. It should be so arranged that the child can be left with safety while the mother performs the household duties. Sometimes the floor of the veranda is laid with a ¼-inch crack between the boards, chiefly for the purpose of shedding water. Such a floor is uncomfortable to walk upon, especially for children with bare feet, and money or trinkets may be dropped through the cracks. A better method is to put in a tight floor with a pitch of one-fourth inch per foot. The boards of the floor should be laid perpendicular to the side of the house so that if they warp up at the edges the channels formed will be in the direction of the flow. The floor should be made of quarter-sawed wood so that it will not sliver. The level of the veranda floor should be a few inches below the level of the main floors of the house.

BALUSTRADE OF VERANDA.

The railing or balustrade should be designed with a view to simplicity, safety, and, above all, durability. It must be kept in mind that the balustrade may be frequently used as a footrest or seat. The top and bottom rails should be beveled to shed water and the bottom rail should be a few inches above the floor. Frail, fancy-turned vertical pieces should not be used; plain rectangular pieces, closely spaced, are better. If the floor of a front veranda is near the ground the balustrade may be omitted if the yard has a front fence, but if the front fence is omitted (see "Fences") the balustrade adds a needed touch of privacy. A pleasing and inexpensive column may be built by using two 2-inch by 4-inch scantlings separated a few inches and interlaced with narrow strips. The scantling should be dressed on all sides and the sharp corners chamfered.

VERANDAS WITH AND WITHOUT ROOFS.

At times it may prove advisable to omit the roof of the veranda, as this is frequently the cause of dark, sunless rooms. Frequently

kitchens have only one side exposed, and if the windows on this side are shadowed by the veranda roof that much-used room is made cheerless. If the veranda is on the north side of the house the roof might be omitted with advantage or if the house has two verandas the roof might be omitted from one. It is undesirable to darken the verandas with vines, but the use of flower boxes should be encouraged. If the roof of the veranda is built flat or with a slight pitch, it may be developed into an out-of-door sleeping porch by the tenant. It appears an unnecessary expenditure to box in underneath the veranda roof; this makes a more finished interior appearance, but does not add to the general appearance of the veranda. This boxed-in space slightly increases the fire hazard.

"BUILT-ON" VERSUS "BUILT-IN" VERANDAS.

The "built-in" veranda should seldom be used on miners' houses, because of its expensiveness. This type of veranda robs the interior rooms of valuable space and is not so open, well ventilated, or breezy, and does not furnish such a variety of outlook as does the "built-on" veranda.

VERANDA STEPS.

The steps are a part of the miner's house that are frequently out of repair. This is generally due to cheap and thoughtless construction, and not to abuse. Although the steps are not designed as cantilevers, they frequently become such in usage by the washing away of ground support. The part of the steps in contact with the ground should rest on a permanent, unmovable, substantial foundation. The stringers should be of 2-inch stock, spaced about 16 or 20 inches apart. The treads should be made of $1\frac{1}{8}$-inch stock, and should be slightly pitched to shed rain. The risers should be made of $\frac{7}{8}$-inch stock, but should always be boarded up for safety. The appearance of the steps is improved by latticing the sides.

The angle of the flight of steps often depends upon the height of the veranda, but should never be steeper than 45°. The following rules are frequently used: The sum of the rise and run should be equal to 17 to $17\frac{1}{2}$ inches. The sum of twice the rise plus the run should not be less than 24 nor more than 25 inches—for example, $7\frac{1}{2}$-inch rise and 10-inch tread. The product of the rise and run should not be less than 70 nor more than 75. Handrails should always be added on high, steep steps. When it only requires one or two steps to mount, these can be advantageously made from concrete.

As formerly stated, appearances can at times be improved by having front steps sidewise to rather than facing the street, and at times a combination of both directions may be used to advantage, particularly on verandas that are rather high. It is economical to

have the steps of a front veranda lead up from the footwalk, which runs from the front to the back of the house. This does away with the necessity of two front gates and the front footwalk, and does not cut up the front yard. The indirectness of the approach by having the steps at the side (see fig. 4) is of small consequence.

OUTSIDE PAINTING.

One of the predominant characteristics of mining towns has been the sameness of all the houses, which has been largely caused by the houses being painted the same color. The appearance of a town is greatly improved by various combinations of harmonious colors.

It is claimed that more durable results are obtained when tinted rather than white paints are applied. "Permanent coloring materials which have been ground by machine into a high-grade white-paint base have the effect of preventing 'chalking' and 'checking,' two defects that are often observed when white paints are used."[a]

In painting new houses the priming coat should contain a large proportion of oil, since much oil is absorbed by the new wood. It is considered good practice to add about a half gallon of raw linseed oil to every gallon of paint used as a priming coat. This makes the paint for priming cheaper and better adapted for its purpose.

Very often blisters form in paint applied over woodwork which has not thoroughly dried. As the paint film is comparatively impervious, the water underneath, not being able to escape, expands and forms a blister. To avoid blistering it is recommended by some to apply only two coats of paint to a new house. The thinness of the two coats will allow the moisture to evaporate, and when the house is a few years old and thoroughly dried a third coat may be added with good effect. Better results are claimed for this method than by adding the three coats at one time.

USE OF CREOSOTE STAINS.

Creosote stains are being used to a large extent as a substitute for paint. Creosote has numerous advantages. It is cheaper, both in cost of material and cost of application; it permits the evaporation of moisture contained in the wood and has valuable preserving qualities. Paint may be added after the wood has been stained with creosote, if later a greater variety in color is desired.

FOUNDATIONS.

TYPES OF FOUNDATIONS.

The foundation of the house will be discussed both as regards healthfulness and stability. The heated house acts like a chimney

[a] Institute of Industrial Research, Circular 2, December, 1911.

and much of the air that enters the rooms is sucked up from the cellar. It is consequently important to see that this air is not vitiated, or the value of other ventilating precautions is greatly lessened.

The air that comes up from under the house may be a combination of atmospheric air and ground air, the relative quantities of each depending to some extent upon the type of foundation. The amount of ground air entering the rooms is larger in houses having unventilated cellars without cement floors than in houses resting on piers. However, unless the openings between the piers are inclosed with boards, local nuisances may arise which will cause the air to become foul before it enters the rooms. The effect of the closed foundations on the warmth and comfort of the house must be given proper consideration.

It is important to see that the space underneath the house is kept dry and free from dampness. If the soil is damp it will increase the moisture content of air entering the house and will promote disagreeable fungus growths.

GROUND AIR.

The ground air[a] is the atmospheric air that has penetrated into the interstices of the soil and has taken part in the various chemical changes in connection with vegetable growth and decay. When decay is going on the carbon dioxide content increases and the oxygen content decreases. Many of the views formerly held on the danger of breathing ground air per se are being changed. Breathing in small quantities the air affected by such natural changes may do no great harm; if, however, the ground immediately surrounding the house is polluted with kitchen slops and leachings from defective drains, choked cesspools, privy vaults, pigpens, and stables, aside from the direct dangers of infection, these conditions doubtless exercise an unwholesome influence on the air breathed.

ADVANTAGES OF FOUNDATION WALLS.

Walls or piers of masonry or timber posts may be used as foundations for the miner's house. Although the choice of these depends largely upon local conditions, the use of the wall in preference to posts is urgently advised. The wall is necessary for a masonry house and is essential in extremely cold climates, but even where these conditions do not apply, the foundation wall has many advantages.

Building a house on widely spaced, inadequately braced wooden posts or imperfectly laid masonry piers, which rest on cheaply improvised footings is false economy. Frost action, weathering, and

[a] For discussion on significance of ground air, see Rohe, George H., and Robin, Albert, Textbook on hygiene, 1908, p. 161.

surface washes weaken the supports; the house timbers settle and sag; leaking roofs, unclosable doors, and sticking windows result; patches and repairs are constantly needed; tenants are always complaining. Moreover, a greater number of plastered houses are being erected now than formerly, because they are warm, cheap, and clean. These require a much better support than the old type wooden-ceiled house, as a settling that can occur with impunity in the latter will cause expensive damages to the plastered house.

CONSTRUCTION OF WALLS.

Concrete, artificial stone, brick, terra cotta, and rubble may be used for walls, but usually concrete will be least expensive, especially where a large number of houses are to be erected.

On a level lot a wall is not an expensive foundation. If the drainage of the town site has been improved there is no necessity of having the walls 3 or 4 feet high merely to have the house "off the ground," a wall 12 inches above sidewalk level serves the purpose. It would be better to place the extra concrete below the surface, so that the bottom of the foundation will extend below the frost line. It is not necessary to have the entire wall extend below the frost line; columns every 8 or 10 feet are sufficient.

If care is taken with the subsurface wall the exposed part need not be more than 10 inches thick. Metal forms, which may be used over and over again, should be considered if much concrete is to be laid. The exposed part should have ventilating holes, the openings of which should not be large enough to permit entrance of rats. Cast-iron gratings are sold which serve the purpose, or narrow vertical slits may be left which do not require any grating and may also be effective as expansion joints. Before the floor system is laid all shrubs, chips, and trash should be removed from the inclosure. Walls permit the use of smaller sills and also do away with the necessity of diagonal bracing and of boarding up the inclosure.

SPECIAL WALLS.

On sloping lots a stepped foundation wall should be built. On a very steep hillside lot the ordinary masonry foundation wall is very expensive and it may be more economical not to use some lots for a dwelling. Under some circumstances it may be feasible to build a foundation wall consisting of concrete piers to carry the main load and have these connected by a thin curtain wall.

CELLAR.

A small cellar about 8 feet square should be excavated under the corner of the house. The cellar should be walled up and the entrance should be from the outside. Such a small basement makes

a cool place to keep milk and butter, as ice is not available in most mining towns, and furnishes a storage place for vegetables for use during the winter.

PIERS.

In a warm climate, if a frame house is to be erected, piers that are properly designed and adequately spaced and braced make a satisfactory and economical foundation. Wooden, concrete, and brick piers are used, but the best pier requires a combination of these materials. In any pier the footing is the most important part. The footing should have a good bearing surface and be permanently fixed so that it is not affected by weathering, surface washing, or frost action. Brick laid in mortar does not make a satisfactory or economical footing; concrete is preferable. The material of the pier necessarily depends upon circumstances. In a low pier 10 or 12 inches high, a wooden post is not satisfactory, because of lightness and liability of splitting; masonry should be used. For a high foundation, brick or concrete piers are difficult to brace; wooden posts on a concrete footing are better. The footing should extend a few inches above the ground and be mixed wet and be puddled to a smooth surface to furnish a good bearing and to prevent water from collecting underneath the post. Plastering the footing with cement after the concrete has set is not effective.

NECESSITY OF CLOSING UP THE SPACE UNDERNEATH THE HOUSE.

If the openings between the piers are not boarded up experience has shown that this shelter will be used in ways injurious to health. Cows, hogs, geese, hens, dogs, cats, or rabbits may get under the house and fleas, vermin, and lice may gain entrance to the house in this way. In winter the warm house acts as a chimney and the unhealthful odors caused by these animals are sucked up into the rooms. The opportunity for children to play underneath the house should not be permitted, as the atmosphere there is impregnated with organic dust which may cause injury to the child's lungs. This space if accessible might be used as a storeroom for old broken furniture, which furnishes breeding places for vermin and increases the fire hazard. Leaving the foundation open exposes the floor to the winds and makes the house uncomfortable in cold winter months. The additional money spent in boarding up between the piers will be well invested.

FRAMEWORK.[a]

KNOCKED-DOWN HOUSES.

When a large number of houses is to be framed there may be economy in adopting a system of construction similar to that used in the

[a] For detailed information on the construction of a house, see Cyclopedia of architecture, carpentry, and building, vol. 2, 1908, pp. 27–118; Kidder, F. E., Building construction and superintendence, pt. 2, 1899, pp. 46–106.

erection of modern steel buildings. This means the standardization in the drafting room and the sawing, planing, and fitting by machinery in the shop of all of the heavy timbers, as sills, girders, posts, studs, joist studs, and rafters, marking each piece and distributing them at the proper lot for erection. There is a saving of labor because of the greater efficiency of power-driven machines over hand tools, and in instances where the company operates its own sawmills much material can be saved by cutting the logs the desired length. This system requires careful planning and intelligent supervision.

There are some house-building companies that carry the idea much further, not only cutting the heavy pieces to fit but also the sheathing, siding, molding, rails, steps, etc. These pieces are marked and the knocked-down houses shipped to any point in the United States.

TYPES OF FRAMES.

THE BRACED FRAME.

There are two types of frame houses; one is known as the "braced" frame and the other as the "balloon" frame. The braced frame is seldom used now on account of its expense, but a short description will be given, as some of its features might be adopted advantageously under certain circumstances. In this type the sills, posts, girders, and plate are all mortised and pinned together, and the posts are diagonally braced by heavy members, which are mortised and pinned. The studs are all mortised into the sill, girder, and plate. The strength of a braced frame is independent of the sheathing, and it is therefore less liable to become distorted than a balloon frame. The braced frame was used when lumber and labor were cheap and nails were expensive. The old colonial houses were of this type, which helps to explain their remarkable durability.

BALLOON FRAME.

The balloon frame is composed of lighter pieces and is more quickly erected. The main timbers are held together largely by spikes and the studs are simply nailed to the sill and extend from the sill to the plate, the girder being omitted. If the studs are not long enough they are spliced. In place of the girder a 1-inch by 7-inch board, called the false girder or ribbon, is nailed on the inside of the studs to support the second-floor joists. On each side of all door and window openings the studs should be doubled, and in two-story balloon-frame houses, where it is necessary for the studs to extend the full height of the wall, it is desirable to have the windows of the second story directly over those of the first. The balloon frame depends for its strength largely on the sheathing which binds the framework together, and for that reason the sheathing should be put on diagonally.

COMBINATION FRAME.

A combination of the above two methods is sometimes used. The braced frame is adopted as far as sills, posts, girders, and braces are concerned, but the studs are mortised at the lower ends and are only

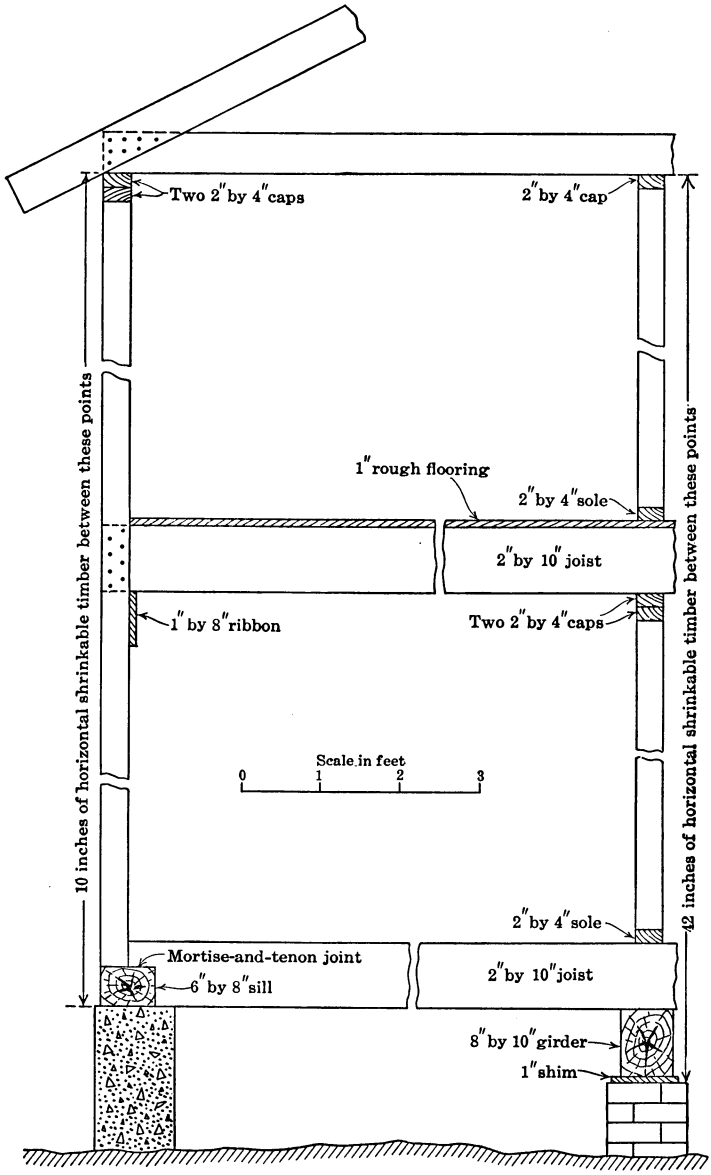


FIGURE 7.—Incorrect method of framing a house.

spiked at the upper ends. If the siding or clapboards are to be nailed directly to the studs (the sheathing being omitted), the method of framing is very important and a combination frame should be considered.

SHRINKAGE.

Under the subject of "Foundations" attention was called to the evils caused by the settling of the house, and remedial measures, in so far as the foundation was concerned, were suggested. Settling is also caused by the shrinkage of timbers, and, although this can not be avoided entirely, it may be minimized by using well-seasoned timber and by erecting the house in the warm, dry season.

The most practical remedy lies in controlling the shrinkage so that it is equally distributed. This can be easily done if certain simple principles are understood and enforced. The amount that timber shrinks along the grain is imperceptible and may be ignored. The chief shrinkage is across the grain, and in ordinary spruce or white pine this may amount to one-half inch for every foot of cross grain. It is therefore important to keep the amount of horizontal timber in the outside walls approximately the same as in the interior walls. Timbers placed vertically or on end do not contribute to the shrinkage, Figure 7 shows how the above practice is ignored and figure 8 shows how the settling due to the shrinkage may be appreciably reduced.

OTHER DETAILS.

The sill should be set in a bed of cement mortar and the bottom side should be painted with two coats of linseed-oil paint to prevent the timber from absorbing moisture from the foundation wall. The broad side of the sill should rest on the foundation wall, but the narrow side should face down, if piers are used. The sill should be set back an inch from the edge of the wall so that a water table (see fig. 8) may be built to shed the rain that drains down the side of the house.

Special attention is also called to the method of framing around a chimney, and under no consideration should any timbers come in contact with or rest upon the brickwork of the chimney. (See fig. 6.) The 2 by 4 inch piece inserted between the studs of a balloon frame on the outside wall at the second story is known as the "fire stop." (See fig. 8.) In case of fire it helps to prevent the fire from creeping from the bottom story or basement up between the partitions to the roof. It also helps to make the house more comfortable by preventing circulation of air between the partition walls.

THE ROOF.

ADVANTAGES OF GABLE ROOF.

When the roof slopes back from the ends of the building the same as at the sides it is called a hipped roof. The well-known gable roof and the hipped roof are the types most frequently used on small,

inexpensive houses. In large houses the size of the span affects the type of roof selected. In approximately square houses the hipped roof is very popular. Although this roof requires less material (considering the saving of gable walls) than the gable type, it is

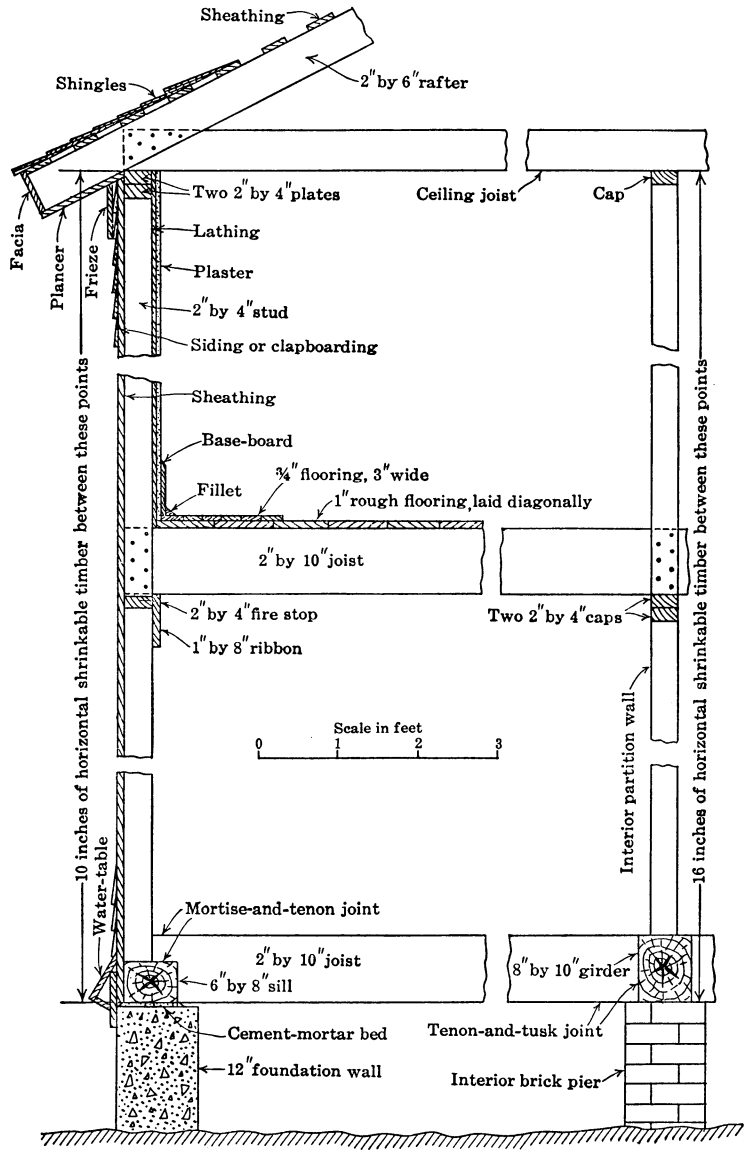


FIGURE 8.—Correct method of framing a house.

questionable whether it is more economical. The labor on it is more expensive, because the rafters must be cut in many different lengths, and four or five ridges must be framed and flashed, as compared with the one of the gable roof. In case the attic space is ventilated,

as it should be, dormer windows are necessary on the hipped roof, whereas a less expensive, plain window may be inserted in the gable ends of the gable roof. Another advantage of the gable roof is that the lineal feet of gutters, cornice, etc., is reduced one-half. Attention is called to the different effects that may be obtained by changing the direction of the ridge on a gable roof, and this resort may often improve the lighting of the adjoining houses.

NECESSITY OF A PLAIN ROOF.

The roof of the house is frequently used as a means of getting ornamental effects, but in this bulletin it is discussed chiefly as regards durability and incombustibility. A plain roof with just as few ridges and valleys as possible is advocated, because these increase the cost, and it is at the intersections that leaks frequently develop. Fancy trimmings on the ridges should be omitted.

FLASHINGS.

It is important that the ridges, valleys, and chimney should be carefully flashed. Tin perhaps makes the best and least expensive flashing material, but it should be painted on both sides. A good paint for this purpose is one made of red lead and linseed oil. The chimney should be surrounded by lead counterflashings in addition to the tin-apron flashing. Flashings on valleys are frequently cut too narrow, with the result that they overflow during heavy rains and the water works its way under the shingles and leaks result. On roofs having a pitch of 45° or more the flashing should be done with strips of tin at least 18 inches wide, and on roofs of less pitch it should be at least 20 inches wide. The end joints on flashings should be locked and soldered.

PITCH.

The pitch or slope of a roof depends largely upon the climate and the character of roofing material to be used. In a damp, cold locality steeper roofs are required than in a warm, dry, sunny one, because the high evaporation of the latter augments the pitch in drying the roof. The roof should not be too steep, but the pitch on a main roof should never be made less than one-fourth, which means that the rise is 3 inches to each 12 inches of span.

ROOFING MATERIALS.

Slate, wooden shingles, roofings composed of saturated papers or felts, finished with a coating of sand, crushed slate, or ground mica, and sheet metals are used for roofing inexpensive houses. The merits of these will not be discussed in full, but certain salient features will be touched upon.

SLATE.

Slate makes a durable fireproof roof, and in Pennsylvania, where slate is comparatively cheap, has been used to a considerable extent for miners' cottages. Its first cost is higher and it requires heavy supporting members, and an 8-inch rise in 12 inches is the least pitch recommended. If slate is used the roof should be simple to the extreme in order that the cost may be reduced. An asphalt-saturated sheet or a good grade of tar paper should be laid over sheathing boards before the slates are applied. In isolated houses, where a cistern must be used as a source of drinking-water supply, slate makes the cleanest watershed, but a mining town should not be dependent on cisterns for drinking water.

WOODEN SHINGLES.

Two methods are used in applying wooden shingles. One consists of completely boarding over the rafters and covering these boards with felt or paper before the shingles are laid. In the other method the shingles are nailed on narrow boards laid a few inches apart. The latter method is by far the cheaper in first cost, and the shingles last longer because of the better ventilation underneath. This method should not, however, be used if the attic rooms are to be finished, as it makes these rooms cold in winter and uncomfortably warm during the summer months.

The untreated shingle roof is objectionable on account of its inflammability, and is condemned by insurance authorities and also by the National Fire Protection Association, which has issued a bulletin condemning this type of roof covering. As clearly shown in that bulletin, burning shingles may be carried great distances by the wind or draft of conflagration, and if they alight on other dry wooden shingles may start other fires. In this manner a dozen separate fires may be started over a radius of a mile or more while the original fire is still being fought. Statistics show that never a day passes but somewhere in the United States or Canada a shingle roof is set on fire by sparks from the chimney.

Notwithstanding its inflammability the shingled roof is desirable on account of its low cost, light weight, coolness, and attractive appearance. Recent experiments by H. A. Gardner, of the Institute of Industrial Research, demonstrate that when shingles are painted with a high-grade mineral paint the deposited film has the effect of smoothing down the fuzzy surface and the mineral constituents increase the fire-retardant properties of the shingle.

PREPARED-FELT ROOFINGS.

Saturated-felt ready roofings are numerous in variety and composition. It is difficult to determine the exact value and relative perma-

nency of some of these products from appearance alone, and attention should be given to their durability in service. Roofings of this type are usually unattractive, and also introduce a certain fire hazard, particularly if the roofing be composed largely of vegetable fiber saturated with volatile compounds.

ASPHALT SHINGLES.

More recently there have appeared upon the market the so-called "asphalt shingles," which are made from roll roofing, cut up and applied in the form of shingles. The general use of such shingles, however, has been too limited as yet to warrant a definite opinion respecting their permanency or durability as a roof covering.

METAL ROOFINGS.

Sheet-metal roofings are available in various forms. That most generally used for houses is the tin roofing, which is more often used where the pitch of the roof is limited. For verandas tin roofing is almost exclusively used. In applying tin it is essential that the boards upon which it is laid present a smooth surface, and it is desirable to have them run from the eaves to the ridge, so that if any warping or shrinkage occurs the channels thus formed will be in the direction of the water flow. It is very desirable to apply between the sheathing and the tin a layer of heavy sheathing paper of good quality.

Another familiar form of metal roof is the corrugated, galvanized, or painted steel sheet, which, however, is not at all attractive as a roofing for houses.

Metal shingles and imitation Spanish tile are made from galvanized and tinned steel sheets, and these produce a more attractive effect than any other form of metal roofing.

The difficulty of protecting the average metal roof against corrosion is one that merits consideration. The various protective methods, such as tinning, galvanizing, and painting, particularly the latter, are only temporary expedients. A multiple system of safeguarding the metal sheets against corrosion consists in first covering the metal with an adhesive, nondrying, bituminous compound and embedding asbestos felts therein. Metal sheets thus protected are available in various forms and colors suitable for general roofing purposes. They are not, however, well adapted for the covering of flat or substantially flat surfaces, owing to the impossibility of soldering them together as is done with tinned metal sheets.

OTHER TYPES.

Other types of roof coverings are available, but are not generally suitable for the roofs of small houses—such as built-up tar and

gravel roof, a method that is not applicable to sloping roofs, and terra-cotta tiles, which generally are too high in first cost, and are too heavy to be suitable for structures of this kind.

GUTTERS.

The advisability of putting house gutters on a miner's cottage depends upon whether the streets are paved and whether the yards are graded and improved with gardens, lawns, and footwalks; in other words, house gutters are a complement of a finished town.

The use of the gutter as a means of conveying water to a cistern is not here emphasized, because cisterns are accessories of isolated houses and should not be found in mining communities of the future. In addition to this use, however, house gutters help to keep the foundation dry and prevent the spattering of mud around the base of the house; they prevent the washing away of soil and permit the utilization of the belt surrounding the house for flower beds or lawns; they prevent the formation of stagnant pools of water and protect the footwalk from mud and ice. Gutters may be made of wood or galvanized iron, and the conductors or leader pipes should be corrugated rather than plain, in order to allow for expansion in case they should freeze, as they frequently do in cold climates. Gutters, conductors, and goosenecks increase the cost of the house and are expensive to keep in repair; many of their advantages are nullified unless there are street gutters or a sewer system to receive the water from the conductors. The installation of house gutters should be postponed until other conditions are brought up to a consistent standard. However a short length of gutter should be placed on the veranda over the steps to prevent dripping of water and formation of ice on the steps.

THE YARD AND ITS APPURTENANCES.

COAL HOUSE.

Few miners' houses have celiars, so that the coal must be stored somewhere in the yard. In places where there are no alleys or where the rear yard is not accessible to a wagon, the coal house or box is placed in the front yard to reduce the cost of delivering the coal. The sight of a coal box on the front property line is anything but pleasing, and is out of place in the modern mining town.

In some places the coal house and privy have been combined. There appears to be no objection to this and it lessens the cost and reduces the number of small buildings in the back yard. This combination idea has been carried further and the privies and coal houses of two adjoining houses have been placed under one roof (Pl. III, *B*), the building being on the division line between the

lots. There is, perhaps, not sufficient privacy and independence to this arrangement to allow it to be universally recommended. If it is adopted the privies should be in the two extremities of the building, and it is better, perhaps, to have the entrance to the privy on the end of the building and not on the side that faces the house.

DOMESTIC ANIMALS IN MINING TOWNS.

The population of mining towns often consists of people who are experiencing a transitional era. Many of them have been accustomed to living on farms, and they often bring along with them customs and practices that give rise to insanitary conditions in a thickly settled community. Notable among these is the keeping of domestic animals.

Animals may be kept with impunity on a farm, where they receive proper attention and where everything is open and spacious, and where the aromas of the barnyard are carried away by the great movements of pure air which come sweeping across the open country. But the circumstances are entirely different when a horse and cow, hens, hogs, geese, goats, rabbits, pigeons, and dogs are crowded together on a city lot of 50 by 100 feet, and when similar conditions prevail on 20 adjacent lots. It should be remembered that not only must the yard contain the patched shacks and coops for all these animals but there must also be room for the privy, washhouse, coal shed, outside oven, woodpile, and clotheslines. Under these cramped conditions the odors from the animal offal, pigsty, privy, steaming manure heaps, chicken coops, kitchen slops, goose puddles, and soggy ground are confined, and if the settlement is in a sheltered valley, as is generally the case, a stagnant miasma will overhang the entire community. Added to this are such nuisances as lice, fleas, and other vermin, the noise, and the scratching and burrowing in the soil of the yard.

PREVENTION EASIER THAN CURE.

In a new mining town certain restrictions regarding domestic animals should be instituted at the very beginning, as abuses are prevented much easier than corrected. Often county or State regulations supply the needed restraints if they are enforced. It might be a good plan to incorporate some of these measures in the house lease which is signed by the tenants. The keeping of hogs, geese, and ducks should be absolutely prohibited within the city limits, as it requires too much time and money to prevent nuisances from arising, in spite of the much-talked-of scavenger trait of the hog. This recommendation is made in the full knowledge of the popular use of pork, the toothsomeness of roast duck, the deliciousness of a fresh

goose egg, and the comfort of sleeping under a "goose-hair" tick. Unfortunately, the community good requires personal sacrifices.

Building permits for stables should be required, and no stable should be erected until a permit has been granted. This regulation should in no way prohibit the keeping of horses, as the miner oftentimes needs a horse to drive to and from work, especially if the town is at a distance from the plant. This measure, however, will furnish control over the location and type of building, and will furnish an opportunity of coming to an understanding about the disposal of the manure, which is very important if the fly nuisance is to be prevented.

The building of stables should be restricted to lots in the outskirts of the town, unless the lot is quite large.

In order to prevent cows from grazing in the alleys and streets, a fenced pasture should be provided by the company. Regulations about diseased horses and cows should be rigorously enforced.

Chickens should not be permitted to roam about the yard, but should be confined within a runway. The coop should be whitewashed at regular intervals.

GARDENS VERSUS DOMESTIC ANIMALS.

In attempting to abolish the keeping of domestic animals consideration must be given to other phases besides strict sanitation, chief among which is the effect of these animals in reducing the cost of living. It is also undoubtedly true that the simple pleasures derived from caring for animals in feeding, breeding them, and building coops or pens is a factor in the life of the miner that should not be disregarded.

One frictionless method of combating the practice of keeping domestic animals is to encourage the planting of gardens. The garden has a wide range of advantages. First and foremost, the products from the garden reduce the cost of living. Not only are fresh vegetables furnished during the season, but many of them may be preserved for use during the winter.

The garden is an indirect means of improving the order and cleanliness of the yard. Trash, rubbish, ash heaps, stagnant water, and disorder will automatically disappear with the advent of gardens.

The gardens furnish a pleasurable and profitable way of engaging the miner's unoccupied time. Spare hours and days in which there is no run at the mine can be spent to great advantage in a garden. There is a wholesome influence from the very contact with green growing things. The miner's family will likewise reap many advantages. Helping about the garden will keep the children out of mischief and teach them thrift and industry.

Raising a garden means the investment of labor in the premises on the part of the tenant, and in the absence of individual ownership creates an added attachment to the place which tends to offset the temptation of packing up and following vague rumors about steadier work, higher wages, thicker seams, etc.

A number of companies have gone to much trouble and expense to encourage the planting of gardens. One company plows the yard, furnishes manure gratis and seeds at cost, and at the end of the season awards valuable prizes for the most successful gardens. (Pl. IV). Once the garden habit is started it ought to become largely self-supporting.

The Department of Agriculture publishes bulletins describing suitable crops for special soil conditions, which will prove valuable to those who desire to initiate interest along these lines. A limited supply of these bulletins is printed for free distribution, and may be obtained by writing to the Secretary of Agriculture, Washington, D. C. An incomplete list of the bulletins is as follows:

Farmers' Bulletin 154, The home fruit garden, preparation and care.

Farmers' Bulletin 218, The school garden.

Farmers' Bulletin 220, Tomatoes.

Farmers' Bulletin 255, The home vegetable garden.

Farmers' Bulletin 289, Beans.

Farmers' Bulletin 324, Sweet potatoes.

Farmers' Bulletin 354, Onion culture.

Farmers' Bulletin 407, The potato as a truck crop.

Farmers' Bulletin 433, Cabbage.

Several States have schools, experiment stations, and departments of agriculture, and by getting in touch with these information of particular local value may be obtained. The operators' associations might collect information from these various sources and distribute it among the workers. This practice has been adopted with marked success by the Alabama Coal Operators' Association.

FENCES.

The fences surrounding the houses in a company-controlled mining town have more significance than is usually attributed to them. If the amount of money involved be considered, perhaps no improvement sets in motion such a train of beneficial results as assigning, by means of a fence, a definite amount of land to each individual cottage. The fence fixes responsibility; it creates a healthy sense of pride and feeling of proprietorship; it insures a certain amount of privacy; it permits the planting of gardens and results in clean yards and premises. (Pl. I, *C*.) The painstaking, though unsightly fences, built by individuals, particularly among non-English-speak-

ing people, display an inherent desire for the control of land, more or less dominant in us all. This trait should be gratified in the construction of new mining towns, and in old towns a little money invested in neat fences will return good dividends.

Certain details of the fence discussed herein may appear farfetched if only an individual house is concerned, but it should be remembered that if three or four hundred houses with large-sized yards are to be fenced every foot of lumber saved counts up. The fence should harmonize with its surroundings; but in this, as in other improvements, economical methods and simplicity of design and construction should govern.

LOCATION OF FENCE.

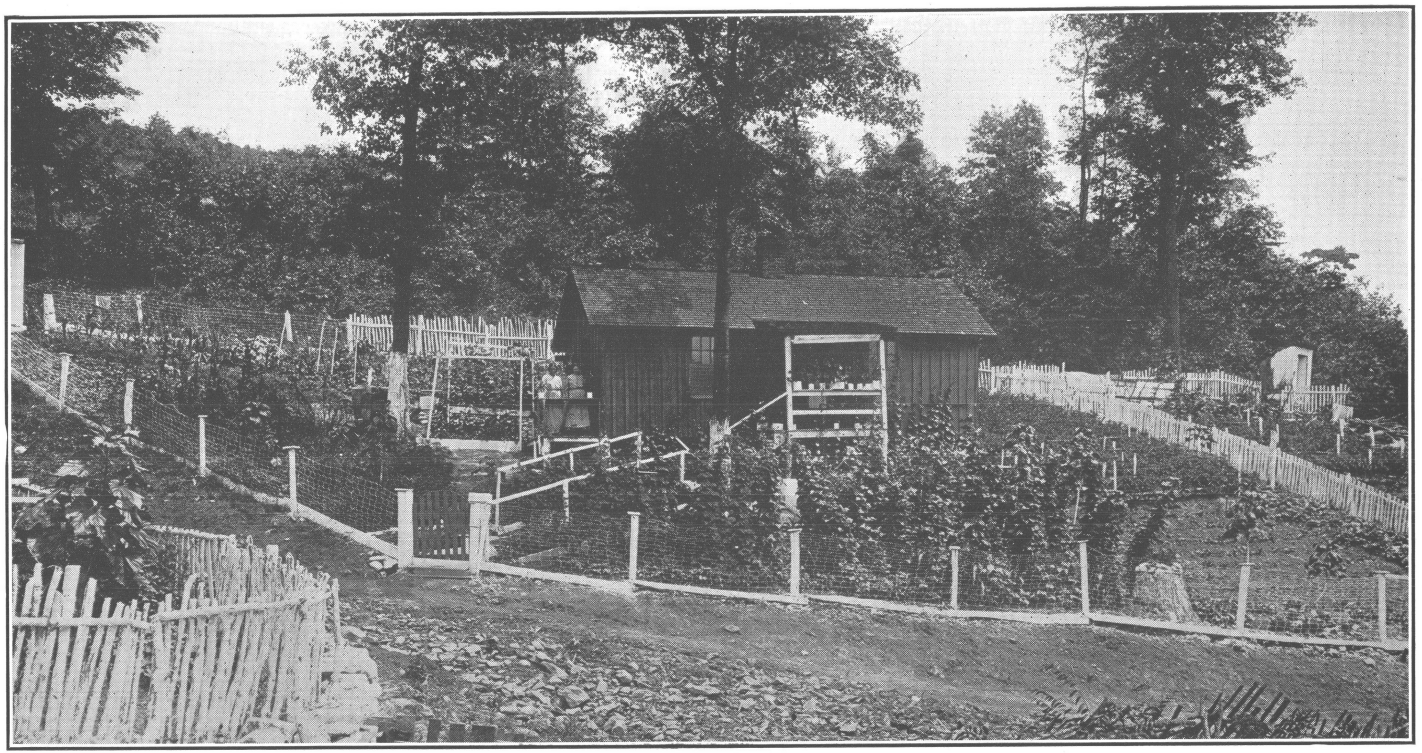
A pleasing effect may be obtained in some cases by setting the front fence back between the houses rather than on the front property line. By this arrangement a parklike area is made between the sidewalk and the houses, which may be grassed and will appear more spacious than if cut up by fences. This method also reduces the linear feet of fence. Similarly, if the house is on the side line rather than centered on the lot, the two side yards will be combined into one and the linear feet of fence required to inclose the lot will be reduced by the depth of the house. (See fig. 4.)

HEIGHT OF FENCE.

Oftentimes a low fence answers the purpose as well as a high one and costs less. As far as preventing people from trespassing, it is in its symbolism more than as an actual barrier that the fence is effective. In some places the fence must be built so as to keep out hogs. Even if the keeping of hogs is not permitted in the town itself, there may be no law against stock running at large in the surrounding country, and the yards and gardens must be protected from the inroads of these "outsiders." Usually this can be corrected by legislation, but a better method is by rigidly enforcing sanitation and cleanliness within the town. This means frequently collecting and destroying the garbage, trash, and other wastes which attract the unwelcome visitors. Hogs, like flies, are attracted by filth.

TYPES OF FENCES.

There are three types of fences largely used in mining towns—the rail fence with certain modifications, the woven-wire fence of various designs, and the pale or picket fence. The rail fence can be made artistic and is usually built rather low. It is not a very effective barrier. Woven-wire fences are usually unnecessarily high and are not very pleasing in appearance. They are, perhaps, the



MINER'S PRIZE GARDEN NEAR WEYANOKE, W. VA.

most economical fence and most effective barrier. In some cases they do not last long when they are built near coke ovens, on account of gases in the air. Specially prepared wire might be obtained to resist this action. The pale or picket fence is the best appearing of the three. In the construction of a new town, pickets can be made very economically by utilizing waste ends and trimmings. A very satisfactory and economical arrangement is to make the front fence out of pickets and the side and rear fences from woven wire. (See fig. 4.)

POSTS.

The post is one of the least durable parts in a fence and fails chiefly by rotting near the ground where it is subject to alternate wet and dry conditions. Creosoting makes the post more resistant to decay, and if it is not practical to have the posts treated under pressure, simply applying a creosote paint will be of some value. By making the height of the fence 4 feet instead of 5, and setting the posts that much deeper, the fence will be strengthened. Corner posts and those to which the gates are hinged should be diagonally braced. It might pay to set all the posts in concrete, in which case the concrete should extend three or four inches above the ground so that the post will be protected at the point most liable to decay. Concrete and metal posts, both of the manufactured and home-made type, are sometimes seen. Old boiler tubes and discarded water pipe when cut and drilled and embedded in concrete make very stable posts. The pipes should be filled with sand and capped with concrete.

GATES.

The gate is a second weak part of the fence, and numerous methods have been improvised for making a strong, durable, self-closing gate. The gate should be made as light as is possible without impairing its strength. This can be accomplished by using light wood and not making the gate unnecessarily wide or high. Long, strong, galvanized, strap hinges should be used and should be attached with long screws driven directly into the framework or standards. The flimsy, haphazard way in which hinges are applied is responsible for many broken gates. How often are gates seen with hinges attached to the picket side of the gate so that some screws must be left out because the hole in the hinge is between the pickets. The patented self-closing cast-iron hinges are easily broken. Figure 9 shows how a gate may be made self-closing with ordinary strap hinges by putting the hinges off center a little. This arrangement detracts little from the appearance and does away with the use of springs and counterweights. This is the same principle used in self-closing mine doors. The gate should swing in.

WATER AND WASTES.

The problems of water supply and disposal of sewage in mining towns are briefly discussed in the following chapter. These important sanitary factors will later be discussed more fully in special publications.

RESPONSIBILITY FOR WATER SUPPLY.

If an epidemic breaks out in a municipality whose citizens through ignorance or willingness to "take a chance" elect to drink polluted water, they are the unfortunate victims of their own shortcomings;

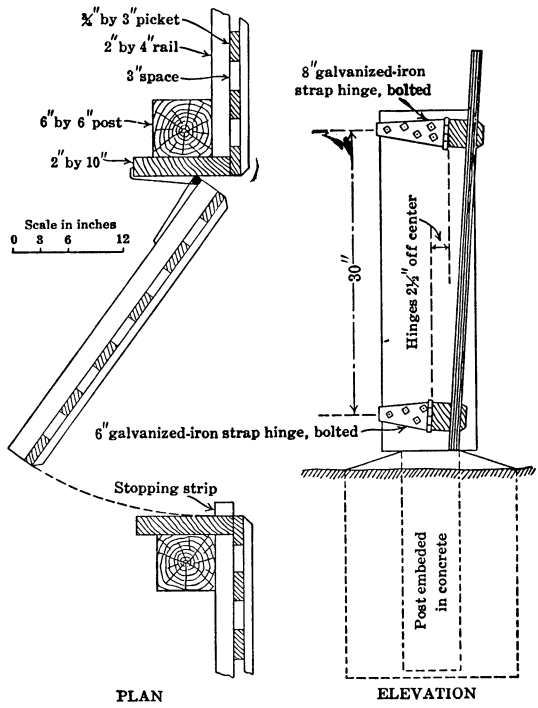


FIGURE 9.—Self-closing gate.

but in a company-controlled town conditions are different, and the furnishing of safe, wholesome water is one of the gravest responsibilities accompanying this system of town control.

With the exception of air, water is perhaps the most important single element vitally affecting the health of every man, woman, and child in the community. Running water within the house should be regarded as a necessary article in a mining town, and not as a luxury. A spigot in the yard or in the street may have been sufficient for the "camp," but it is not in keeping with town life. The necessity of having good water should exert a powerful influence on the selection of the town site. The water system should have the approval

of a competent sanitary engineer; his resourcefulness and wide experience with this phase of town building will be a guaranty against future regrets.

SOURCES OF WATER SUPPLY.

SHALLOW WELLS.

In many of the established mining towns the introduction of an expensive water system is impracticable, but reasonable measures should be taken to improve the unsatisfactory conditions that exist. Shallow dug wells with rope and bucket are in common use, and these are particularly susceptible to pollution when found in conjunction with other insanitary conditions. The most effective step toward improving the water supply from shallow wells is the abolishment of neighboring insanitary privies, stables, and pigsties.

DEEP-DRILLED WELLS.

It is easier to protect bored wells from pollution than dug wells, and if palatable water can be obtained at moderate depths wells should be bored throughout the village and equipped with easily operated hand pumps. If it is necessary to drill very deep for water, at least one such well should be drilled and equipped with a gasoline pump and the water distributed to taps situated at convenient places in the settlement.

SPRINGS.

If there is in the vicinity a spring that flows the year round and the water proves satisfactory upon analysis, it may be used for drinking and cooking; water from wells will do for washing and other household uses. The spring should be concreted to prevent local contamination, and the immediate surroundings and approaches to the spring should be improved and beautified. Periodical bacteriologic examination of the water should be made.

CISTERNS.

Unless no other source of supply is available at reasonable cost, drinking water should not be obtained from cisterns, although cisterns may be used to good advantage to supply water for general housework. In old mining towns unsightly conditions often develop in connection with the collection of rain water. Old tubs, kegs, and buckets of all shapes are kept around the kitchen door for the purpose of storing up the rain water. Mosquitoes breed in these vessels, with the result that skin inflammation, sleepless nights, and malaria follow. If it is necessary to collect rain water in the absence of cisterns, the company should furnish a neatly painted 50-gallon barrel, which should stand above the ground and be protected in such a way as to prevent mosquitoes from breeding in it.

MOSQUITO PREVENTION.[a]

The united and continued efforts of every one in the community are necessary if mosquito breeding is to be prevented. The company's efforts in draining swamps or filling in lowlands will be frustrated if careless tenants permit tin cans or broken crockery to lie around and collect stagnant water. All weeds in the yards, streets, and alleys should be cut, as they not only in themselves furnish sheltering places for mosquitoes but they conceal broken bottles and old shoes which will hold sufficient water for hundreds of "wigglers" to be hatched.

DISPOSAL OF WASTES FROM KITCHEN SINK.

CESSPOOLS.

When water is piped into the house some method of disposing of the waste from the kitchen sink must be provided. Individual leaching cesspools are unsatisfactory, chiefly because they do not remove the wastes from the zone of habitation. The soil surrounding the cesspool soon becomes saturated and choked with foulness, and rancid odors are given off which destroy the wholesomeness and healthfulness of the dwelling site. On warm sultry nights the odor is particularly obnoxious, but the evil is going on to just as great an extent at all times.

STREET GUTTERS.

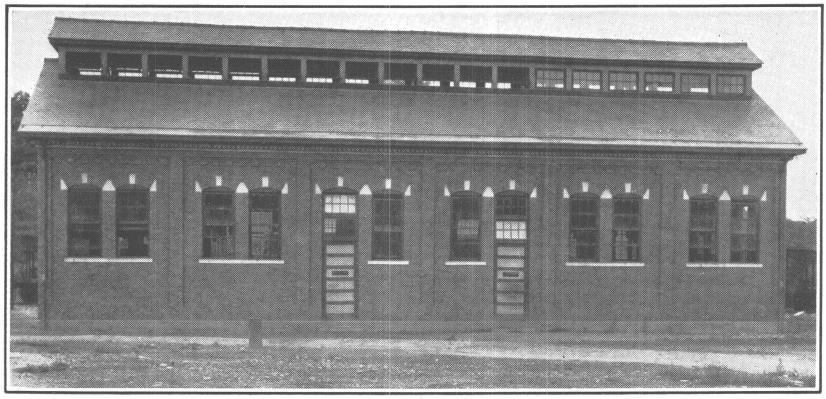
In the absence of an underground sewer system, perhaps the best method is to build open concrete street gutters and utilize these for removing the kitchen wastes. The gutters are open to inspection at all times and can be flushed out regularly. In some cases it may be feasible to circulate mine water through the gutter system, which greatly improves conditions.

WASH AND CHANGE HOUSE.

It may not be practicable to install stationary bathtubs in all the individual houses. A cheaper and better arrangement, as far as the miners themselves are concerned, is the establishment of a wash and change house (Pl. V, *A*) at the mine mouth. These houses are being rapidly introduced at many mines throughout the United States, and their merits will be briefly discussed here. A paper on wash and change houses is being prepared and will be presented in a later publication of the bureau.

Mining necessarily is dirty work, but it does not follow that the miners should carry the evidence of their day's toil through the

[a] For a fuller discussion of mosquito prevention see Howard, L. O., Remedies and preventives against mosquitoes: Farmer's Bulletin 444, U. S. Dept. of Agriculture, April, 1911.



A. CHANGE AND WASH HOUSE AT EDGEWATER, ALA.

B. INSANITARY ARRANGEMENT OF WELL, HOUSE, AND PRIVY.

streets and into their homes. Cleanliness in person and clothes stimulates self-respect, and, better still, indicates consideration for the people and property with whom one comes in contact on the streets, in the stores, or on the trolley cars. The wash and change house encourages these commendable traits. Its use also shows a consideration for the folks at home. It lightens the burden of keeping the house clean and does away with the necessity of lighting fires to heat water. Strict privacy in bathing in a miner's home is difficult because of lack of facilities, and the wash and change house relieves the many inconveniences necessitated where good standards of modesty are maintained.

The shower bath refreshes the workman so that he returns home in a more agreeable frame of mind. Fatigue is caused by the accumulation of the by-products of muscular activities, and experiments have shown that the shower causes the more rapid elimination of these toxins. The wash and change house helps to conserve health. Coming out of a warm mine, with damp clothes and feet wet because of inadequate drainage, the miner is susceptible to colds and pneumonia. The shower helps to restore his heated and perspiring body to normal temperature.

The wash and change house can be heated, lighted, and furnished with hot and cold water economically by utilizing the exhaust steam from the power plant. The plumbing fixtures and drainage system can be installed en masse at much less expense than at the individual houses and the maintenance and repair costs will be greatly reduced.

SEWER SYSTEMS.

As scientific investigations and practical observations have demonstrated that typhoid fever, hookworm, and many diarrheal troubles are disseminated by the careless disposition of fecal discharges, many of the loose practices formerly followed should no longer be tolerated. Reduced to the nauseating truth the question resolves itself into preventing the reentrance of bowel discharges into the system through such mediums as water, food, flies, dust, and common towels. How can this be best accomplished? In cities the method generally adopted is the immediate removal by means of water flushed through sewers to some distant point, where the sewage is emptied directly into some large body of moving water or treated in a disposal plant, the refinements of which depend upon circumstances. Two of the reasons why private communities often defer the building of a sewer system are: First, the convenience of a sewer system is never fully appreciated until it has once been enjoyed; and, second, a sewer is a buried investment and adds nothing to the appearance of the town, as surface improvements do. In the mining towns of the future the sewer system should be regarded preemi-

nently as an agency of community health and should be installed if the cost is not prohibitive. As was true of the water supply, the possibility of an economical sewer system should be an important factor in determining the town site and town arrangement.

SUBSTITUTES FOR SEWERS.

In some new towns and in many old ones it may not, however, be feasible to install a sewer system, and a less expensive substitute must be selected. As the sewer system presupposes a public water supply, it is practically out of the question in many of the established mining towns. In selecting the substitute emphasis should be laid, first, on the feature that aims to get the body sloughings outside the zone of habitation as quickly as possible; second, on the prevention of nuisances between periods of removal.

SANITARY PRIVIES.

A sanitary privy is very practicable for mining towns, more so, indeed, than for isolated houses, because it can be taken care of much easier as a system than as a unit. A water-tight receptacle (preferably of metal) under the hole will prevent soil pollution and consequent contamination of wells. If lime or dirt from a convenient box is used to cover each stool, the odors and the danger of transmission by flies will be minimized. The receptacles should be emptied at least once a week during the cold months and twice a week during the hot summer season. An extra wagon load of buckets should be provided, so that it will be necessary only to exchange the empty bucket for the full one at the privy, deferring the emptying of the bucket until the wagon arrives at the disposal site. The material should be thoroughly limed and buried in a place where it is not possible to cause a nuisance or pollute a water supply. In some cases it may be advisable to burn the waste matter in an incinerator.

LEACHING VAULTS.

Leaching earth vaults are not satisfactory and have absolutely no justification in a mining town where community control reposes in a central authority. These vaults possess all the nuisances of the cesspool, with the very dangerous element of disease germs added. In wet seasons the ground is saturated, and instead of the liquid seeping out the ground water leaks into the vaults. When the water table lowers, the pollution from the walls will be carried great distances.

CONCRETE VAULTS.

The water-tight concrete vault is much better than the leaching type, but it is objectionable because the human wastes are stored

continuously close to the human habitation. A second objection is the high cost and the difficulty of making the vault water-tight.

MAKE THE PRIVY SAFE.

In a number of old-type mining towns the privies are so built that the bowel discharges simply drop upon the surface of the ground, whence they are scattered about by animals, rain, wind, or flies. In conjunction with this crude arrangement are often found shallow wells which furnish drinking water for the people (see Pl. V, *B*). This deplorable and dangerous combination of conditions should be corrected at once. As a matter of relative importance, however badly the house of the miner may need repairs, the first and most important duty is to make the privy safe. The most illiterate man will discover a way of patching up his house to protect himself and his family from the cold, but he is not apt to guard against such insidious foes as typhoid-fever germs and hookworms.

CLEAN-UP DAY.

Many municipalities are adopting what is known as a clean-up day, which is a development of the spring and fall house-cleaning days.

This practice has been in vogue in some mining communities for many years. Some companies have recently made the clean-up day more ceremonious. The legend on a placard used by one company whereby better cooperation was obtained is given below. This placard also served a useful educational purpose.

CLEAN-UP DAY.

Saturday, April 5, has been set aside as "Clean-up Day" for all the camps of the * * * corporation, and it is hoped that every family will use some effort on that day to make our camps more healthful and sanitary than they have ever been.

Burn all trash, leaves, chips, bones, cast-off clothing, old shoes, etc.; in fact, everything that will burn that is of no value. Tin cans, old tin buckets, and things of that kind, should be heated until they melt or will not hold water. Stagnant water in such things is a breeding place for both malaria and typhoid fever.

Scald out the rain barrel and cover it with a coffee sack or cotton cloth. This will keep out the wiggletails. Every "wiggle" will be a "skeeter" bye and bye.

Cinders, old iron, crockery, and things that will not burn should be piled in some place convenient for a wagon. Arrangements have been made to have the company team haul this rubbish away.

Clean out well from under the floors and fix so that neither hogs, dogs, nor chickens can stay beneath them. Fleas and flies both spread disease. Sufficient lime to sprinkle under a house will be furnished by the company, free of charge, when properly applied for.

Flies are the cause of 75 per cent of the typhoid fever in this country. Wall up, or box up, around the privy vault, and throw on sufficient dirt to

make it fly tight. Scrub out the closets at least once a week with hot soap suds and pour a little lime and coal oil in the vaults occasionally. Screen your house early and well against the fly. Mosquito bar is cheap and answers well for one season. Mr. Fly takes his breakfast in the outhouse and his dinner with you, and is not at all particular to take off his hat or wipe his feet when he comes in.

We are anxious to make these camps the model sanitary camps for the State of Kentucky. We will do our part. Will you help?

(Signed by officers of corporation.)

REGULAR SCAVENGER SERVICE.

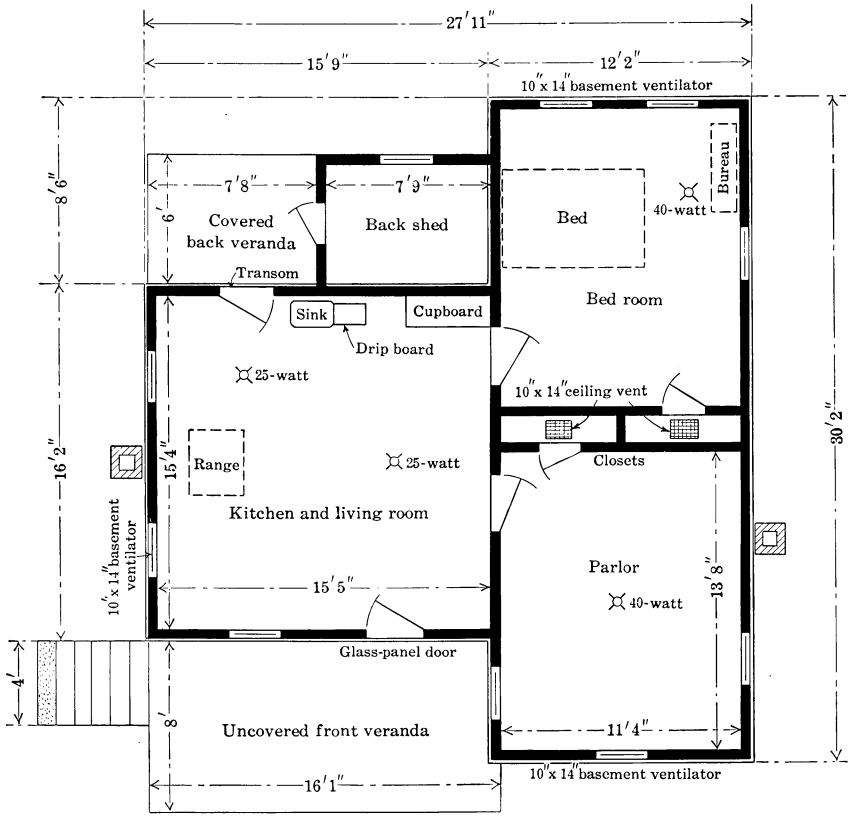
Clean-up days serve a purpose, but they should not by any means be considered a substitute for regular scavenger service. A system based upon the frequent removal of garbage, rubbish, ashes, and other wastes, is by far the most sanitary. A water-tight receptacle, protected from flies and animals, and small enough to be handled by one man is recommended. If such receptacles are placed near the alley so that the scavenger can load them quickly it may be possible to visit each house every two or three days. This material should be burned or buried in such a manner so that no nuisances will arise.

DETAILED PLANS.

Plates VI, VII, and VIII will aid the operator in drawing up plans and specifications for cottages to be built by contract. Many of the suggestions contained in the bulletin are incorporated into these drawings. The special features of the cottage are: Substantial, well-ventilated foundation wall; double flooring lined with paper; large window area with weighted sashes; glass-panel front door and transom over back door; ventilators in closets and louvers in gables; roomy kitchen facing both street and back yard; spacious front veranda facing northeast; usefully located electric lights.

Although these plans have been put to a practical test they should not be followed blindly, as local conditions might require numerous revisions to be made.

FRONT ELEVATION



FLOOR PLAN

PLAN AND ELEVATION OF MINER'S FRAME COTTAGE.

PUBLICATIONS OF MINE ACCIDENTS AND METHODS OF MINING.

A limited supply of the following publications of the Bureau of Mines is temporarily available for free distribution. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls., 4 figs.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell; with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls., 5 figs.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 61 pp., 10 pls., 12 figs. Reprint of United States Geological Survey Bulletin 423.

BULLETIN 20. The explosibility of coal dust, by G. S. Rice, with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 204 pp., 14 pls., 28 figs. Reprint of United States Geological Survey Bulletin 425.

BULLETIN 42. The sampling and examination of mine gases and natural gas, by G. A. Burrell and F. M. Seibert. 1913. 116 pp., 2 pls., 23 figs.

BULLETIN 45. Sand available for filling mine workings in the northern anthracite coal basin of Pennsylvania, by N. H. Darton. 1913. 33 pp., 8 pls., 5 figs.

BULLETIN 46. An investigation of explosion-proof mine motors, by H. H. Clark. 1912. 44 pp., 6 pls., 14 figs.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1913. 50 pp., 3 pls., 7 figs.

BULLETIN 51. The analysis of black powder and dynamite, by W. O. Snelling and C. G. Storm. 1913. 80 pp., 5 pls., 5 figs.

BULLETIN 52. Ignition of mine gases by the filaments of incandescant electric lamps, by H. H. Clark and L. C. Ilsley. 1913. 31 pp., 6 pls., 2 figs.

BULLETIN 53. Mining and treatment of feldspar and kaolin in the southern Appalachian region, by A. S. Watts. 1913. 170 pp., 16 pls., 12 figs.

BULLETIN 56. First series of coal-dust explosion tests in the experimental mine near Bruceton, Pa., by G. S. Rice, L. M. Jones, J. K. Clement, and W. L. Egy. 1913. 115 pp., 12 pls., 28 figs.

BULLETIN 57. Safety and efficiency in mine tunneling, by D. W. Brunton and J. A. Davis. 1914. 271 pp., 6 pls., 45 figs.

BULLETIN 59. Investigations of detonators and electric detonators, by Clarence Hall and S. P. Howell. 1913. 73 pp., 7 pls., 5 figs.

BULLETIN 60. Hydraulic mine filling; its use in the Pennsylvania anthracite coal fields; a preliminary report, by Charles Enzian. 1913. 77 pp., 3 pls., 12 figs.

BULLETIN 61. Abstract of current decisions on mines and mining, by J. W. Thompson. 1913. 82 pp.

BULLETIN 62. National mine rescue and first aid conference, Pittsburgh, Pa., September 23–26, 1912, by H. M. Wilson. 1913. 74 pp.

BULLETIN 66. Tests of permissible explosives, by Clarence Hall and S. P. Howell. 1913. 313 pp., 1 pl., 6 figs.

BULLETIN 68. Electric switches for use in gaseous mines, by H. H. Clark and R. W. Crocker. 1913. 40 pp., 6 pls.

BULLETIN 69. Coal-mine accidents in the United States and foreign countries, compiled by F. W. Horton. 1913. 102 pp., 3 pls., 40 figs.

TECHNICAL PAPER 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1912. 28 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 11. The use of mice and birds for detecting carbon monoxide after mine fires and explosions, by G. A. Burrell. 1912. 15 pp.

TECHNICAL PAPER 13. Gas analysis as an aid in fighting mine fires, by G. A. Burrell and F. M. Seibert. 1912. 16 pp., 1 fig.

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TECHNICAL PAPER 21. The prevention of mine explosives, report and recommendations, by Victor Watteyne, Carl Meissner, and Arthur Desborough. 12 pp. Reprint of United States Geological Survey Bulletin 369.

TECHNICAL PAPER 22. Electrical symbols for mine maps, by H. H. Clark. 1912. 11 pp., 8 figs.

TECHNICAL PAPER 24. Mine fires, a preliminary study, by G. S. Rice. 1912. 51 pp., 1 fig.

TECHNICAL PAPER 28. Ignition of mine gas by standard incandescant lamps, by H. H. Clark. 1912. 6 pp.

TECHNICAL PAPER 29. Training with mine-rescue breathing apparatus, by J. W. Paul. 1912. 16 pp.

TECHNICAL PAPER 30. Mine-accident prevention at Lake Superior iron mines, by D. E. Woodbridge. 1913. 38 pp., 9 figs.

TECHNICAL PAPER 33. Sanitation at mining villages in the Birmingham district, Ala., by D. E. Woodbridge. 1913. 27 pp., 1 pl., 9 figs.

TECHNICAL PAPER 39. The inflammable gases in mine air, by G. A. Burrell and F. M. Seibert. 1913. 24 pp., 2 figs.

TECHNICAL PAPER 40. Metal-mine accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 54 pp.

TECHNICAL PAPER 41. The mining and treatment of lead and zinc ores in the Joplin district, Mo.; a preliminary report, by C. A. Wright. 1913. 43 pp., 5 figs.

TECHNICAL PAPER 44. Safety electric switches for mines, by H. H. Clark. 1913. 8 pp.

TECHNICAL PAPER 46. Quarry accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 32 pp.

TECHNICAL PAPER 47. Portable electric mine lamps, by H. H. Clark. 1913. 13 pp.

TECHNICAL PAPER 48. Coal-mine accidents in the United States, 1896–1912, with monthly statistics for 1912, compiled by F. W. Horton. 1913. 74 pp., 10 figs.

TECHNICAL PAPER 52. Permissible explosives tested prior to March 1, 1913, by Clarence Hall. 1913. 11 pp.

TECHNICAL PAPER 56. Notes on the prevention of gas or dust explosions in coal mines, by G. S. Rice. 1913. 24 pp.

TECHNICAL PAPER 58. Action of acid mine water on the insulation of electric conductors, by H. H. Clark and L. C. Ilsley. 1913. 26 pp., 1 fig.

TECHNICAL PAPER 59. Fires in Lake Superior iron mines, by Edwin Higgins. 1913. 34 pp., 2 pls.

TECHNICAL PAPER 61. Metal-mine accidents in the United States during the calendar year 1912, compiled by A. H. Fay. 1913. 76 pp., 1 fig.

TECHNICAL PAPER 67. Mine signboards, by Edwin Higgins and Edward Steidle. 1913. 15 pp., 1 pl., 4 figs.

TECHNICAL PAPER 71. Permissible explosives tested prior to January 1, 1914, by Clarence Hall. 1914. 12 pp.

TECHNICAL PAPER 75. Permissible electric lamps for miners, by H. H. Clark. 1914. 21 pp., 3 figs.

MINERS' CIRCULAR 3. Coal-dust explosions, by G. S. Rice. 1911. 22 pp.

MINERS' CIRCULAR 4. The use and care of mine-rescue breathing apparatus, by J. W. Paul. 1911. 24 pp., 5 figs.

MINERS' CIRCULAR 5. Electrical accidents in mines; their causes and prevention, by H. H. Clark, W. D. Roberts, L. C. Ilsley, and H. F. Randolph. 1911. 10 pp., 3 pls.

MINERS' CIRCULAR 6. Permissible explosives tested prior to January 1, 1912, and precautions to be taken in their use, by Clarence Hall. 1912. 20 pp.

MINERS' CIRCULAR 7. The use and misuse of explosives in coal mining, by J. J. Rutledge, with a preface by J. A. Holmes. 1913. 52 pp., 8 figs.

MINERS' CIRCULAR 8. First-aid instructions for miners, by M. W. Glasgow, W. A. Raudenbush, and C. O. Roberts. 1913. 67 pp., 51 figs.

MINERS' CIRCULAR 9. Accidents from falls of roof and coal, by G. S. Rice. 1912. 16 pp.

MINERS' CIRCULAR 10. Mine fires and how to fight them, by J. W. Paul. 1912. 14 pp.

MINERS' CIRCULAR 11. Accidents from mine cars and locomotives, by L. M. Jones, 1912. 6 pp.

MINERS' CIRCULAR 12. The use and care of miners' safety lamps, by J. W. Paul. 1913. 16 pp., 4 figs.

MINERS' CIRCULAR 13. Safety in tunneling, by D. W. Brunton and J. A. Davis. 1913. 19 pp.

MINERS' CIRCULAR 14. Gases found in coal mines, by G. A. Burrell and F. M. Seibert. 1914. 23 pp.

MINERS' CIRCULAR 15. Rules for mine-rescue and first-aid contests, by J. W. Paul. 1913. 12 pp.

MINERS' CIRCULAR 17. Accidents from falls of rock or ore in metal mines, by Edwin Higgins. 1914. 15 pp., 8 figs.

MINERS' CIRCULAR 19. The prevention of accidents from explosives in metal mining, by Edwin Higgins. 1914. 16 pp., 11 figs.

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