THE CUSTODIAN at work

N. E. VILES

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By

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Foreword

THE IMPORTANCE OF adequate school housing facilities to the welfare of the child and to the work of the school merits the attention of all school officials. Suitable operating and maintenance practices are essential to efficient modern school programs. Teachers and administrators have complained of poor service but have made no concerted effort to improve this service. The lack of acceptable standards and of basic information on methods, materials, and procedures available to janitors and administrators has delayed progress.

The material contained in this volume was developed to provide information on general methods and procedures for all who have any duties or obligations in school plant management. While this information was prepared primarily for the school janitor, it should be of value to superintendents, principals, or to teachers in rural schools, all of whom are interested in housekeeping, sanitation, safety, heating, and ventilation. It was assembled over a period of years in directing custodial training schools and in supervising the maintenance program. It is hoped that it may be of value to the administrators in supervising their maintenance programs, to janitors now employed, or to those prospective janitors who are training for a position. It should also serve as a general source or textbook for janitorial training schools. In order to provide the needed information and to insure its relation to various situations and conditions, certain basic facts and procedure outlines are repeated in more than one section.

The complicated task of school plant maintenance makes it essential that a competent janitor be employed. He should be able to plan his work in an intelligent manner. He should be interested in learning more about his job. The capable janitor should not need regulations outlining in detail each task to be done. To this end the information provided here is presented on an instructional basis rather than as a set of rules and regulations on a "do" and "don't" basis.

In presenting this volume, credit must be given to the school plant specialists in the National Council on Schoolhouse Construction under whose direction this study was started, and to the many janitor-engineers who have spent much time in the study of school plant care. Credit is also due the progressive janitorial supply and floor maintenance firms who have contributed much to the improvement of school plant maintenance.

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Nelson E. Viles

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Chapter 1

The School Building and a Modern Educational Program

FOR MANY DECADES much attention has been given to the improvement of educational practice, but only during recent years has much attention been given to the improvement of the school building facilities and to the methods of maintaining these facilities.

Much tradition and some sentiment has grown up around the mythical "little red school house." Tradition does not tell us of the lack of comfort existing in these buildings where pupils froze on one side while they baked on the other; where they sat in uncomfortable seats and were subjected to eye strain and other discomforts. It is true that many a boy has left his mark deeply carved on such buildings. It is even more easy to believe that such school houses have left lasting marks in depreciated vitality and physical defects upon the boys and girls who attended them.

No longer do we depend upon or expect to see many of the old cast iron box stoves. The old Smede or burn-out toilet systems and the slate urinals are being superseded by modern equipment. Modern buildings being erected today do not contain winding wood stairways to become fire traps for children. Neither are modern school buildings equipped with flat grain pine floors which splinter and become difficult to maintain.

The old water bucket with the common dipper is in most places only a memory or a relic. The increasing complexity of the modern educational program has made it necessary to provide a greater variety of facilities in the present day school buildings. The dark old schoolroom lighted by a few windows covered by stringy window shades, effectively shutting out much of the light is now being replaced by modern rooms with windows reaching to the ceiling. Likewise, the old single drop fifty-watt light bulb is being replaced with modern electric fixtures of the semi-direct or indirect type, using as much as 1200 to 2000 watts of light for the ordinary classroom.

The old flat grain pine floors, covered by accumulations of grease and oil, are being replaced with hard maple or beech wood floors or with some of the newer linoleum or mastic types of surfacing. Stairs and corridor floors are surfaced with tile, terrazzo, or some other non-combustible material. Tile or linowall wainscots are now provided to protect the walls from heel marks and fingerprints. Acoustical tile board and acoustical plaster have been applied to reduce reverberation and noise in the building. Large playroom areas and assembly units have been provided for the group activities of the school and community.

With these changes in housing methods have also come many changes in the mechanical systems and facilities. Electric clocks, electric bells and motors call for a different type of maintenance than did the old kerosene lamp and the hand bell. Central heating plants with a battery of boilers or furnaces distribute heat some distance from the source. This heat is regulated to a range of two or three degrees with automatic control. These plants have delicately adjusted machinery and appliances which must be properly installed and protected in order to deliver the type of services desired. School officials have found open window ventilation is not always effective, for on cold days all windows are closed. Present day systems are planned to change the air in the classrooms at fixed intervals and to do it without a noticeable change of temperature or air movement. Vacuum cleaners have been installed to replace the corn broom and shovel. Controlled humidity is provided to help regulate the temperature in the schoolroom. Modern plumbing facilities provide sanitary features for all school pupils.

With the newer buildings and with the improvements in the older buildings have come demands for a better type of housekeeping. This demand came first from those responsible for installing the modern machinery and service features in the school building. As the patrons learned of the improvements that were being made, the demand became equally imperative from the public that the school buildings be maintained in a manner which would provide more adequate heating facilities, improved ventilation, automatic temperature control, and sanitary facilities.

One of the major purposes of school maintenance is to preserve the district investment in school property. This may seem to be a small factor when we consider only one school janitor at a time. It becomes far more important when we recognize the fact that the elementary and high school districts of the public schools in the United States have an investment of approximately six billion dollars in school plants and equipment. Lack of proper care may cause this property to deteriorate rapidly. It is often stated that the life of a school building is approximately fifty years. If we accept this figure as a basis, it seems evident that any program of maintenance that prolongs the life of this property by as much as three or five years will effect substantial savings to the school districts in the United States. School maintenance involves more than the saving and protection of property. It also involves the protection of materials and supplies brought to the building for use.

A second and more important purpose in school housekeeping is to provide facilities for the protection of the children. With groups of children collected in a school building, we may expect to find some disarrangement and some disorganization. In short, we may expect the building to show the effects of being used. While pupils should aid in protecting the school building, the nature of the work done in the building will cause some wear. The maintenance program should be developed to provide the facilities needed, with the least possible building deterioration.

One of the essentials of a school building is that it shall preserve the health and safety of the pupils by providing suitable and adequate conditions. Every building should provide fire resistive exits, non-slip stair treads and other features designed to provide safety for the children. In housekeeping, it is essential that no obstructions be permitted in corridors and exits, and that exits be unlocked when the pupils are in the building. It is also important that safety from explosions or from flying glass in doors or windows be provided. A second phase in safety is that of health protection. To protect the health of pupils, it is essential that the building have properly regulated temperature, suitable air movement, and adequate sanitation. It is also essential that the pupils work in classrooms which are free from draft. The light should be of proper intensity to prevent eye strain, thus preventing eye fatigue and later sight defects. The school is the home of many children throughout the day. Here they may be exposed to contagious diseases and many other common ailments. It is essential that these hazards be reduced to a minimum by proper care of the building.

A third effect of proper school housekeeping is on the conduct of the students. A dull, uninteresting room or building invites marking and marring much more than does a clean, attractive, well lighted building. Children have energies that must have outlet. Under conditions where this energy is directed into proper channels, there will be less tendency on the children's part to display it in non-sanctioned school activities. Pupils who are proud of their school and who feel it is theirs want to support the school and to be on their best behavior when in the building. Pride in a building can be developed if the building is worthy of appreciation. Few of us had any real pride in the older schoolrooms. The scarred desks, the torn window blinds, the unattractive and unsanitary toilet rooms are not cherished memories. Too often the school building and grounds were an eye sore on the landscape.

The fourth purpose of school housekeeping is to keep the building in such condition that effective and economical work may be done. In order to do good school work, the pupil should be alert and active mentally. Children are more likely to be receptive to mental improvement when the schoolroom and conditions are conducive to mental activity. Listlessness, mental lethargy and a slowing of the learning processes are to be expected in rooms that are not properly heated or ventilated. It seems apparent that poor housekeeping methods may cost the school system many times more each day than the amount paid for housekeeping services.

Pupils learn more readily when in a happy mood. A happy mood is associated with comfort and cheerful surroundings. School housekeeping is of even greater importance when we realize the value of the school building as a teaching device. One of the major purposes of education is to teach the boys and girls to want the better things in life and to help them, insofar as possible, in developing the necessary skills to satisfy these wants. For many boys and girls, the school building is the finest building that they will ever call home. For many of them it is the best appointed, the most comfortable, the most sanitary and the most convenient building in which they will ever live. Many of the boys and girls set up their ideals of conveniences and of comfort, as well as of housekeeping practices, by the conditions they find in the school building.

Housekeeping in the School

The housekeeping program for a school system is a cooperative enterprise in which each member of the system participates to some extent. A lack of understanding of the importance of school housekeeping by any one group will nullify the work done by others.

I. The first responsibility rests with the school administrator. Many of the school administrators are well versed in teaching methods but have not had an opportunity to secure training in school plant management with all its varied factors. While it does not seem feasible to request these men to become specialists in building care, it is essential that they know something of the principles involved. It is also essential that they have the ability to organize and supervise the work of the people directly responsible for the care of the building. Care in planning is needed that there may be a proper balance between utility and ease in cleaning. It is obviously impossible for the administrator to supervise closely all the activities necessary in building care and it is essential that he delegate power and hold responsible those to whom authority is delegated.

II. It naturally follows that the administrator should have authority to recommend for employment men for the janitorial and maintenance force. He should also be expected to have authority to recommend for promotion. He should be able to organize this force of men by appointing certain men as supervisors or directors. He should assist in setting up and should pass on a program of work to be set up by these men. Since many of the school janitors are not trained for their jobs, the superintendent or administrator in charge should aid these men in securing adequate training. However, the responsibility of the administrator does not end here. He should supervise the training of teachers in the principles of building care. Finally, he should directly or through his assistants to whom he has delegated authority judge the results obtained. He should be able to sense weaknesses or defects in the organization before they are obvious to the casual observer. He should be able to instill enthusiasm and to secure cooperation of all concerned in the use and care of the school plant.

III. The teacher also has a definite responsibility in building care. She should not be expected to dust erasers or to clean windows, but she must accept the responsibility if pupils fail to assist in maintaining buildings in a satisfactory manner. She is the leader of the pupils and by her actions and teaching sets up the housekeeping standards for the pupils. It is she who can do most to teach pupils to appreciate suitable surroundings and to develop a pride in their buildings. It is often difficult for the teacher to overcome some of the handicaps of a poorly planned room, a lack of storage space, and poor surroundings. However, the ingenious teacher will be able to improve conditions now found in many buildings. She should never forget that proper ideals and practices in housekeeping may be as essential to the child as the development of skills in some of the class subjects. One of the first steps in schoolroom housekeeping is to develop a system for storing equipment and supplies needed in the room. Spaces should be provided for globes, maps, books, and other teaching devices. The children should be taught to store these materials in the space assigned. The teacher should teach the pupils responsibility in the care of individual wraps and supplies. Her work in housekeeping does not end at the door of her room. She can teach pupils never to enter the school building with mud on their shoes. The teacher is expected to train the pupils to refrain from marking on the walls. She should teach them to conserve toilet room supplies and to protect the shrubbery on the grounds. The teacher may also supervise the hanging of pictures and the development of many of the decorative features that aid in making the school building a fitting school home for the children. She should also learn to cooperate with the janitor in his work and to encourage him in his efforts to maintain a clean, spotless building. In order to have a check on her work in school housekeeping, the teacher might set up some guiding principles similar to the following:

1. Know the principles of heating and ventilation. Use a thermometer. Have ventilation, but avoid drafts.
2. Provide a sample of housekeeping in my end of the room that I am willing to have the pupils copy.
3. Teach pupils not to carry dirt into the building on their shoes.
4. Teach use of the wastebasket. Do not permit pupils to leave paper on the floor.
5. Have a place for everything. See that supplies are kept in their proper places.
6. Leave desk tops clean that they may be dusted.
7. Teach a sense of fitness. Do not use desk tops for storage purposes.
8. Teach children to use the walks and not to destroy the shrubbery.
9. Do not permit pupils to throw paper on the ground.
10. Teach pupils to erase blackboard when through with it.
11. Teach pupils to hang wraps in space provided.
12. Visit toilets frequently. Teach pupils that these rooms should be kept in a sanitary condition.
13. Do not drive nails in plaster or trim.
14. Do not paste stickers on windows or blackboards.
15. Lock cases and doors if same are to be locked. Lend keys only on order of superior officers.
16. Cultivate the good will of the janitor.[1] He may become a friend in need.

The teacher as the leader of the pupils may assume a double responsibility. Many of the pupils are young and have had little training in housekeeping. Unless the teacher can aid them in developing a pride in their building, she cannot expect them to assist in maintaining a schoolhouse of which she and they will be proud.

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[1] As used in this and later chapters, the terms "janitor" and "custodian" have the same meaning. As used they apply to those men whose chief duties are school housekeeping. The term, "janitor-engineer," as used will apply to those men whose chief duties are the care of heating and ventilating systems, but who may also have some housekeeping duties.

Chapter 2

The School Janitor and His Job

THE NEW AND improved school building facilities that have been provided will not render the service for which they were intended if the men employed for building maintenance service fail in their duties. The modern school janitor fills an important place in the school program. He reaches the building first in the morning to prepare it for the activities of the day. He takes charge of the building after the teachers and pupils have completed their duties for the day. He is the caretaker, the engineer and the person having direct responsibility for the comfort of the occupants of the building. The janitor who does his work well contributes much to the efficiency of the school system. The best janitor is the janitor who does his work quietly and thoroughly.

He should be considered an integral part of the school system and should be consulted when making plans for the schools. Many schools have found it desirable to have him attend an occasional faculty meeting. This relationship typifies the growing conception of the importance of the school janitor. School officials are beginning to realize that the modern janitor is better qualified and that he is better trained than was the janitor of a few years ago. The old type of janitor received his position through pull or friendship and often knew little of building care. He is being replaced by well trained men who are willing to put forth some effort to give adequate service. The janitor who sees in his job only the tasks of firing the furnace and an occasional sweeping of schoolrooms has no place in our modern school buildings. Not until a majority of our school building maintenance departments are manned by alert, capable, well trained janitors and janitor-engineers may we expect the buildings to render the service for which they were intended.

Janitorial Qualifications

It is difficult to set up qualifications in terms of age, experience, and specific training for janitors. In a building or system where many men are employed the work may be so organized that each man does the tasks for which he is best trained. In the smaller systems or even in the smaller buildings of any school system one man may be required to do all tasks connected with the maintenance of a building. In such cases it is essential that the janitor in charge have a wide range of abilities. Womrath [1] stated that the janitor should be an economist in the use of supplies, a sanitarian, a moralist, a first-class housekeeper, a sociologist, a diplomat, a maintenance engineer, and an expert mechanical engineer.

Age and Physical Condition

Many school boards will not employ a new janitor who is less than twenty-five or more than fifty years of age. Physical ability is usually considered more important than age for the men already employed. Many boards do not set up a definite age limit for the retirement of janitors from active service. If no retirement age has been set up some boards permit the janitor to remain in service until he is physically unable to do

[1] Womrath, G. F., *Efficient Business Administration of Public Schools.* 1932, pp. 279–81.

the work in an adequate manner. Litle[2] found from a sampling of Missouri school janitors that the average age of the men now in service is 49.16 years. He also found that the average janitor had 5.22 years of experience.

Lack of good vision and partial deafness are handicaps which may make it difficult for the janitor to perform his work in a satisfactory manner. The work of the janitor in firing the furnace, in cleaning windows, and in making repairs, coupled with the long hours that many of the men work, require a man with some agility and a good physique. Many of the tasks involve much risk for a janitor who is not sure of his footing on ladders and on window ledges. Other tasks require lifting of tables and other heavy objects. The school boards that select janitors physically unable to do the necessary tasks around a school building may expect patrons to complain of the type of service rendered. In addition to physical ability, the janitor must be free from contagious diseases. He should be required to conform to the same health regulations as the teachers.

Character and Personal Qualities

The janitor has an important influence on the lives of the school children. In the elementary schools, he is often the only male employee of the school system with whom the children have intimate contact. Some of them go to him for advice and many model their actions on his. The influence he exerts makes it important that he be clean in body, mind, and habits. He should be the type of person with whom the parents are willing to have their children associate. His character and reputation should be above reproach. He should never forget that he is a representative of the school system. Mothers realize that his

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[2] Litle, Roy F., "A Study of Missouri School Janitors," 1937, an unpublished manuscript, University of Missouri, Columbia, Missouri.

work may directly or indirectly affect the physical and moral welfare of their children. It is essential that he cultivate habits that merit the respect of teachers and patrons. He should not be addicted to the use of liquor or narcotics. Surliness, excessive familiarity, vulgarity, the use of profanity, laziness, or the chewing of tobacco around the school building, will bring criticism from parents and will undoubtedly result in the loss of position for the janitor. In general, the ideal janitor is a citizen of the United States, married, courteous, dependable, industrious, truthful, honest, and respectful.

General Education

There are no definite qualifications in terms of years of schooling for janitors. There are several different types of janitorial positions and some require more general training than do others. Most boards require that the janitor have the equivalent of an eighth grade education. He should be able to read and write reports and records. He should be able to read and understand written and printed instructions relative to his work, his tools, and the supplies that he uses. It is also desirable that he have a background that enables him to understand the organization, purpose and function of the school system. He should be able to speak the English language. In addition to his general education, he needs certain specific training which will be discussed under another heading.

Dress and Appearance

The janitor is the maintenance engineer and the school housekeeper. Cleanliness and neatness begin with him. It is difficult for a janitor who is not clean in person and in dress, or who does not know what cleanliness means, to maintain an attractive, sanitary school building. Children are sent to school to develop habits and ideals. Remember that not all the learning takes place in the schoolroom. Pupils develop ideals of housekeeping, or cleanliness, and of sanitation from their surroundings in the school building. In spite of the tasks that the janitor has to perform, he should give attention to his personal appearance. He should shave each day and should have his hair cut every two or three weeks. He should bathe every day. Dirty fingernails, uncombed hair, tobacco stain on his teeth, and a dirty face or clothes are to be avoided.

The janitor is often the first person visitors meet when they enter the school building. His dress and appearance should be in keeping with the dignity of the school. It is understood that he has many dirty tasks to perform. For this work he should provide overalls or coveralls that may be removed before he comes before the teachers and pupils in classrooms or corridors. Dilapidated shoes run over at the heels, bibbed overalls, a vest without a coat, exposed suspenders, baggy trousers, shirt open over the throat and upper chest, all detract from the personal appearance and show a lack of self respect. The janitor should be proud of his appearance.

Many schools require the janitors to wear a uniform consisting of trousers and shirt to match, shoes, tie, and a belt. Most janitors welcome this change. The colors perferred seem to be gray trousers with or without a light stripe and a gray shirt. However, some schools have adopted a khaki color with satisfying results. These are accompanied by black shoes or oxfords, black hose, a black belt, and a black bow tie. Many janitors have been able to secure black leather (semi-leather) neckties that look well, wear well, and do not require laundering. A head covering is not recommended for indoor work, but if one is desired it should be a cap to match the uniform. Dress caps or old hats should not be worn in the corridors or schoolrooms.

These uniforms may be obtained at the regular clothing counters in light weights for summer and heavier weights for winter wear. The clothing should fit snugly but should allow freedom of movement. It should be of a material that will wear well and that may be cleaned easily. It is essential that each janitor have more than one uniform that he may have clean clothing as needed. The cost of this clothing is no more than that of any other good outfit that the janitor may assemble. The belt should be fitted with a leather tool kit that will hold a small screw driver, a putty knife, and a small pair of pliers. The janitor should avoid wearing a flowing tie or loose clothing that may be caught in fans or other moving machinery.

Skills and Abilities

In a school system where a chief engineer, a repair crew, and other specialized workers are employed, there is opportunity for each man to perform the tasks for which he is best fitted. In such systems each man may train for a specific type of service. In other school systems or buildings where these special service men are not available, each man in charge of a building should be able to do most of the essential tasks necessary for building care and maintenance. The skills discussed in the following paragraphs are those essential for complete building care. In the smaller systems it may be necessary for each janitor to possess most or all of the skills listed.

With the introduction of vacuum cleaning systems, vacuum pumps, motors, automatic temperature control, humidifying systems, as well as several types of floor finish, public address systems, and rheostat control for stage lighting, the building maintenance tasks have become varied and complex. It is anticipated that there will be some tasks for which a skilled mechanic from outside the school system should be employed.

These instances are becoming less frequent as the janitors improve in their ability to care for school buildings. Where the men employed by the district have the skill to do minor repair jobs in a satisfactory manner, these repairs may be made when needed and usually at less cost than if outside mechanics are employed. The janitor who does not have the skill or ability to do minor repair jobs is being taught to do them or is being replaced by men with greater ability. Many school systems now find it unnecessary to employ any outside help unless new construction is contemplated.

As a Housekeeper

The janitor must be a good housekeeper. He should know the best methods of cleaning and preserving the various types of floors found in school buildings. He should know the composition of and the effects of various types of cleaning agents on different surfaces. It is essential that he know the best methods of cleaning glass, wall surfaces, furniture, building hardware, and blackboards. He is responsible for maintaining sanitary conditions in the building. He must know the value and use of water traps to prevent seepage of sewer gas into the building. It is essential that he know modern methods of cleaning fountains, urinals, lavatories, toilet stools, toilet rooms, and shower stalls of all waste accumulations or water deposits that might mar their appearance or aid in creating unsanitary conditions. His sense of order and arrangement should be apparent in the manner in which he leaves each classroom with each article of furniture properly located and with the erasers in place, or in his own quarters where all supplies are properly stored, tools in place, and where all rubbish has been eliminated. The good janitor knows and practices modern methods of building maintenance, knows how to eliminate dirt, and is eternally vigilant for marks or dirty spots that might mar the appearance of his building.

The janitor of yesterday whose experience as an engineer was confined to having fired a boiler for a sawmill or even to a short period as a locomotive fireman is not necessarily qualified to care for the heating and ventilating systems for a modern school system. The janitor in charge of the heating and ventilation should have a knowledge of the principles involved and some experience either as an apprentice or in other capacities in similar systems. He should know the principles of fuel combustion, the value of various fuels and the proper methods of firing. He should know the proper temperature range for the various school units and the importance of humidification. The well trained heating engineer will know the principles of heating and ventilation and the importance of securing this ventilation economically and without noticeable drafts. He will know how to clean the boilers, to care for radiator traps, motors, and fans so that the whole system may render the service for which it was intended.

In addition to his routine operating tasks the janitor has a definite duty to preserve the building from too rapid deterioration. He must possess many skills that enable him to repair breaks and to replace pieces which are too badly worn to give adequate service. The janitor should have sufficient skill in the use of woodworking tools to make shelves and window boxes. He should be able to make roof repairs, to tighten loose windows, to replace broken window cords, and to replace broken glass. He should be able to adjust door closers or panic exit devices, and to repair lockers. He should be able to use a sanding machine, to repair desks, and to replace broken pieces with those salvaged from discarded desks. There are times when the ability of the janitor to make minor plumbing repairs such as opening clogged pipes or stools or the adjusting of leaking valves, will maintain all fixtures ready for use, prevent a waste of water, and save a plumber's bill. While it is not essential that the janitor be a licensed electrician, he should know how to replace blown fuses with fuses having the proper resistance. He should know how to care for motors, lamps, and electrical appliances. In practice the well balanced and well trained janitorial force does not need to call a boiler maker to replace boiler flues or to replace a broken water glass.

The janitor should know how to care for and to trim hedges and shrubbery, to care for flower beds, and to maintain lawns. It is generally understood by school officials that public support of the system is closely related to public appreciation of the schools. To a large number of citizens the exterior appearance of the building, yards, and playgrounds is a measure of the efficiency of the school system. It is much easier for patrons to appreciate and to develop a pride in a well-kept, attractive school yard and building than in a poorly kept yard and a dilapidated, unpainted building. Hence, the ability of the janitor to maintain an attractive building may be an important factor in public approval of the schools. Although the janitor may possess many skills, we may perhaps best summarize by stating that he must be an expert housekeeper.

Responsibilities and Obligations

The janitor has many responsibilities in the care, preservation, and protection of school property. It is his duty to maintain a sanitary building. It is also his duty to provide the heat and ventilation needed to protect the health of the children in the building. His work in maintaining the building in such condition that the pupils may work in comfort may add materially to the efficiency of the school system. In addition to the regular duties, the janitor may be called on to care for the building for many evening activities. It is desirable that he be given assistance for evening duties, but if not, in spite of long hours of service, he feels obligated to be present when his building is open for use.

The janitor should attempt to prevent property loss that may be caused by freezing, neglect, or careless usage. He may find it necessary to drain pipes or to maintain fires over week-ends or during holidays in extremely cold weather. He should conserve the supplies and equipment used in the building. He should watch for breaks or weak spots in the building and, if he cannot make the needed repairs, should report them to his superior officer. Negligence on the part of the janitor may be responsible for losses of various sorts. He is the "keeper of the keys." These, he should not let out of his possession except on the order of his superior officer. Before leaving the building each evening, he should check to see if doors are locked and windows latched as per his (written) instructions. It is advisable that he make a circuit of the building each morning to determine any loss during the night.

Responsible for Safety

In his position as caretaker, the janitor is responsible for many factors that add to the safety of the children in the building. He is obligated to see that snow is removed from walks and doorways, and that sand, sawdust, or cinders are scattered over icy spots on steps or walks when needed. He should see that exit lanes are unobstructed by cases, tools, or furniture, and that all exits may be opened easily when pupils are in the building. He should be alert to the dangers of fire escape doors that do not operate freely, ice on fire escapes, hanging icicles, loose hand rails, and loose stair nosings. He should install and make use of temperature control valves on hot water lines to lavatories and showers. Door closers should be adjusted to prevent a too rapid slamming of heavy exit doors during windy weather.

The janitor in charge of each building is responsible for preventing and eliminating many fire hazards. There may be certain structural defects which create fire hazards, but which the janitor cannot eliminate. He should report these in writing to his superior officer. There are many fire hazards which he may remove. He should keep fire extinguishers filled as per the schedule of instructions for each type and ready for use. Inflammable materials should not be stored in the building unless in a fireproof vault. A recent disastrous school fire originated when a janitor, after having applied too much floor oil to a floor that was already fully soaked, decided to dry up the excess oil by building a big fire in the furnace, which had little clearance or protection between it and the oil soaked joists and floor boards above it. A janitor should avoid storing paper, oils, or other combustibles under stairs, stair landings, or exits. He should know the hazards of the careless use of the electric service. Before leaving each evening, the janitor should make a circuit of the building to look for fire hazards. He should make frequent detailed inspections of the building from the attic to the basement to look for any loose wires, accumulations of waste, or other fire hazards. Frequent inspections should be made in "hot spots" such as the furnace room, home economics department, science rooms, and shop units for any possible fire hazards. When a fire does occur, the janitor should aid first by sounding the alarm. His second and most important duty is to aid in getting the pupils out of the building safely and without panic, and his third duty is to protect property values.

Public Relations

The janitor should understand that the purpose of all his work in the building is to provide an adequate place for the activities of the pupils and teachers. Personal desires or personal opinions should not be permitted to interfere with the activities necessary to promote the work of the school or the welfare of the pupils. The practice of employing janitors directly by board members on the basis of friendship, sympathy, or any basis other than efficiency is passing.

Few janitors now find it necessary to apply to board members for a position or to make any reports directly to the board. The janitor should understand that he is under the supervision of and responsible to his superior officer. In some cases he is responsible to the superintendent of buildings and grounds or in the smaller systems to the superintendent of schools for the general care of the building, and to the principal of the building for his daily housekeeping activities.

Relation with Teachers

The janitors and teachers have a joint responsibility in maintaining clean, attractive, comfortable buildings. The tactful janitor should be able to secure the cooperation of the teachers in teaching pupils not to bring dirt into the building, to avoid scattering paper on the floor or grounds, and in preventing the marking and marring of the walls of the building. Teachers often request janitors to erect shelves or to make some other improvements in their rooms. In some cases they may request him to run errands or to perform some task which may interfere with his regular duties. The janitor should expect to give assistance when it will promote the work of the school, but the thoughtful teacher will understand that the janitor has a regular schedule of work and that she should not expect too much of his time. The diplomatic janitor does not refuse to perform tasks outside his assigned duties, but may request the teachers to get the approval of the principal of the building if the janitor is to vary his schedule in doing non-routine tasks. Teachers should know what periods of the day the janitor is available for other than routine tasks and the type of service he is able to render. Conflicts between teachers and janitors over the time for cleaning rooms and over the conditions of the rooms may be avoided by developing a mutual understanding of the duties and obligations of each in relation to the school. The trained janitor will study the desires and the schoolroom habits of each teacher and attempt to make her his friend.

Pupil Relations

The janitor is thrown into direct contact with many pupils. Some of them go to him for advice and many of them copy his ideals and habits. The janitor who does not like children nor have the ability to get along with them should secure another job where he will not come into contact with children. The janitor who is fair but firm in his dealings with children is usually able to secure their respect and cooperation. A janitor who is domineering or one who caters to children of influential parents may find his path difficult and his future in that building uncertain. It does not seem desirable to have the janitor punish children, but since he is charged with the conservation of supplies and oftentimes with the general management of the toilet rooms, pupils should understand that he is in charge of and responsible for certain parts of the school property. He may advise students in regard to the care of school property and is obligated to report to the principal infractions of certain fixed school regulations. The tactful janitor will be able to secure the cooperation of the teachers and pupils in maintaining a clean, scarless building, not marred by pencil or heel marks, and a yard with a protected lawn free from paper and other rubbish. He should be able to secure the cooperation of the teachers in preventing the accumulation of waste paper on the floor, in teaching pupils to flush toilets, in checking waste of sanitary supplies in the toilet room, and in developing in and with the pupils a pride in the building and grounds.

The Janitor and the Public

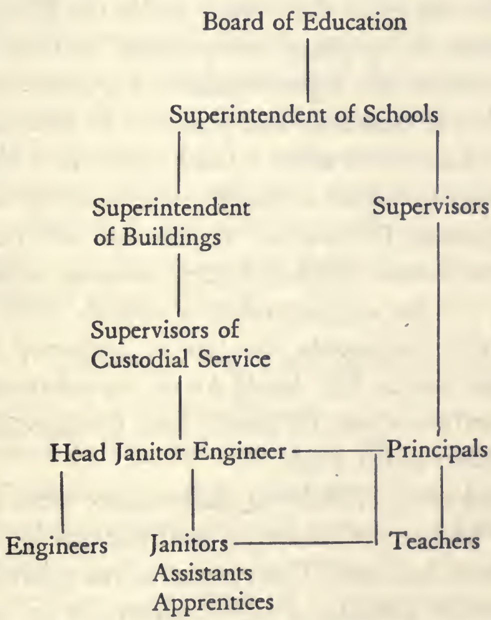
The janitor is the most intimate contact between the school and a portion of the public. He often contacts certain groups that no other representative of the school has reached. He should understand that it is his duty to promote understanding of and good will for the school system. Many friends and patrons will come to him for information about the school. Knowing he is not the authorized information bureau for the school, the wise janitor will not, by implication or by word, cast any reflection on the management of the school or the work of the teachers.

The janitor may be an important contact agent between the school and a portion of the public. He often contacts certain groups that no other representative of the school has reached. Many friends and patrons and even some inquisitive board members may come to him for information about the school. Some janitors having the best intentions are flattered by this attention and give out information that may be misinterpreted by those who do not have all of the facts. The diplomatic janitor can aid his friends in developing an appreciation of the school system without resorting to cheap gossip.

Chapter 3

Organization for Janitorial Service

In most systems the superintendent of buildings and grounds is recommended by and is responsible to the superintendent of schools. The line of authority, as it relates to janitorial service usually found in these schools, is illustrated in the diagram shown here.



The board of education or the board of trustees is in nearly all cases designated by law as the control body for the local school system. The members of these boards are usually laymen who are not trained in school administration, and who do not have time to give attention to the details of school management. Therefore, a school head or manager is necessary. These boards select a superintendent of schools to serve as a leader and an executive officer. He is responsible to the board for the school system. He delegates to various other officials, principals, supervisors, and the superintendent of buildings and grounds certain duties and obligations.

This type of organization may vary in the different school systems. In some systems the superintendent of buildings and grounds may also be the business manager. If no special supervisors are employed there may be one or more head janitors or engineers who are to do their work under the direction of the superintendent of buildings and grounds. In some of the smaller school systems the superintendent of schools may also be superintendent of buildings and grounds. In such cases he usually finds it desirable to select a head janitor or a head engineer and to grant him some authority in directing the work of building maintenance. If the school systems are such that only two or three janitors are employed, these men are usually responsible directly to the superintendent of schools. Each janitor should understand thoroughly the line of authority in that particular school system. He should know his relationship to other janitors and to whom he should look for directions for the technical phases of his work.

In a few school systems, building maintenance work is done by a contractor who agrees to care for the buildings for a specified sum of money each year. This system has not proved popular and will not be considered or recommended in this discussion. It will be noted from the diagram that the janitors and head janitors also receive some direction from the principal of the building. From the nature and organization of the school system this dual responsibility seems inevitable. The work in each school building is for the purpose of promoting the educational program in that building. It is understood that the principal is in charge of this program. It is generally found desirable for the janitor to receive instructions for all tasks that immediately affect the educational program from the principal of the building. He receives instructions for the technique of his work from, and is responsible to, the superintendent of buildings and grounds for the general condition of his plant. He also works under the superintendent of buildings and grounds in making repairs and in the use of fuel and certain supplies. In theory all requests from teachers for janitorial assistance should come through the principal. In practice, particularly in the smaller buildings where the teachers and janitors are more intimately associated, the teachers often make their requests directly to the janitor. This seems to be a satisfactory procedure in caring for minor tasks if the doing of these tasks does not interfere with the routine work of the janitor. Many janitors state that small favors done for teachers may aid in securing their cooperation in preventing an accumulation of waste and dirt in the rooms.

Employment, Tenure and Salary Schedules

In former years the employment of janitors and the control of janitorial service was under the direct supervision of the board. In some cases each board member was responsible for the appointment, retention, and promotion of the school janitors working in his ward. Although this type of control has proved inefficient and although it is condemned by students of school administration, certain phases of the system still prevail in some of the smaller school districts.

Selection and Promotion

It is generally agreed that the janitor should be selected on the basis of his ability to do a particular job. Up to this time no one seems to have determined the best method of evaluating the merits and abilities of prospective janitors. Many school officials accept new men without investigation, hoping that the new man will be better than the old one. In some cases the janitor is required to pass a civil service examination before becoming eligible for appointment. In other school districts, janitors who have charge of heating plants must pass an examination set up locally for engineers and firemen. During the last few years an increasing number of school systems require each new janitor to pass an examination outlined for that particular district. Each of these systems has some merit in eliminating untrained men. On the other hand, no examination system seems to be by and of itself an adequate basis for selecting new janitors. The best system seems to be an examination prepared by school officials preceded or followed by an investigation of the applicant's character, ability, and habits.

The best practice seems to be for the supervising officer, superintendent, or superintendent of buildings and grounds, after giving all examinations desired and after making proper investigations, to recommend new men for employment. This supervising officer should keep a file showing the standing and availability of each applicant. It is understood that the final authority rests with the board of education and that all contracts which call for a payment of district funds must be passed on by the board. However, it should not and generally would not be necessary or wise for individual janitors to appeal to board members for positions or for promotions. Authority for promotion should go with the power of selection. When a new janitor is employed he should be put on probation for six months or one year. During this time it is desirable to have him work as an assistant to a well trained janitor. At the end of the probation period he may be promoted to regular assistant or placed in charge of a small building. Regular promotions should come only upon recommendation of the principal of the building in which he works and the supervisor under whose direction he has worked.

Tenure

After a janitor has passed his period of probation he should be able to feel secure in his position as long as work, habits, and attitudes warrant retention in the system. In school systems where teachers and other employees must be elected each year, the competent janitor should be re-employed without having to apply for the position. Unfortunately this practice is not always followed. Many experienced and well qualified janitors have to compete with untrained men on a price basis each year in seeking re-employment. This lack of stability is demoralizing to the janitorial force, leads to less efficient service, and fails to encourage janitors to secure additional training for their jobs. Records that are available seem to indicate that janitorial tenure in the larger school systems is more secure than in the smaller schools. They also indicate that trained men have a decided advantage over the untrained men in holding their positions. Litle[1] found that of 400 Missouri school janitors, fifty per cent had been in their present positions four or more years. In spite of recent movements toward permanent tenure, there is still some question of the value of any tenure system that is not coupled with a program of evaluating services rendered, in

[1] Litle, Roy F.

order that merit rather than seniority may be a determining factor in retention and promotion.

Salary Schedules

Information provided by the Research Division of the National Education Association[2] indicates that the average annual salary for school janitors in 1936–37 was:

In Cities with a Population of	
100,000 or more	$1,297
30,000 to 100,000	1,298
10,000 to 30,000	1,231
5,000 to 10,000	1,068
2,500 to 5,000	1,023

Litle found that during the same year the average annual salary for Missouri school janitors in school districts with a population range of from 100,000 to 1,000 was $807.50. These salaries are below the average salary generally recommended for skilled workmen in other lines of activity. A study of the situation seems to indicate that several factors contribute to the maintenance of the present low wage scale:

1. The hiring of men not trained in building maintenance principles and practices.
2. Custom, coupled with an old feeling that anyone can take care of a school building.
3. The hiring of men physically unfit for strenuous work.
4. Poor standards of housekeeping demanded by school officials.
5. Small buildings which require the presence of a janitor but not the full time labor of a capable man. School boards may try to economize here by selecting the type of man that may be hired at a small annual salary.

There are many factors involved in establishing a satisfactory wage scale for the janitor in any school system. Some of these

[2] National Education Association, Research Bulletin, Vol. XV, No. 2, March 1937, P. 62, 63, 64, 65.

factors are: the prevailing wage scale in other lines of work of similar difficulty and importance, the hours of labor, the amount of evening work required, the number of months for which a salary is paid, the security of tenure, living costs, pay for overtime, vacations with or without pay, holidays granted, time off for illness, the responsibility, the repair work done, experience, training, ability, and the amount of work assigned to each janitor. One of the irksome features of janitorial work as now planned in many school systems is the time that the janitor is expected to remain on duty. Where two or more men are employed in each building, this difficulty can be overcome by alternating the hours of labor. A few school systems have at least partially solved this difficulty in one-janitor-buildings by the use of a flying squadron of night men who have the buildings warm when the regular man reports for duty, and by employing special men for duty when the building is open at night. School officials can and should, in so far as possible, employ and pay on a twelve months basis all janitors who render real service in maintenance and repair work during the summer months.

A satisfactory work program and wage scale should include:

1. A living wage if employed full time, regardless of the size of the building.
2. Decent working conditions.
3. Fair treatment with promotion and retention based on merit and the services rendered.
4. A salary scale based on responsibility, labor involved, and ability to do the job.
5. Hours of labor limited to acceptable standards.
6. Employment during summer months.
7. Security of position.
8. Extra pay for overtime.
9. Vacation and sick leave permits similar to those granted teachers.
10. A retirement plan.

It is understood that many of these standards are not met, particularly in some of the smaller school systems. These represent ideals which should be kept in mind by school officials and janitors. Until some of these conditions prevail we cannot hope to have adequate maintenance service in our schools. In general the schools are paying for the type of service they are receiving. Janitors should not feel discouraged over the lack of some of these advantages. As training programs are developed and the janitors become more proficient, working conditions and salaries will be brought into line with the services rendered. Regardless of the salaries paid and of other conditions under which he must work, the school janitor should expect to do in a proper manner the work assigned without grumbling or fault finding. It is entirely proper for him to consult his fellow workers about salaries and working conditions, but he should remember that the school is operated not for his benefit but for the benefit of the children. If he cannot improve conditions peacefully or receive what he thinks a desirable wage for the services rendered, he should seek employment elsewhere.

Rules and Regulations

A study of the organization for janitorial service indicates that in a majority of the smaller school systems all directions are given orally and that few of them have a typed or printed list of rules and regulations. On the other hand, many of the larger systems have detailed codes or rules and regulations covering each and every activity of the janitors. Each of these extremes may be subject to some criticism. Regardless of the size of the system it is desirable to have an outline setting forth the general status, duties, obligations, and responsibilities of the janitors. The extent to which the rules and regulations should be detailed will depend on the type of men employed and the degree of freedom granted these men in planning the work in their buildings.

In keeping with the modern trend toward cooperative planning and greater participation by school employees in the general management of the system, many schools now invite members of the janitorial staff to aid in setting up a proposed set of regulations and approved practices of building care and maintenance. This trend is worthy of commendation. School administrators hope to develop a janitorial staff of skilled men each of whom is vitally interested in the schools and in the job he is doing. In fact, certain principals occasionally invite the janitor to sit in conference meetings with a part of the faculty to discuss school and building policies. An examination of the available rules and regulations leads to the belief that many of these were prepared by school administrators. Few of them gave consideration to the rights, privileges, or position of the janitor in the school system. Little attention is given to technique or methods of work. However, much attention is given to such problems as: eligibility, dress, line of authority, habits, salaries, cooperation, hours of work, care of supplies, duties and responsibilities. The following list of rules and regulations is not offered as a model list, but as a sampling of some that are now used.

I. Organization and administration
   1. The general line of authority shall be:
      Superintendent of buildings and grounds
      Supervisors and chief engineers
      Head janitors and engineers
      Assistant janitors and engineers
      Apprentices and substitutes.
   2. Directly and through his supervisors the superintendent of buildings and grounds shall have charge of the care of the physical plant. Each janitor shall be responsible to him for the

general condition of the building and the technique of his work.

3. The principal in each building shall have general control of the building and the activities therein. Janitors should confer with, and take orders from the principal on the care of the building and on all tasks necessary to promote the work of the school and the welfare of the pupils.
4. Where more than one janitor is employed in a building the assistant janitor shall work under the supervision of the head janitor.

II. Eligibility, qualifications, promotions

1. Janitor shall be twenty-one years of age, physically able to do the work, free from contagious diseases, and should, if possible, reside within easy walking distance of the building.
2. After the janitor has passed the physical and technical examinations he may be selected for apprenticeship training. Each janitor shall serve first as an apprentice and then as an assistant janitor before being placed in charge of a building.
3. A janitor shall pass the required examinations and have the approval of the head janitor and the principal before being promoted.

III. Personal habits

1. The janitor shall wear the uniform approved by the school.
2. He shall be neat and clean in appearance.
3. He shall refrain from profane and indecent language.
4. He shall not be addicted to the use of liquor or narcotics. Smoking in the building other than in the janitor's quarters is forbidden.

IV. Duties and responsibilities

1. He shall maintain the building in a proper condition for the work to be done therein.
2. In so far as possible he shall protect the building from damage and loss through fire, theft, and too rapid deterioration.
3. He shall leave the building during the hours of his employment only when he has the permission of the principal. He shall so plan his work that he may employ his time to the best advantage.
4. He shall have the building open, clean, and with the temperature properly regulated, at least thirty minutes before school opens in the morning.

5. He shall make the required records and reports on time and on the proper forms.
6. One or more janitors shall be on duty at all times when the building is in use.

V. Care of tools and supplies

1. The janitor shall keep his tools properly stored and in a usable condition.
2. He shall be responsible for the economical use of the supplies allotted to the building.
3. He shall keep a record of gas, electricity, water, and coal used in the building.

VI. Salaries and hours of labor

1. Salaries shall depend on the rating of the janitor, the hours on duty, the type and size of the building.
2. Hours of service shall be from ____ to ____ each day school is in session with a ____ hour period of service on Saturday.
3. Time off for illness shall be the same as that allowed teachers in the system.
4. The janitor shall accept no pay from non-school organizations using the building. The board will collect all fees and the janitor will be paid at the rate of ____ times his hourly wage for such overtime. For occasional school activities held during the evening the janitor will receive no extra pay. If evening school work calls for frequent use of the building a night man will be assigned to the building.

Other special regulations relate to the frequency of cleaning, care of keys, etc.

In a school system where the buildings are large enough to require the services of several men in each building it is not difficult to plan the work so that each man will have what may be termed a normal load of work. In many other systems where the buildings are smaller, part time and night men may relieve the men in the one man buildings by taking over a part of his work of cleaning or by having the building warm each morning when he reports for duty. In many of the smaller school systems little attempt is made to develop equitable work schedules. On the other hand, many of these schools vary the salary according to the size of the building. One result is that the pay in the smaller buildings is insufficient to attract and hold skilled men. It naturally follows that many of these buildings are cared for by men untrained and physically unable to render the type of service needed. The development of reasonable work schedules should make it possible to pay adequate salaries for each man, should aid in securing the type of man needed, and in improving the quality of the janitorial service.

The Work Load

School boards and school administrators find it difficult to determine the desirable work load in developing a work schedule for each janitor. General information provided in the following paragraphs is developed as an aid to administrators in studying the work load. (A more detailed outline of the work of the janitor in developing a work program will be discussed in Chapter 9.) Several standards such as the number of classrooms, floor area, and the number of pupils enrolled, have been used to measure the work load of each janitor. All of these taken together do not constitute an adequate measure of the work to be done. They do not even provide a reasonable basis for comparison unless many other factors are recognized. In studying the work load of each janitor the administrator should consider the importance of the following factors and conditions.

1. Where only one man is employed, hours of service are not easily alternated.
2. If special men are employed for repair work, night service, or for early morning firing, the work of the regular janitor is made easier.
3. Buildings in smoky areas are harder to maintain in a satisfactory manner.
4. Old buildings usually present problems not found in modern plants.

5. The lack of scrubbing machines, brushes, mops, etc., and of the proper cleaning materials, increases the time required for cleaning.
6. Old wood, or pitted concrete floors, require more cleaning time than do smooth surfaces.
7. Small glass panes, although having other advantages, require more time for cleaning than do large panes.
8. More time is spent in temperature control in an area where the temperature is below freezing for many days during the year.
9. There is usually more night work in junior and senior high school than in elementary school buildings.
10. Ash hoists, automatic temperature control, and stokers, now do many of the tasks once done by janitors.
11. Gas and oil fuels require less labor and cause less dirt than does soft coal.
12. Old enamelware plumbing fixtures check and require more attention than does the smooth surface of porcelain.
13. The large areas now recommended for playgrounds with their ornamental planting require care and attention.
14. Muddy grounds or surfaces covered with gravel or cinders permit the tracking in of material injurious to schoolroom floors.
15. The use of the building at night, particularly by non-school organizations, calls for extra care and attention on the part of the custodian.
16. Work shops, science rooms, and rooms where cooking is done, are usually difficult to maintain.
17. Small fixed seats with multiple legs are factors in the time required for daily cleaning.
18. Smooth glazed wainscots absorb little dirt and require less cleaning time than do rough surfaces.
19. In some areas the water is impregnated with minerals that accumulate on plumbing fixtures and in heating systems, thus involving more work on the part of the janitor.
20. It is necessary to know the amount of assistance that the janitor will give in toilet room supervision or in other non-cleaning jobs.

In computing the work load and the amount of work to be assigned to each janitor, it is desirable to list the tasks and to determine the time that should be allotted to each task in that building. It is also necessary to know how often these tasks must be done. The supervisor or administrator should aid and encourage the janitor in an analysis of his job and in developing a schedule of work. An excellent analysis of this type has been made by officials of the Minneapolis Public Schools.[3]

A Plan of Work Essential

There are many duties and tasks to perform in caring for a school building and if the janitor is not taught how to plan his work he may neglect some of these duties. If the janitor is to do his work in an efficient manner and to make the best use of his time, the work must be so planned that certain tasks may be done at a time when routine activities are demanding less of the janitor's attention. Some of his tasks must be done daily, and some several times daily. Certain other tasks should be done weekly and some need to be cared for only after longer intervals of time ranging from two weeks or a month to a year. A systematic schedule or work program will enable the janitor to do more work and to avoid to some extent peak loads of work during certain hours of the day.

In developing a work program it is not possible entirely to separate operation and maintenance activities. Certain repairs and replacements must be made as the need arises. However, aside from the problem of financial accounting, there seems to be little need to distinguish between the maintenance task of replacing broken glass and the adjustment of seats which may be termed an operation task. No complete schedule can be developed that would apply alike to all classes and types of buildings. In order to develop a suitable work schedule, it is necessary to analyze the work load as outlined in previous paragraphs. In the larger buildings where several men are em-

[3] Pykaski, Conrad. *Methods of Calculating Public School Janitorial-Engineering Man-Power.* Board of Education, Minneapolis, Minnesota, September 1935.

ployed, the hours of service may be alternated and the work divided so that each man will have certain tasks to perform. Even in smaller buildings where a special man is employed to care for the building during night meetings a schedule may be arranged permitting him to do certain cleaning tasks while he is in the building. In school systems having several small buildings one man may be employed to give part time assistance in two or more buildings. Any work schedule developed should allow some time for repair and other non-routine tasks. In a few two-janitor-buildings the work is so outlined that janitor "A" comes on duty in time to heat the building before school opens. He remains on duty until noon. He is then off duty until about three o'clock when he returns to assist in the daily cleaning. Janitor "B" comes on duty at noon and works until about five o'clock. He then returns to the building at about seven P.M. for night service and to complete all cleaning. The work schedule for each building should represent the combined thinking and planning of the principal, the superintendent of buildings and grounds, and the janitor in charge.

The development and use of a schedule calls for some records and reports. These should be simple for the clerical work of the janitor should be reduced to the minimum. Schedules should be typed or mimeographed. It probably will not be necessary for the janitor to check his daily chart after he has become accustomed to the routine. He may check the weekly, monthly, or yearly charts as a reminder to himself and as a report of tasks done. For these charts a dating as (2/12) may serve as a check.

Janitorial Cooperation

Any man who must work alone, and who is denied the inspiration obtained from talking with and exchanging ideas with others interested in the things in which he is interested, may easily become self centered and is sure to miss hearing about some of the newer methods or supplies used by others in the same line of work. It is natural for each janitor to crave companionship and friendly relations with other men having similar interests. In many school systems the janitors, particularly those in the smaller buildings where only one or two men are employed, have had little opportunity to associate with other janitors. A lack of cooperation and oftentimes a feeling of rivalry and jealousy have aided in preventing progress or the improvement of morale in the janitorial force. The thoughtful supervisor or administrator encourages and makes an opportunity for his men to get together that they may discuss problems of common interest.

There has been an attempt in certain cities to unionize school custodians and engineers. The fact that school custodians are public employees and thus restricted from some activities has prevented this movement from becoming popular. There is a National Association of Engineers and Custodians which has attracted some interest. However, this organization is too remote from the average janitor to have much direct influence or appeal. The janitors see more immediate profit from local organizations where the men have frequent personal contact with other members. Such organizations have been in existence in some city school districts for a number of years. Since the development of janitorial training schools in Minnesota, Colorado, Oklahoma, Iowa, Nebraska, Missouri, and elsewhere, many local janitorial clubs or associations have been organized. In most cases these men meet monthly to discuss their work and to exchange ideas. School administrators often cooperate with the janitors by setting aside one evening each month for janitorial meetings. All buildings are closed on these evenings and no other public meetings calling for janitorial service are scheduled for this time. In many of these organizations the men prepare their own refreshments and a few of the more ambitious ones serve an annual banquet to which the school board and other school officials are invited. The school boards and other school officials in a few districts sometimes reverse the order by serving a dinner in a school cafeteria for all local and visiting janitors. School administrators generally report that these janitorial organizations have aided in improving the morale of the men, reducing discontent, and in developing a cooperative spirit among the men. In some school systems the janitors have developed for themselves a code of ethics for their use. A sample code developed by and for the custodial force at Columbia, Missouri, is given below.

"Code of Ethics for the Columbia, Missouri, Public School Custodians" [4]

The following Code of Ethics was adopted by the janitors of the Columbia Public Schools December 15, 1936:

That we may ever have our thoughts directed toward the proper care of the school plants, and that custodians' work may truly be a profession, we proclaim this code of ethics:

We Believe That

First: Our profession stands for ideals and efficient service.

Second: Our highest obligation to the boys and girls is keeping the schools in a sanitary condition.

Third: Custodians should be selected or appointed upon the basis of professional merit.

Fourth: The custodians should apply for a position to or through the superintendent of schools.

Fifth: No custodian should be elected unless recommended by the superintendent of schools.

Sixth: The custodian should be physically sound and in good health. For his own happiness and for the well-being of the pupils, the custodian must guard his health at all times.

[4] The word custodian includes engineers.

Seventh: A worthy custodian will possess a pleasing personality and a love for children.

Eighth: A worthy custodian will possess a desire for knowledge of and training in operation and maintenance of the school plant.

Ninth: It is perfectly proper at all times for custodians to seek preferment and promotion by legitimate means.

Tenth: It is the duty of the custodian to inform the administration as soon as possible of a definite decision to resign.

Eleventh: It is unprofessional for a custodian to violate a contract. Unless the consent of the Board of Education is obtained, releasing the obligation, the contract should be filled.

Twelfth: Whenever the work of any custodian is unsatisfactory, the administration should notify the custodian and give him a chance to make the correction before dismissal is recommended.

Thirteenth: If a custodian is not re-elected he is entitled to know the cause of non-election, if it is in the power of the administration to report the same.

Fourteenth: It is unprofessional for a custodian to offer a destructive criticism to the administration; to other custodians, teachers, pupils, or to patrons about a fellow custodian, teacher, pupil, or about the management of the school in general. All criticism should be constructive in character and voiced to the proper authority and only for the purpose of remedying the existing evil. It becomes equally unprofessional not to report to the administration, therefore, matters that involve the best interests and well being of the school.

Fifteenth: The custodian should consistently refrain from becoming a partisan upon issues which divide the community.

Sixteenth: We believe that our Code of Professional Standards and Ethics is a statement of conscientious practice.

Control of Supplies

While a more detailed discussion of supplies will be given later, it seems advisable to state that the control and use of supplies plays an important part in the administration of the janitorial service. Without proper supplies the janitor in charge cannot hope to do an efficient job in an economical manner. It is futile and wasteful to attempt to clean rough oily floors without the proper cleansing agents. On the other hand, the use of a strong soap or cleansing powders may mar the finish of floors or woodwork. Each janitor should be encouraged to study the use and composition of various cleaning compounds. In the larger schools, the supplies will be kept in a central storehouse and delivered to each building upon request. Each janitor should be taught how to estimate his needs, to make out his requisition forms, and to check on supplies used.

In a well planned school system the janitor will feel that he has a definite place in the school organization. He will understand something of the duties and obligations of his fellow workers. The alert janitor will know enough about the school system to enable him to adapt his program to the needs of the school. He will know how to plan his work, without waiting for detailed instructions for each activity. He will be proud of his school and his school will be proud of him.

Chapter 4

Housekeeping

Cleaning Tools

MANY JANITORS FAIL to realize full value for the energy expended in school building care because they do not have the proper tools and supplies for the work they are to do. On the other hand, some of the men do not know how to secure best results from the tools and supplies available.

The janitor is responsible for the operation, protection, and maintenance of the school building. Hence, it is essential that he have the proper tools and that he know how to care for them. In many cases, the poor quality of the work found in the building may be attributed partly to the lack of proper tools and partly to the condition of the tools that are used. It is important that the janitor know the composition and use of cleaning agents. He should know that certain agents clean through a chemical action, that others clean through an abrasive action, and that some agents combine both actions. Some abrasives may scratch and mar polished surfaces. On the other hand, certain agents may contain chemicals that attack the surface to be cleaned. The alert janitor will know that strong alkaline preparations may bleach wood floors, and that acid cleaners will attack enameled iron. One janitor states that, when in doubt, he uses water. While this is generally a safe practice, it is true that water may be harmful to certain fabrics or to fiber board ceilings and tack panels.

In many cases, one tool or implement may be adapted to use in more than one location or for more than one purpose. The use of the proper tools and materials will effect a saving in time and will bring more satisfying results. In his daily housekeeping and maintenance duties, the janitor will need a number of cleaning tools, tools for yard work, and special small hand tools for a handy repair kit. Other tools which are necessary for the heating engineer may also be of some value to the maintenance and repair man. Wherever possible, the tools should be standardized to a sufficient extent that the men in the various buildings may use similar tools for like activities. This will permit greater possibility in the exchange of tools and will facilitate the purchase of tools for all of the men at one time. It will also make it easier to provide repair and replacement parts.

The cleaning tools will include brooms, brushes, mops, dusters, pans, pails, squeegees, chamois skins, cheese cloth, and many others which will be used by the custodian in his care of the building.

Brooms

The old corn broom, long the chief tool of the school custodian, is now practically out of use in modern school plant maintenance. A few of these brooms have been retained for cleaning up around boiler rooms and coal rooms, and for the sweeping of walks. In some places, the corn broom is still used by pupils as an aid in cleaning mud from overshoes. When a corn broom is purchased for the purposes outlined above, it should be one having stiff straws bound securely to the handle. There is another broom known as the palmetto broom which has been used for rough cleaning and for the sweeping of leaves. This has not found general favor in schools.

Brushes

Many types of brushes are used in school plant cleaning. Some of these are of fiber construction, some of bristles, some of horse hair, and some of a combination of these. Each of these types of brushes probably has use in a school building and each may be adapted to several uses. The use of a brush not adapted to the work to be done may result in a waste of time and effort.

Floor Brushes

Several years ago there was a decided swing away from the use of the corn broom to the use of floor brushes. At the present time, the floor brush is being replaced by sweeping or dust mops. There is still some need for floor brushes in school buildings where the concrete floors are old and pitted or on certain wood floors that are rough and can not be cleaned easily with a sweeping mop. In some cases, the janitor finds it necessary to use a floor brush, even in buildings having good floors, if the playground and soil conditions outside contribute to the carrying in of excessive amounts of dirt on the feet of the pupils. In these cases, the janitors often use the floor brush to remove the heavy dirt and follow up with the dust mop. The size of the floor brush best fitted for a particular job will depend upon the area to be cleaned. In schoolrooms with fixed seats it probably is not possible or desirable to use a block over 16″ in length. On large areas, such as corridor units, the janitor can use a 36″ block or head with a saving of time to himself and with satisfying results. The best floor brush commonly found in school buildings is that of Russian or Chinese bristles.

The cost of a pure bristle brush is high and most schools find it desirable to purchase a brush composed of about sixty-five or seventy per cent bristles with fifteen to twenty per cent horse hair and some fiber. The fiber aids in holding the bristles in an erect position when sweeping. Most janitors prefer a brush with bristles about 4″ in length with these bristles extending out at the end and to each side in a sort of flare. The use of rubber bumpers at the ends of the brush will be unnecessary if the bristles of the brush have the proper flare at the end. With the general abandonment of heavy floor oils, the problem of using a wire set instead of a glue set brush seems less important. One feature that the janitor demands in a floor brush is that it have "kick." When the janitor lifts the brush at the end of his stroke, the bristles should have resiliency enough to kick out and throw the dirt slightly ahead, freeing the brush of particles of dirt. This prevents the carrying back of dirt on the brush, to be dropped at the beginning of the next stroke. These brushes usually come with holes bored on two sides of the block to permit changing the handle that the brush may wear evenly from both sides. In general, the smooth handle treated with oil is preferable to the painted one in that it moves more easily through the hand. Most janitors do not prefer the handle attached to the brush with a spring. While the handles come in various lengths, it is desirable to reduce the handle length so that when the brush is standing on the floor, the top of the handle comes approximately to the eyes of the one using the brush. If the bristles become matted or filled with lint, they may be cleaned by combing.

Scrub Brushes

Under modern methods of floor maintenance not much scrubbing is done. Scrubbing, as used in this connection, refers to a scouring process to release dirt and grime from the floor. A considerable part of the scrubbing is done by machine but some must be done by hand. For this purpose, the hard fiber brush of palmetto or similar material is desirable. These brushes should be purchased in pairs, one for the hand and one on a handle. The fiber should be comparatively short, preferably not over 3″. The block should be of a type of wood that resists deterioration from frequent immersions in water and scrubbing solution. These brushes should be rectangular in shape with square corners so that they may be used to reach corners in the building. No specific care is necessary other than that of cleaning the caustics and other scrubbing compounds from the brush after it has been used.

Toilet Brushes

The janitor finds frequent use for a stiff fiber brush mounted on a short handle for the purpose of cleaning toilet stools, urinals, and other fixtures. Some janitors prefer to have two or three brushes of different shapes in order to reach into all of the corners. Some of the brushes have a wood handle with a wire set fiber. Others have a wire head with fiber twisted into it. Each type seems to work satisfactorily. At least one brush used for this purpose should be so designed that it may be used to reach otherwise inaccessible corners and crevices in the fixtures. One of these brushes with stiff ¾″ to 1″ fibers may be used to scrub heavy incrustations from fixtures.

Radiator Brushes and Counter Brushes

The janitor will need a radiator brush of horse hair which may be used in cleaning between the sections of the radiator and which may be used to clean back of or under the radiators. Most brushes of this type are on wire handles and are cylindric or oval in shape that they may be inserted between the sections of the radiators. The counter brush is usually a small hand brush like that used in the home to brush crumbs from tables.

Mops

Mops may generally be grouped into two classes commonly known as *dry mops* and *wet mops.*

Dry Mops

The dry mops, commonly known as dust mops, are used for dry cleaning or for sweeping. Three types of dust or dry mops are found in the various school buildings. The first is the short string mop with strings 4″ to 6″ in length attached to a mop head. In some cases these mops are made in the form of a pull-on or mitten type which may be slipped over a head of heavy wire or wood. These mops are composed of short strings attached to or through a heavy canvas cloth. The mop head used for sweeping or cleaning the rooms with fixed seats is usually not over about 16″ in length. Those used for cleaning large areas may be as much as 36″ to 42″ in length. There is another type known as the dry dust mop with a straight head 18″ to 30″ long and with strings of about 9″ to 12″ in length. These mops are generally used as push mops in cleaning large areas. In using this type the strings may be piled up in front of the mop as it is pushed down the corridor over the floor surface. Another dry mop has strings 12″ to 15″ in length attached to a round head. This long string mop is generally used in a sort of circular motion for picking up dust and light particles of dirt. All the dust mops need to be cleaned frequently, hence should be detachable. These mops should be washed in warm water with a neutral soap preparation. When they are partly dry they may be sprayed with a light application of a suitable polish or wax preparation. The mop is then ready for use and will pick up and retain dirt better than will an untreated mop. Heavy applications of oil should be avoided.

Wet Mops

The wet mops are used for damp cleaning, particularly on tile, linoleum, and asphalt floors. In certain cases they are also used on wood floors. These mops usually have a string from 15″ to 20″ in length and are rigidly attached to the mop head. There is not complete agreement among janitors relative to the comparative merit of linen and cotton strands for these mops. The cotton strand does seem to pick up and hold dirt more readily than the linen. There is some tendency for the cotton strand to ravel and to catch on projections more than does the linen strand, and the linen strand usually wears better. Wet mops should be washed out frequently. It is a waste of time to attempt to clean a floor with a dirty mop. These mops are not scrub mops and should not be used as such. The mops of unbleached material are cheaper and more durable. The loosely twisted (4 to 8 ply) mops do not wear as long as the denser twists but are more absorbent. For the skilled janitor a 24 to 32 ounce mop is desirable. For less skilled moppers, a 16 to 24 ounce head is satisfactory. Full length strands with several rows of head stitching are best. All mops or dusters should be washed in clean warm water using a neutral soap.

Dusters

The old feather duster gave way to the dust cloth which has in turn been generally superseded by the string-mop duster. The use of old rags for dusting is generally objectionable. In many cases the rags have heavy seams and sometimes buttons and catches which may mar surfaces to be dusted. Although some janitors do use cheesecloth, experience seems to indicate that the string-mop dusters do the work as efficiently and more rapidly.

The string-mop duster is usually composed of cotton strands, 2″ to 4″ in length, attached to the canvas back which is made into the form of a mitten to be used on the hand or as a slip-on head to be pulled over a wire form fitted into a handle. The most desirable length for the duster head seems to be 8″ to 12″ of dusting surface. The longer head seems cumbersome. The shorter heads do not cover enough area. For most janitors the handle should be approximately 10″ to 14″ in length. Special dusters are made with forked heads to be used on chair rounds or Venetian blinds. Several dusting heads should be provided so that a fresh supply will be on hand while others are drying. When these dusters become soiled they should be washed with a warm water and neutral soap solution and then dried. They may be treated with a light application of furniture polish after washing. Special duster head mops of the floor mop type may be used for dusting walls. The handle of the duster may be reversed so that it may be used to remove the dust from the tops of the ledges, picture moldings, and railings above the normal reach of the janitor.

Pans and Pails

In building maintenance and in cleaning operations, the janitor should have an ample supply of pans and pails.

Dust Pan

It is desirable to have a dust pan about 16″ wide to pick up dust and dirt while cleaning the building. These may be obtained with either a short or a long handle. The short handled one is less expensive and less cumbersome than the one with the long handle. The dust pan with a hump to hold back the dirt has not been favored by many janitors. If the long handled dust pan is used, it should be weighted or balanced so that the dirt collects at the back end when the pan is lifted.

Pick-up Pan

The janitor also needs a pick-up pan for water. These are usually made with a hump so that the water may be shoved into the pan by the use of the squeegee. It is necessary that the lip extending to the floor be on the long side of the pan to permit use of a long squeegee. The pans of heavy galvanized materials do not rust out as quickly as do the lighter weight pans.

Pails and Wringers

It is desirable that the janitor have a tight pail of large dimensions or a fiber board case for the collection of waste paper. This should be tight enough that it will also hold dust. It should be equipped with a bail or strap for ease in carrying. The janitor should have several ten or twelve quart pails for the transfer of water and other liquids. He will also need one or two mop pails of sixteen to twenty quart capacity. He should have a mop wringer which may or may not be attached to the pail. Some wringers are equipped with cranks, but most janitors prefer wringers that press the water out of the mop. The press wringer may be either a foot pedal or a hand lever type. In either case, the wringer side should be perforated so that water pressed out of the wringer may fall back into the pail. If the hand lever wringer or press is used, it may be desirable to have a pedal on the mop pail that the janitor may steady the pail with his foot. In many cases it is found desirable to have the pail on casters so that it may be moved while mopping without leaving marks on the floor. A heavy screen or a grill should be provided for the bottom of the mop pail in order that the sediment settling to the bottom of the pail will not be picked up by the mop each time it is dipped. Some janitors like to use a mop pail truck. This has some advantages in ease of moving but presents difficulties in transferring from floor to floor unless the building has elevators. The janitor will also need one-half pint, pint, quart, and gallon measures.

Scrubbing Machine

While the scrubbing machine will not eliminate wet mopping in daily floor cleaning, it is a valuable tool for use in removing heavy accumulations of floor dirt.

There are various types and makes of scrubbing machines on the market. Prices vary and the scrubbing machine purchased should be the one best adapted to the task to be done.

Miscellaneous Cleaning Tools

It is essential that the janitor have available a number of towels for use in cleaning. He should also have a lambs-wool applicator for use in applying wax. This may consist of one head with several pads. The janitor will also need a number of chamois skins for the various cleaning jobs. The good chamois absorbs water readily and does not harden when dried. The best chamois skins are imported. Some of the cheaper native skins may feel clammy when wrung out. After use, chamois skins should be rinsed and then dried slowly. These skins are not scrub cloths but are to be used for drying and polishing smooth washed surfaces.

Toilet Tools

It is essential that the janitor have available a plunger, known as "the plumber's friend," for aid in freeing the passage of choked stools. It is also desirable that he have a flexible worm or snake equipped with a handle for use in opening closed stools and drains.

Pocket Tool Kit

No janitor should feel fully equipped for work who does not have a pocket kit containing one small putty knife, one small screw driver, and a pair of small pliers. These can be carried easily if put into a pocket case which may be attached to the belt or carried in a pocket. These tools are invaluable in making minor repairs, removing gum from the floor, and repairing seats as the janitor works about the building.

Yard Tools

The importance of yard maintenance to the appearance of the school and to the public and pupil appreciation makes it essential that the janitor be provided with the necessary tools for maintaining the premises in a suitable manner. He will need a common rake that may be used around flower beds. If there are many trees on or near the yard he will need a heavy leaf rake that can be used to collect leaves. He should have one or two hoes for use in cultivating shrubs and flower beds; a spade, shovels, sprinkler, and an ample length of water hose. Probably the water hose should be arranged on a reel and should be accompanied by a sprinkler head. The janitor should be provided with hedge shears, a hand ax, and the necessary tools for maintaining the lawns. A lawn mower is indispensable. If the area to be mowed is large, this lawn mower should be a power driven machine. A step ladder for use in and out of the building is essential, and for roof and gutter cleaning a long extension ladder will be needed.

Window Jack

The janitor will also find it necessary to have the tools needed for window cleaning. For this purpose, he will need a window jack that may be attached to the various windows in the building. This jack should be one which is secure so that when he risks himself on it he may be assured that it will not give way. A home-made jack may be made from assorted lengths of 2 x 4's with 1 x 6's for the platform. It is also desirable that the janitor have a suitable belt and strap for window washing. The window strap is of more value if adequate loops or hooks are fastened to the walls at each side of the window so that the straps may be snapped into these loops. The window belt should consist of a heavy body belt with straps running from this belt to the wall loops. This should be reinforced with a second set of ropes or straps which will catch the body in case one of the first straps gives way. This belt and strap should support a weight of 800 to 1000 pounds.

There are many pieces of equipment which are so vital to the cleaning program that the janitor often thinks of them as cleaning tools. Some equipment items that play an important part in cleaning are the foot scrapers and the door mats. Foot scrapers are of many types. The common bar type attached to the edge of the sidewalk may present a hazard to pupils who play in this area. This hazard can be in part removed by placing a gas pipe shield two or three feet above the foot scraper. Some janitors make the scrapers portable by attaching to a small frame platform. Another plan is to install scrapers along the walk but parallel to and near the building. All foot scrapers should be far enough off the ground to permit the dirt to collect below the scraper. It is often desirable to provide a brush rack where the pupils may complete the shoe cleaning process. The janitor can make these brush racks by attaching stiff fiber brushes to a rack. One of these brushes should be placed at the bottom of the rack with the fibers up. Two other brushes may be attached to the side of the rack with the fibers pointing toward the center. The door mats are usually placed near the entrance. There are about three types of door mats in common use. Many janitors place a steel mesh mat outside the entrance doors. If the grounds are quite muddy they place a cut rubber mat just inside the door. A fiber mat may then be placed in the entrance or corridor. The use of several mats may aid in eliminating much of the dirt and grit that might be carried into the classrooms.

Tool Selection, Purchase and Care

The janitor should make a study of the tasks he must perform and of the tools best adapted for his work. He should become acquainted with new tools that are being developed by other janitors and by the various supply houses. While he may not have authority to order his own tools, he should be able to recommend and to back with suitable proof his recommendations for tools of a certain type and quality.

After tools are purchased proper attention should be given to their care. Some tools need to be conditioned or broken in before being put into regular use. Mops, brushes, dust pans, and other tools should not be left in corridors, alcoves, or corners open to public view. Mops and brushes should be stored in suitable racks or hung on hangers designed for that purpose. Pails and pans should be stored where they will be out of the way yet accessible when needed. Bench tools should be stored in cases or racks near the work bench. Each tool should be so maintained that it is ready for use when taken from its case or place of storage. It is difficult to keep tools in good condition if used by various unskilled workers. For this reason, it has been found desirable to keep a separate set of tools to be used by teachers and pupils in occasional project activities.

Cleaning Supplies

Modern building maintenance requires many types of supplies for cleaning and general use in the building. In the cleaning of a building, the chief cleaning agent is water. In some cases water is the carrier for the cleansing agent, but in nearly all cases water is the chief cleaning agent. Dirty water is of little value in cleaning and the water should be changed frequently so that only clean water will be used.

Abrasives

For many years, people have realized that certain abrasive substances may be used to remove dirt. Some of the abrasives used today are tripoli, talc, chalk, and coarser abrasives such as fine sand. Some of these abrasives are combined with soap in order to reduce their cutting effect. The janitor should be careful to use a type of abrasive that is fine enough not to mar the surface to be cleaned. Most of the floor scouring powders contain abrasives. These are generally more effective when applied to damp surfaces in powder form than when suspended in water.

Bowl Scouring Powder

There are a number of bowl scouring powders which are used in school buildings. In general, these have a slight amount of abrasive action with some cleaning or soap action. Tripoli with tri-sodium phosphate (commonly known as T.S.P.) is often used as a basis for these powders. In some cases a small amount of muriatic acid is added, particularly for use in toilet bowls. This powder is usually not coarse enough to scar the surface of the fixtures. Powder used on toilet bowls, lavatories, or fountains, should contain no iron.

Floor Scouring Powder

The term scouring powders refers to those used on bowls and floors. Scouring powders are often used on dirty or greasy floors. Most scouring powders have an abrasive in the form of tripoli, volcanic ash, or lava. Some abrasives have bone meal in them, but bone meal tends to dissolve and become gummy on the floor. Most good floor scouring powders do not have much alkali but consist primarily of abrasive materials with a small amount of soap to give a smooth action effect and to reduce the sharp cutting of the abrasive.

Steel Wool

Steel wool as an abrasive material has gained in popularity with janitors during recent years. It is used for buffing floors and for the purpose of removing accumulations of grease and even patches of varnish. Steel wool with a rather coarse texture is used on the floor to smooth the rough surface and after the surface becomes smoother, a finer texture is used. The steel wool may be used as a hand tool, in pads on brushes, or on rotating drums.

Whiting with Oxalic Acid

One abrasive that is used by a number of janitors is a combination of whiting with oxalic acid. If one is careful where this is used and if it is rinsed off afterwards, it makes a rather satisfactory abrasive. Another abrasive used by many janitors is a combination of whiting and T.S.P. In this mixture the T.S.P.

may act as a chemical in dissolving some of the oils on dirty surfaces.

A janitor can test the coarseness of an abrasive and determine the possible effect in scratching the finish by grinding some of the powder between two pieces of glass.

Soap

Soap is one of the cleaning agents most often found in school buildings. Soap is generally made from caustics such as caustic potash or caustic soda (lye) in combination with fats or oils. Soaps are of two types, according to composition. These are known as alkaline soaps and neutral soaps. The alkaline soaps contain more "builder" than the neutral soaps. The builder is usually some material like tri-sodium phosphate or some similar substance. The alkaline soaps are more harsh in effect than the neutral soaps. The heavier alkaline soaps usually have from seven to eleven per cent builder. The neutral soaps usually contain about one per cent builder.

The janitor may use soap chips or dry soap mixed with water to make up the soap for use. The liquid soap may contain seventy to seventy-five per cent water. If he desires a soap with an alkaline content, he should add some builder like tri-sodium phosphate. Some of the milder soaps are used as cleaners and some of them are used for toilet purposes. There has been much contention relative to the comparative merit of liquid and powdered soap for cleaning purposes. It is true that soap action is effective only when water is present, but it is not difficult for the janitor to add the water. Powdered or chip soaps are usually cheaper than liquid soaps. Pleasing aromas and brilliant colors may make the soaps more attractive but add nothing to their cleaning qualities.

For toilet purposes it is desirable to have a mild soap, free from caustics. However, there seems to be little reason to pay high prices for highly scented soaps. It is estimated that the germicidal effect of the so-called chemical soap is slight. Most toilet soaps are made with a coconut or olive oil base. This is usually purchased in a forty per cent base and reduced to about ten per cent by dilution. In using this soap it is desirable to see that the dispensers are kept clean and that the holes are open so that action may be free. There are many other soaps used for heavier cleaning. Some of these will be discussed as special cleaners under the section on floor scrubbing. A majority of these heavy duty cleaners are made up of soap and an alkaline substance like T.S.P. with or without an abrasive, depending on the anticipated use. There seems to be no one best soap for all uses. The many types of surfaces make it desirable to use several types of soap. For heavy cleaning where oils and dirt accumulations require a strong cleaner, an alkaline soap may be used on surfaces not affected by the alkalies. On most fabrics and finishes found in school buildings, it is advisable to use only neutral soaps.

However, a majority of the cleaning compounds have some soap content. The janitor should understand that the detergent value of the soap depends to a great extent upon its saponification. In other words, if the soap does not make the water "slick" it is of little value as a cleaner. After the soap makes the water slick, the soapy water tends to form a film around the dirt particles so that they may be more easily floated off in the cleaning process. Soap that is slow to dissolve in the water forms this film slowly. The water may be so hard that it takes a lot of soap to get results. In many cases this saponification can be speeded up and more economical results obtained by the addition of some substance which will break down the hardness, thus making it possible to obtain the results desired. Failure to soften the water means the use of more of the costly soap materials.

Drain Pipe Cleaner

There are a number of drain pipe cleaners on the market. Most of these are composed of lye or sodium hydroxide with zinc or some other metal to speed the action. If the drain pipe is only slightly choked and if this material does reach an opening, it is valuable in removing grease and other things that often choke drain lines. However, if the pipe is sufficiently choked that the material does not go on through, it may unite with the grease in the pipe and form a jelly-like soap which may be more difficult to remove than the original obstruction. For this reason, many janitors prefer to use a pump or worm to remove obstacles in drain pipes. Some janitors have all of their drain lines equipped with plugs or a "T" at each bend so that they may get at them more easily for cleaning purposes.

Acids

School janitors should beware of the use of strong acids. Practically all of the acids will affect any material containing lime or calcium and are particularly hard on marble finish or on limestone which is used in concrete. They may also affect iron and may burn wood. The janitor can usually detect the acid by its sour taste. However, it is not advised that he attempt to test the stronger acids in this manner. There are three principal acids used in school building cleaning.

Muriatic

Muriatic acid (which is commercial hydrochloric acid) is much used to clean mortar off brick. It is also used in toilet bowls to remove rust and iron stains. It acts as a corrosive and should be diluted before being used. This acid is often used as a basis for various commercial bowl cleaners. An acid or cleaner of this type is not needed if the bowl is already clean. This acid should not be used on enameled iron or on other surfaces where the effect may be harmful. When it is used, the surface should be rinsed thoroughly to remove all the acid. Adding one spoonful of formaldehyde to dilute muriatic solution may reduce its effect on iron.

Sulphuric Acid

This acid is not often used in school building cleaning. It has an effect similar to that of muriatic acid.

Oxalic Acid

This is a milder form of acid than the muriatic. It is often used to remove ink stains from the floors and may be used to remove a number of other stains. This acid deteriorates when kept in an open container so many schools purchase the acid in a crystal form. In some instances, this powder form is put on the floor to take out certain discolorations. It seems to have more effect if moistened and scattered lightly on the spots to be removed. The fumes from this acid are harmful and the janitor should be careful not to breathe them. Floors or other surfaces should be rinsed well after the use of oxalic acid. All of these acids are used in chemical laboratories, and if poured in sinks may affect the pipes. If spilled on masonry floors or window stools, they may cause partial disintegration. The janitor should provide earthenware jars for acid wastes in chemical laboratories. These jars should not be emptied into enameled sinks.

Caustic Cleaners

The school janitor should also be careful in the use of any strong caustic solution in cleaning the building. The strong caustic solution may cause a discoloration of the floor and is harmful to the finish. It may discolor wood, leaving it somewhat red in appearance. It will remove varnish and paint. It will discolor certain metal and masonry finishes and may take the sheen off marble. Strong caustic solutions will burn the hands.

Caustic Soda

One of the principal caustics used in school buildings is sodium hydroxide or caustic soda ($NaOH$) commonly known as lye. This is often used as the basis of a drain cleaner. It is also used as a basis for certain soaps. Like most caustics, it has a slippery feeling when wet.

Caustic Potash

Caustic potash (KOH) is also used in soaps. It has an effect much similar to that of sodium hydroxide.

Tri-sodium Phosphate

During recent years, there has been an increase in the use of tri-sodium phosphate (commonly known as T.S.P.), both as a water softener and as a cleaning agent. The T.S.P. is sometimes used alone in water as a cleaner and sometimes in combination with other compounds. It is one of the basic ingredients of several cleaners sold in packages; however, the local school can purchase it in the natural state or powdered form at approximately one-third the cost of most commercial preparations. The T.S.P. is somewhat like sugar in appearance and has a bitter taste. It has a tendency to precipitate and thus to remove sulphates and lime from a water solution. It serves as a water softener and thus assists in reducing the surface tension of the water. It also has a slight tendency to break down greases and certain other organic compounds and thus becomes an active cleaning agent. When the T.S.P. is used in strong solutions, it may be harmful to many surfaces. It may even remove paint. When the T.S.P. is used as a water softener, only enough should be used to give the water a slick feeling. If added to water used in washing glass, it aids in cleaning without giving the slippery effect often obtained when washing with soap.

Ammonia

Ammonia was once used extensively in cleaning. It has a somewhat caustic effect. However, the ammonia fumes were hard on the eyes and for this reason it has been generally discarded in building cleaning. It may cause discoloration of marble.

Sodium Bi-sulphate

Sodium bi-sulphate is still used in some schools to remove iron stains in toilet stools. This is sometimes known as niter cake. This material is not good for use on enameled iron but is satisfactory for vitreous china. As with the other cleaners, this material is not needed in bowl cleaning if the bowls are maintained in a satisfactory condition.

Disinfectants

Much money is spent for disinfectants in school buildings. In many cases disinfectants have been used to smother odors, when it would have been more desirable to remove the cause of odors. The use of disinfectants is not a satisfactory substitute for cleanliness and in many cases the presence of strong odors from disinfectants or deodorants leads one to question the cleaning practices in that particular building. Since cleanliness is the basis of sanitation, the best disinfectant is a combination of soap, water, and labor.

It has been contended that drinking fountains may spread disease from one mouth to another; that toilet stools may contribute to the spread of venereal diseases, and that shower room floors may spread athletes foot. There may be some basis for this contention, but even in these places cleanliness is the best preventive. At one time there was a common practice of spraying disinfectants on walls, floors, and ceilings of classrooms to kill disease germs. This practice is of questionable value in the elimination of the hazards of contagious diseases.[1] It seems more desirable to remove the person carrying the disease germ than to attempt to control the hazard through disinfectants. There are a number of disinfecting agents on the market.

Carbolic Acid

One of the most common disinfectants is carbolic acid, which is made from coal tar. This acid, or its derivatives, forms the basis of many of the disinfectants. In fact, disinfecting standards of various compounds are usually rated on the basis of the phenol coefficient. (Phenol is a strong antiseptic or disinfectant, often called carbolic acid.) The phenol disinfectants have obnoxious odors.

Chlorine

Chlorine is another basic disinfectant. Chlorine is a pungent gas and comes to the school in many forms; one of these forms is known as chloride of lime or bleaching powder. The chlorine disinfectants, like those from the carbolic acid, are contact disinfectants. However, the chlorine disinfectants have an odor that is pleasing to many people.

[1] Adapted, *"Journal of American Medical Research,"* March 28, 1931. Page 1098.

Sodium Hypochlorite

Shower rooms and locker rooms where pupils walk in their bare feet may contribute to the spread of a disease known as "athletes foot." One of the best preventives for this disease is sodium hypochlorite. This may be used in scrub water for these rooms with some effect. Best results seem to be obtained when a solution of water and sodium hypochlorite is placed in a shallow pan where pupils may immerse the feet when leaving the showers. This vat or pan should not be located directly in front of the showers where the solution may be diluted until it has no effect. Sodium hypochlorite deteriorates rapidly and it is necessary to add to that in the pan frequently. A solution of one per cent seems to be effective. If the stock solution of sodium hypochlorite is left open to the air it loses some of its value. There is now on the market a powdered form of sodium hypochlorite which may be mixed with the water in the foot bath to make an effective solution. The powdered form does not deteriorate as rapidly as does the liquid form.

Another chlorine disinfectant is known as javel water which is a combination of chloride of lime and sodium hypochlorite. This is often used to remove fruit stains.

Of the many commercial forms of disinfectants on the market, most are based on one of the two basic disinfectants listed here. Much money could be saved and better results obtained by removing the cause of foul odors and by using a simple disinfectant when one is needed. The use of T.S.P. and certain other mild caustics is an example. These mild caustics will dissolve the fats that may accumulate in and around toilet fixtures. These fats may then be washed off, thus eliminating the cause of many foul odors. The disinfectants listed here should kill disease germs on contact. The older practice of attempting to kill disease germs by scaring them away with obnoxious odors does not seem to have been effective. Fumigants and air sprays are seldom used in modern schools.

Deodorants

The deodorants leave a fragrant odor in the air. They generally have little or no disinfecting value. Some of the deodorants have a pine oil base with an attractive odor added. Others are a combination of formaldehyde and perfume diluted with water. If it is felt desirable that these should be used in school buildings in order to provide a pleasing odor, the janitor can at a small cost prepare a deodorant by using a small amount of formaldehyde, adding some perfume and then diluting. He can also prepare the pine oil deodorant if desired. The pine oil is a good cleansing agent and in that respect has some disinfecting value. Many janitors use a machine containing pine oil and some other preparation to allay toilet fixture odors. Others throw a quantity of deodorant blocks in the toilet stools or urinals to keep down odors. These have little more value than do other deodorants. If the cause of the odor is removed there will be no need for deodorant blocks.

Concrete Floor Hardener

As stated previously, strong acids and strong alkalines are harmful to concrete floors. However, many concrete floors are inclined to dust and some type of surfacing is desirable. Of the effective concrete floor hardeners on the market, sodium silicate is one of the cheapest and most easily applied. This material is also used to some extent for crack filling in terrazzo and cement floors. When purchased for this purpose, it is probably desirable to get the heavier combination with about thirty-five to thirty-six per cent silicate and about thirteen per cent alkali.

This is mixed with water and diluted to the ratio of about one to four.

A second simple concrete floor hardener is known as magnesium silico fluoride crystals. This is applied in two or three coats, making the first coat rather thin and the next coat somewhat thicker. This is usually prepared by using about five pounds of crystals to two gallons of water. It serves as a stock solution and is mixed in the ratio of about one-two with water for the first coating in using as a floor hardener. The U. S. Bureau of Standards, L. C. No. 139, outlines some of these materials in more detail.

Floor Seals

The newer practices of floor maintenance have called for a different type of floor treatment. Hence there has been a growing demand for floor seals. At one time there was an extensive use of linseed oil as a floor seal. This has been used less during recent years, partly because of its tendency to rise to the surface and oxidize. Most of the floor seals today have a china wood oil base (commonly known as tung oil). If this seal is not loaded too heavily with gums of various types it is what is known as a penetrating seal. If it does have a quantity of gums included it may become a surface seal. It may adhere to the floor, but it may build up a surface on top of the floor. Some of the gums used in seals are copal, bakelite, etc.

The bakelite seals usually dry quickly. However, if they contain much bakelite they may be inclined to build up a surface on the wood. In general the requirements for the seals are that they shall not powder. They should be resistive to alkali, they should be fairly rapid in drying, and should not turn white when moistened. The solids in the seal should not settle to the bottom, and the seal should be resistive to heat, shoe burns, and friction. Many manufacturers like to put in about one pound of the bakelite to three pounds of china wood oil. However, the combination should vary for different uses.

Terrazzo Seal

Much difficulty has arisen in attempting to maintain a desirable surface on terrazzo floors. Waxes usually make the floor too slick. Seals may darken the floor and may fail to penetrate sufficiently to give the bond desired and to give the sheen needed. Many terrazzo seals are on the market. Most of them have some value. Many janitors today are obtaining satisfying results by the use of a sodium silicate preparation mopped on the floor. This usually is mixed about one part of sodium silicate to four parts of water. If this wears off, it is easy to apply another coat. This solution will be inexpensive and is easy to apply. A new application may be made when the old seal shows the effects of wear. A seal of this type usually prevents blooming or efflorescence of terrazzo floors.

Floor Wax

Liquid waxes are now used almost exclusively in schools. There are two general types, the spirit solvent and the water emulsion wax. The first needs polishing but the second is often called a self-polishing wax. Most schools prefer to use liquid waxes. They have a liquid carrier and a gum suspended in the liquid. The spirit solvent waxes include benzine or some similar solvent. These waxes usually need buffing. The water emulsion waxes are often called non-buffing waxes.

Dance Floor Preparations

Many good gymnasium floor finishes are spoiled by use for dancing and for other activities where people must be on the floor with various types of shoes. A preparation of borax crystals may be scattered on the floor before use for these purposes. This gives the type of surface usually desired for dancing.

Miscellaneous Preparations

Roach Powder

One base for roach powder is sodium fluoride. This is not costly and is used in many commercial roach powders.

Crack Filler

Equal parts of corn starch and wheat flour mixed with linseed oil and Japan filler may be used.

Varnish Remover

One quart of benzol, plus one ounce of paraffin dissolved. To this, add one quart of denatured alcohol and one quart acetone. This is spread on the floor and sprinkled with scouring powder. When scrubbed with warm water, most of the old varnish is removed. Caustic soda or T.S.P. may also be used to remove paint or varnish. (Do not use on oak.) These may be mixed with starch. Apply hot. Rinse well. Protect hands and clothes.

Paint Remover

Wood alcohol—2 pints
Benzine—2 pints
Paraffin—1 pound

Grease Spot Remover

Mix whiting with carbon tetrachloride, chloroform, kerosene, or turpentine. Make paste, cover the spot, let stand, then wash. This prevents spreading and rings from grease. May be used on fabrics if used before setting.

Ink Spot Remover

To remove ink spots from an unprotected floor after it has been cleaned, add to three gallons of warm water three pounds of oxalic acid crystals and mop entire floor if spots are scattered over the room. Allow solution to remain on the floor until dry. Then rinse with clean warm water.

Cleaning Stone

1 gallon soft soap
1 quart of water
2 pounds of F. F. Powdered pumice stone
1 pint liquid household ammonia

Brush the loose grit and dirt from the surface, apply with a brush. Let stand fifteen or twenty minutes; then scrub with warm water and rinse off.

Cellar Wall Mold Remover

Use one tablespoon of arsenate of lead to one gallon of water for mold on cellar walls.

Gum Solvent

When chewing gum is imbedded in a surface so that it cannot be scraped off, it usually may be dissolved by the use of carbon tetrachloride, gasoline, or naphtha.

Furniture Polish

One of the best furniture polishes is a thin wax solution similar to that used on the floor (water wax). However, the janitor may, if he wishes, make up a polish with an oil base.

No. 1 Paraffin—one part
Kerosene—one part
No. 2 Paraffin oil—three parts
Turpentine—one part
Vinegar—one-half part

Mix oil and turpentine together and add vinegar. If he uses an oil base he will need to rub furniture vigorously to remove all traces of dust catching oil.

Cleaner for Paint

Lukewarm water—one gallon
Tri-sodium phosphate—one teaspoonful
Neutral soap—one-fourth pint
Fine scouring powder—one tablespoon

Stir often and after using this cleaner wash the surface thoroughly with clean water to which has been added a little vinegar.

Whitewashes

1. Soak 5 lbs. casein (glue substance) in two gallons hot water until softened. Dilute three pints ammonia (commercial) with one gallon of water. Add to casein mixture and dissolve. To hydrated lime 50 lbs. (or 38 lbs. quick lime) add six gallons of water. When cold, mix two solutions—stir well. Just before using, mix five pints formaldehyde with three gallons of water and add slowly to first mixture, stirring constantly.

2. Make thick cream 50 lbs. hydrated lime and about seven gallons of water. Mix 3 lbs. glue and two gallons of water. Mix and stir. Thin as needed.

3. Use two parts lime, one part Portland cement, add water to thinness desired.

Metal Polish

Paraffin oil
Fine scouring powder
A little ammonia

Mix to desired thickness, apply with a cloth, let dry and polish.

Floor Sweeping Compound

While there is little demand or need for the use of sweeping compound in modern school buildings, it is still used in some places. If the janitor must use a sweeping compound he can make one much more economically than and equal to those purchased. One is made as follows:

Fine sand—20 to 35% by weight
Sawdust—40 to 50%
Paraffin oil—8 to 15%
Water—6 to 10%

Purchase and Storage of Materials

It is not intended here to recommend that the janitor prepare any or all of the cleaning agents. It has seemed desirable to call attention to the need for a study of the various cleaning agents, their value, methods of purchase, and their use. It is difficult to set up specifications for supplies and equipment. There is still much experimenting and testing needed in this field since the materials are not sufficiently standardized to permit general purchase on specifications. As a result, those in charge of school buildings have resorted to purchasing from known distributors. This practice may be commended, particularly if the purchasers and users know that they are getting materials best suited to their needs at a reasonable cost. It must be remembered that many distributors depend upon commercial salesmen who must sell quantities of material in order to earn their commissions. Some of these salesmen are willing to overload the buyer or to sell materials not needed. Some schools do attempt to buy on specifications but find it difficult to make specifications that designate the material desired without limiting the competition to one bidder. When purchasing, the school officials should expect the distributor to guarantee that the material purchased is on a par with the sample presented, that it meets specifications set up, and that it has behind it the guarantee of a reliable distributor. The purchaser should understand that price alone is no indication of quality or cheapness. Purchase orders should state whether the material is to be delivered f.o.b. the school, the local shipping point, or the factory. They should also state whether containers are included in the price listed. Purchase orders should also state how goods are to be delivered.

When goods are received they should be checked in to the general storeroom by the janitor in charge, unpacked, and the condition of the contents noted. Each item should be checked against the invoice and later against the purchase order. When materials are checked, this list should be added to the storeroom list of stock on hand, showing total gallons or pounds of "X" material available. Materials of like quality should be stored together. Combustible or highly inflammable materials should not be stored in places where they present a fire hazard. Supplies should not be sent from the shipping point directly to a building other than the general storage room, unless they are delivered in full or one-half case with a definite record made of the distribution. In general, it is desirable to have all materials come to the general storeroom and to charge against each building and to the janitor in that building the supplies distributed to that building. In this way, a check may be made of the materials used in each building. If materials are taken from the general storeroom for each building, the storeroom records should be extended to show how the materials are distributed.

The janitor in each building will probably not have the authority to purchase any of the supplies or tools used in his building. He should, however, keep some record of the various materials used. He should be able to inform the purchasing agent of the utility and durability of the supplies and tools used in his building. He should have a record of the date certain floor finishes were applied and value of these finishes.

Chapter 5

Daily Floor Cleaning

PROBABLY NO TASK of the janitor is more important than the daily cleaning of classrooms. One of the principal parts of this daily cleaning is that of floor care. Teachers and pupils alike seem to react quickly and favorably to clean, attractive floors. On the other hand, unattractive floors may mar the appearance of a room even though the walls and ceiling are in a satisfactory condition. There was a time when sweeping, and firing the furnace, constituted the two principal tasks of a school janitor. In many schools the term "sweeping" was even then a misnomer since the amount of dirt carried in made the cleaning procedure almost a shoveling process.

The changes that have come in school plant construction and school plant maintenance have made a great difference in the floor cleaning tasks of the janitor. Surfaced yards have cut down the amount of dirt carried into the building. Treated floors of better materials have made it easier to remove the dirt that has been brought into the building. The development of new cleaning tools and machinery have made easier the cleaning tasks. On the other hand, an awakened consciousness of the necessity for clean floors has made it imperative that the floors be maintained in a satisfactory condition. Teachers, pupils, and janitors need to cooperate in maintaining satisfactory floor conditions. School officials should realize that all floor finish is subject to wear and that it cannot be maintained in a satisfactory condition unless protected from unusual and unnecessary abuse. Muddy yards may yield bushels of dirt to be carried into the rooms by the pupils. It should be the duty of the janitor and the school administrators to provide suitable playground surfaces and adequate and sufficient foot scrapers, brooms and brushes at the door, that all mud may be cleaned from the shoes before pupils come into the room. It should be the duty of the janitor to keep these tools and cleaning appliances in a satisfactory condition. It should be the duty of the teachers to see that no pupil comes into a room until shoes have been properly cleaned. The teacher should instruct the pupils how to aid in floor care by keeping the floor free from scrap paper, chalk, or sharp sand. By the use of suitable door mats, the janitor can also help protect his floors from the harmful effects of sand, dirt, and water that may be carried in on the shoes of the children. Some janitors find it desirable to provide three sets of mats near the entrance. The coarse metal mat in front of the entrance, a cut rubber mat just inside the entrance and a fiber mat in the entryway. Pupils entering will have an opportunity to remove all mud and grit from their shoes before entering the classrooms. The janitor should clean these mats frequently. It is desirable to have more than one fiber mat for each entrance, that one may be drying while another is in use.

The title "daily floor cleaning" is used because some floors may be mopped daily and others will be swept with some type of cleaning broom. The term "sweeping" when used should be interpreted to mean any accepted method of daily floor cleaning.

Tools for Cleaning

The type of tools needed in floor cleaning will depend upon the condition of the floor, the amount of dirt carried in, and the furniture in the room. In a few places, such as the boiler room or on walks, the janitor may need to use the corn broom. In other rooms where much dirt has collected, he may need to use the floor brush. In rooms with treated floors he should be able to use either the long-string or the short-string dust mop. In almost all floor cleaning it will be essential that he have a dust pan and a counter brush. In rooms where radiators are exposed he may need to have a radiator brush. It is anticipated that the janitor will have in his pocket tool kit a putty knife to be used in scraping gum from the floor. In each room there should be a suitable waste paper can. The janitor will need to carry with him some sort of pail or receptacle into which he will put the dirt and sweepings from the floor. In some cases, janitors deposit floor sweepings in the can used to gather waste paper. Most janitors find it better to provide a large container for waste paper and to use a fourteen or sixteen quart pail for the sweepings. It is obvious that the dust receptacle and the room waste paper basket should have solid sides so that shavings from the pencil sharpener, and other small bits of rubbish will not fall through the sides to the floor.

Care of Tools

It is particularly desirable that the janitor know how to care for his cleaning tools. Sweeping brushes should have reversible heads and should be reversed often so that the brushes or fiber will not develop a permanent set in one direction. These brushes should be combed out often with a palmetto or wire brush. When not in use, the brush should be stored in racks erected for that purpose, or should be hung on racks or hooks so that the heads do not touch the floor. Dust mops should be of a type that may be slipped off the head. They should be washed as soon as they become soiled. For this purpose the janitor will need to have several dust mops for each head. The mop can be washed by soaking overnight in a solution of warm water and neutral soap. If the janitor has steam pressure, the mops can be immersed in a small tank of water so connected to the boiler that steam pressure may be used to cause the water to boil. After the mop heads are washed they should be rinsed out in clear warm water and hung up to dry. While the mop is still a little damp it should be given a treatment which will make it better adapted for picking up dirt. Where the mop is used on oiled floors, this treatment may consist of a small amount of high grade oil. For use on treated floors the mop should be treated with the wax or other preparation used on the floor. This may be sprayed on the mop or in some cases it may be applied by pouring some of the solution into a pan, letting it contact the sides and bottom of the pan and then by pouring the solution out of the pan leaving only that film that is on the side and bottom. If the mop is placed in this pan it will absorb some of the treating liquid. The treated mops should then be stored in fireproof containers until ready for use. The janitor should keep a pair of shears to trim off loose and ragged strands from the mop.

Vacuum Cleaning

Until a few years ago there was a tendency to install vacuum cleaning units in all of the larger buildings. Vacuum cleaning systems are of two types. The type that has been generally favored is the central vacuum cleaning system with motor and suction fans located at a convenient point in the basement and connected to each room by suction lines. In these systems the janitor carries into the room fifty to sixty feet of hose with a suction nozzle. He attaches the hose to the suction pipe in the wall and proceeds with his cleaning. Of course, all openings in the suction pipe must be closed tightly except the one in use. A second type of vacuum cleaning system which has been used some during recent years is the portable type. One of the most common portable types of machine is that used in the home for rugs and floors. These are not generally large enough for school cleaning. There is, however, a larger portable machine which has been used satisfactorily. Some of these machines are of considerable size and are not easily moved from floor to floor in buildings that do not have elevators. There are a number of advantages in the use of vacuum cleaners. In the first place, there is no dust to float about the room and since dust is a germ carrier, this is very desirable. They are particularly good on stairs and in corners where it is difficult to reach with a broom. Vacuum cleaning units are also good on rugs, mats, and other materials of this type. The vacuum cleaner will pick up small pieces of paper, and in cleaning large areas like corridors the janitor can clean with a back and forth movement, thus reducing his travel distance. There are, of course, some disadvantages. The hose is cumbersome and difficult to manipulate in rooms with a considerable amount of furniture. The central systems are costly, and if not properly adjusted are subject to a considerable amount of wear.

In the use of vacuum cleaners it is necessary that the janitor have the joints and connections tight. The vacuum nozzle part is usually moved lengthwise of the boards rather than across the boards. During the time when cleaning methods stirred much dirt into the air, vacuum cleaning was so much superior to other methods that many systems were installed. Vacuum cleaning is still preferred by many custodians, but the use of the dust mop which is lighter and more quiet, has made it possible to use other methods without raising an excessive amount of dust.

Sweeping Compound

Up until a few years ago the janitor felt that he could not sweep a floor unless he first put down a quantity of sweeping compound. This compound was usually composed of sawdust, sand, and floor oil. In some cases this sweeping compound cost a considerable sum of money each year. Today few janitors use sweeping compound and do not use it at all on rooms that are cleaned with the dust mop. A sweeping compound which contains oil should not be used on linoleum or asphalt tile floors or on wood floors having a waxed surface. The sweeping compound may spot these floors. Sweeping compound is probably not needed on floors having an oiled finish. On untreated floor surfaces the sweeping compound may have some merit.

Frequency of Cleaning

The frequency of sweeping will depend almost entirely on the location of the building and the use of the floor. Most janitors find it necessary to sweep or clean classroom floors each day, although in instances where much mud is brought into the building it may be necessary to clean floors more often than once a day. Corridor floors may need to be swept two or three times a day. Offices are usually cleaned daily. The frequency of cleaning the auditorium and gymnasium floors depends on their use. If the auditorium is used for daily assembly purposes it may be necessary to clean it each day, and if used for evening meetings it may be necessary to clean it again before evening usage. However, auditorium units used only occasionally will need to be cleaned just before usage. In general the room should be cleaned as often as necessary to maintain it in a satisfactory condition. Gymnasium floors used regularly should be cleaned each day.

Time of Cleaning

A few years ago the janitor was not permitted to enter the classroom to sweep the floor until all of the teachers had gone home. This often created difficulties, particularly in those buildings or rooms where teachers wished to remain in the room until five or six o'clock. In these cases, the janitor often had to work long hours in order that the cleaning might be done before he left the building. However, during that time the methods of sweeping raised so much dust that the teacher could not easily stay in the room while it was being cleaned. The amount of dust raised made it almost impossible to sweep the room in the morning before pupils arrived and to have the dust settled sufficiently to be removed by dusting. With present methods of cleaning with a dust mop many janitors clean the room while the teacher is still in the room after the pupils have gone, without creating any dust or annoying the teacher.

In other schools, the schedule is so arranged that the janitor can clean several rooms at some time during the day when these rooms are not in use for classes. In many buildings the janitor cleans all of the classrooms during school hours, and in these buildings he may be ready to complete his work within thirty to sixty minutes after the close of the last class period. Experience indicates that this does not make for poorer cleaning and it does relieve the janitor of the long hours of daily service. It should be understood by the janitor that the classrooms are erected for the purpose of providing school facilities for the pupils. On the other hand, it should be understood by the teachers and administrators that when the schedule of classes permits, the janitor should be allowed to clean vacant rooms at a designated time. The janitor should expect to start the day with a clean corridor floor. Then if the corridors become dirty he should expect to clean them again during the day, preferably during class periods, when he will interfere least with the pupil traffic.

In general it is possible to clean the auditorium unit sometime during the day when it is not used for pupil activities. The exact time for each particular auditorium unit will depend upon the schedule of usage. In many cases it is not possible to clean a gymnasium in the evening because of practice classes in gymnasium activities. If the janitor does not find a vacant period during the day when he can clean the gymnasium he may find it necessary to clean this unit each morning. In many cases, offices are in use until the time the janitor wishes to leave the building in the evening. In these cases it probably will be necessary to clean the office unit in the morning before the teachers and principals arrive. The janitor can clean the toilet rooms and dressing rooms for boys at any time during the day and if a matron is employed she can care for the toilet rooms for the girls in the same manner. If no matron is employed, it may be necessary to leave the cleaning of the toilet and locker rooms for girls until evening.

Methods Vary with Type of Floor

The procedure to be followed in the cleaning of floors will depend somewhat on the type of floor to be cleaned. In general, floors composed of linoleum, asphalt tile, or mastic can be cleaned with a dust mop. Smooth wood floors may be cleaned rapidly with a dust mop if the floor is treated with wax or other suitable material. Smooth wood floors that are covered with a heavy oil may need to be cleaned with a floor brush. Rough wood floors may best be cleaned with a brush. This is particularly true with flat grain pine or other floors that are cupped and splintered. It is also necessary to use a brush on floors that have wide cracks or that are so badly worn that the splinters of wood would catch on the mop. Terrazzo and marble floors may be cleaned with either a brush or a mop. In neither case should a tool having oils on it be used. If these floors are smooth, the mop seems to give the best result; if the floors are rough or pitted, or if they have numerous cracks, it may be necessary to use a brush. On rough concrete floors use a brush for satisfactory results. On smooth concrete floors with a treated surface, use either a brush or mop for satisfactory results.

Methods Vary with Tools Used

There is still a use for a floor brush in many school buildings. Floor brushes are necessary on rough concrete floors, on rough wood floors, or untreated smooth floors. There are two general types of movements practiced in sweeping with the brush. Some janitors attempt to use the brush as they would a push mop, attempting to bear down on the brush or to push it from one end of the room to the other. Brushes are not designed to serve as squeegees or shovels and should not be so used. Brushes work best when used with a stroke of thirty to thirty-six inches (depending on the dirt on the floor). At the end of the stroke the brush should be raised so that the bristles may have a chance to kick out, thus freeing themselves from the dirt on the head. When the brush is brought back to a point near the advanced foot, it should be set down with a sliding motion and should not be dropped on the floor. This practice helps avoid depositing a quantity of dirt off the brush at the place the brush strikes the floor.

In using the brush with the stroke method, janitors find that they secure better results if the handle of the brush is cut off to the proper length. The proper length for each janitor is usually determined by setting the brush head on the floor and marking the point about even with the eyebrows. Then when using the brush the skilled operator places the power hand (which is usually the right hand for right-handed men) on the end or near the end of the brush handle. The other hand serves as a guiding hand and is placed on the handle with the palm down at about an arms length from the power hand. This hand provides the power to pick the brush up and also helps guide the stroke. The janitor permits the handle to slide through the guiding hand as he makes the stroke.

Use of Dust Mops

The type and condition of the floor may be an important factor in the use of dust mops. On treated floors with large open areas the dust mop may be used in one continuous movement; that is, the janitor starts at one end of the floor area and places the mop head on the floor. Then by resting the mop handle against his hand which is in turn supported by his shoulder, he pushes the mop from one end of the floor area to the other where he shakes the dust free from the mop and turns to repeat the process going to the other end of the room or floor. For this type of sweeping, most janitors prefer the long string mop with strings ten to fourteen inches in length. In this case, the mop head is given a flip before being set down so that the strings pile up in front of the mop head. A mop with a head of thirty to thirty-six inches in width is preferred. If the janitor does not have this type of mop head, he may get rather satisfactory results by using two mops. In sweeping with the short string mop some janitors attempt to use the pushing method similar to that used with the heavier long string long head mop. The light string does not have the weight necessary for this type of stroke on dirty floors. Some janitors use the short string mop with a slight circular movement. In using this stroke the strings are supposed to contact and hold the dirt. Where there is not much dirt and with a properly treated mop this stroke is quite effective. If there is much dirt on the floor, or if the mop is not treated, this stroke serves principally to move the dirt from one place to another. Many janitors use the short string mop with a straight stroke method similar to that used with the brush. In using this stroke the janitor must be particularly careful not to drop dirt on the floor at the beginning of the stroke. It requires some practice before the janitor learns to obtain the best results for each floor with the short string mop.

In using the long string mop with the round head a swing motion is used. This movement should cause the mop strands to contact the dust on the floor. Some skill is required if the janitor is to reach all corners and around all furniture. The motion should be regular and should not flip or twist the mop to throw off the dust. When using this stroke the mop is not shaken until the janitor reaches the end of the room.

Usually the corn broom is not used except in the furnace room, on walks, or other areas that may be very dirty. Even on these surfaces the broom should be used in such a manner that little dust is thrown into the air. The corn broom gives best results when the ends of the straws are in direct contact with the surface to be cleaned. An excessively long stroke reduces the efficiency of the broom.

Methods Vary with Room Use and Equipment

Sweeping methods vary with the type of floors and also with the usage of the room. If all floor areas were free from furniture and other obstacles, sweeping would be a comparatively easy task. However, furniture is essential in schoolrooms and the janitor must adapt his method to the type of furniture and equipment found in the room. There are many types of equipment used in school rooms. Some rooms are equipped with desks having four legs each and accompanied by chairs or seats having four legs each. Other rooms are equipped with a combined desk and seat having four legs attached to the floor. Still other rooms are equipped with combined pedestal desks and seats. These make for ease in sweeping but experience indicates that they are not popular with pupils and teachers. Still other rooms are equipped with pedestal desks and pedestal seats. Some of the rooms for primary pupils are equipped with low seats which make it difficult for the janitor to get the sweeping tools under the seats. Some classroom and many library units are equipped with tables and chairs which must be moved when the janitor sweeps the room. Still other rooms are equipped with movable tablet arm seats so arranged that there is only one aisle from the back to the front of the room. Each of these call for a different procedure in cleaning the floors.

Classrooms with Fixed Seats

Through practice many janitors have developed a regular method of procedure in sweeping classrooms with fixed seats. With the single pedestal seat the janitor can sweep the room almost like an open area. However, most rooms are equipped with the combined seat and desks having four legs. Tests and experience seem to indicate that the janitor will save time in cleaning these rooms if, on entering the room he carries his pail and tools to the front inside corner of the room. He then proceeds to wipe out the chalk tray and to use his counter brush to rake paper or waste from under the radiator and the radiator brush to remove dust from the radiator. He then picks up the sweeping tool, either the brush or mop, carrying it in a perpendicular position with the head down and the strings or bristles away from his leg. The sweeping tool is carried in his right hand and with his left hand he raises the seats as he goes down the outside aisle to the back of the room. He then sweeps to the rear of the seats, pushing the dirt down the aisle and under the seats. He proceeds down the outside aisle, sweeping the aisle and under the row of seats to his right, pushing the dirt under the seats as far as his sweeping tool will reach conveniently. As the brush or mop is brought out from under the seat he sweeps the dirt in the aisle ahead of him. When he reaches the front of the room, the dirt is swept across the front of the room towards the dust pail. He then picks up the mop or broom and proceeds in the same manner down the next aisle, raising the seats as he goes. This procedure is repeated until all of the dirt is gathered at the front inside corner of the room. He then proceeds to pick it up, using the sweeping tool and the dust pan. All dirt should have been removed from around the seat legs and the corners. Pencils and books should have been picked up before starting the sweeping process. He gathers his tools and proceeds to the next room. Note that this process or procedure does not take care of the waste paper in the room but most janitors can handle the waste paper more readily if they bring to the corridor a basket or box big enough to handle the waste paper from each room, and gather the waste paper before they start sweeping. The procedures outlined here are for men who are right handed and who use their right hand to give power to the sweeping movement. Men who are left handed will start at the other side of the room and will reverse the process, winding up in the front outside corner of the room.

The process outlined here will be applicable to untreated floors or to treated floors of either wood, linoleum, or asphalt having fixed seats. In some instances, schoolrooms have fixed seats on runners or strips of wood. In these cases the use of the long string mop may not prove practical. However, the short string mop or the brush may be used with ease. The procedure will vary somewhat for classrooms with different types of seats but in general the process outlined here will be found usable.

Classrooms with Loose Seats

There are a number of different types of loose seats. One type of loose seating is that which has the seat and desk built into one unit and connected by a gas pipe or rod near the floor line. These present some difficulty since the janitor's sweeping tool will not pass under this connecting bar or rod. This may make it necessary to move these seats when cleaning in the room. A second type of loose seating is that which has a chair and desk combined with book rack or drawer under the seat. These seats have little open area between the book rack and the floor and it becomes necessary to move the seats when cleaning the room. A third type of loose seating is that known as the tablet arm chair. These are usually located close together so that the janitor cannot sweep between them. Hence these too must be moved.

One of the first precautions of the janitor caring for the rooms with loose seats is to see that all seats are equipped with gliders or other appliance that makes it possible to move them over the floor easily without scratching or marring the floor. Janitors differ as to the best method of moving the various types of movable seating. Some janitors like to proceed as with fixed seats, leaving their tools at the front of the room, cleaning the chalk rail and the radiators and then sweeping the outside aisle, moving the first row of chairs over in this aisle, thus making another aisle or row to be cleaned. Other janitors prefer to get behind a row of seats and to push all seats toward the front of the room, thus making it possible to clean a considerable area of the floor at the back of the room before the chairs are moved back. This method is somewhat difficult because of the fact that chairs are not always in straight rows or because the tablet arm or desk part may extend out sufficiently in front of the chair seat to cause the chairs to get out of line. Probably the most efficient method is that where the janitor pushes the back row of seats up to the next row and then proceeds to sweep the side and back aisle, after which he moves back one or two rows of chairs into the swept area. He then proceeds in a like manner with the next chairs and the area under them. Either of these procedures involves moving the chairs at least twice. However, the moving of only one row of chairs at a time seems to cause less scratching and marring of the finish on the chairs. It has one distinct advantage in that the chairs may be moved with the floor boards more easily than across the cracks. In moving the chairs the janitor may find it desirable to give the chair a slight bump on the floor to remove the dirt that might be around the legs of the chairs, before moving it back into the cleaned area. After the whole room is swept, the janitor proceeds to pick up the dirt as in the process described for rooms with fixed seats, and passes on to the next room. Many janitors have developed methods of sweeping rooms so that they can clean an average classroom in a satisfactory manner in from four to six minutes.

Classrooms with Tables and Chairs

These rooms present several problems in floor cleaning. As a rule, the janitor cannot sweep under the chairs. Hence, the chairs must be moved. A few janitors practice pulling out one chair from the table and placing this chair in the aisle and then sweeping the area where this chair originally sat. They then move the next chair into this place and proceed in that manner on around the table, placing the chair first moved into the place vacated by the last chair. This method makes it necessary for the janitor to move one chair at a time, and if he uses his hands to pick up the chair, he finds it necessary to remove his hands from the brush or mop handle. If he tries to shove the chair over by the use of the mop he may scar the chair or leave a streak of dirt on the chair from the mop. It also has the objectionable feature that a part of the dirt is pulled out from under the table and chair while a part of it is pushed through. Experience seems to indicate that the dirt can be pulled with the mop but that the brush works better when pushed.

A second procedure is to set all chairs on top the tables, sweep the room, and then to come back and place the chairs in the proper position. This procedure has merit provided the tables are free from obstructions and provided the chair legs are clean and smooth and do not leave dirt or scratched places on the table. This method permits the janitor to complete his sweeping at one time and to handle the chairs at one time. Where this method is not practical, a number of janitors practice pulling out the chairs from the table, sweeping the dirt from under the table, and then replacing the chairs. This method is practical if the tables are far enough apart that the chairs can be moved about with ease. Throughout all of the rooms where loose furniture is used, the janitor should be very careful not to bump chairs against plastered walls or against tables. In all sweeping he should be careful to avoid bumping the brush or mop against the baseboard or the furniture. It will be easier to do this if he uses mops or brushes of the proper size for that particular room. It seems obvious that a primary room having the chair or desk legs only seventeen or eighteen inches apart cannot be swept with an eighteen inch mop head without bumping against the furniture. For these rooms, a fourteen or sixteen inch mop or brush head should be used. For larger equipment it may be possible to use either a sixteen or eighteen inch head.

Cleaning Floors in Special Rooms

The janitor faces many problems in cleaning special rooms. Shop units often have an accumulation of metal shavings, bits of metal, and perhaps of oily drippings from drills and machinery. Usually the shop instructor will teach the pupils to remove the metal pieces so that the janitor may sweep the room. In some cases, the instructor has the pupils clean the room each evening. In these rooms the janitor usually finds that he must keep a special brush or broom that is not used in other parts of the building. Methods of sweeping will depend almost entirely on the arrangement of the equipment and the type of floor. A similar condition exists in the woodworking rooms. In each of these rooms the janitor should be careful to watch for any condition that creates a fire hazard or that might become a hazard to the health of the pupils. Some of these hazards will be discussed in Chapter 8. One hazard that he should watch in his cleaning is that of greasy spots or slippery places near power machines.

In Home Economics units teachers usually instruct the pupils on methods of cleaning and in most cases the janitor does not have the task of daily sweeping. He does have the occasional task of mopping the rooms. If he is required to sweep these rooms he should use the dust mop if floor conditions will permit. Living room units having a mat or rug floor covering should be swept as are the office units. Kindergarten rooms and those used for primary pupils, where the teacher follows the practice of permitting the pupils to play on the floor or to lie down on the floor on mats, should never have sweeping compound or oils placed on the floor. If possible, these rooms should be cleaned only with the dust mop. If there is an excessive amount of dirt it will be desirable first to sweep the rooms and then to go over them with the dust mop to leave a surface suitable for use by the small children. Offices are often equipped with rugs or carpet floor coverings. In many cases the janitor has spoiled the finish of these coverings by the use of a brush containing some of the floor oils or wax picked up in other rooms, or by the use of brooms which pull the nap out of the rug. Rugs and carpets should be swept with a carpet sweeper or vacuum sweeper adapted to rug cleaning. If a part of the floor is not covered with rugs this can be cleaned with the dust mop. The janitor should be careful to raise the edges of the rug frequently that he may clean around and under the borders. While it is necessary for the whole school to be cleaned, he should remember that this is one place where visitors are to be received, and should attempt to maintain it in a satisfactory condition.

Corridors

As stated previously, corridors should be swept as frequently as needed. Most janitors find it desirable to sweep the corridor sometime before noon and then again sometime during the afternoon. Where the corridor has smooth floors either of asphalt tile, linoleum, terrazzo, or concrete it can be swept with the long string dust mop in a very short time. If the corridor floor is rough or if there is an excessive amount of dirt it may be necessary to sweep it with a brush. In either case, the dust mop or brush with a thirty to thirty-six inch head saves time for the janitor and secures satisfactory results. The brush should be used in a stroke method. The janitor usually finds it desirable to sweep lengthwise of the corridor when using a brush, covering the whole width as he proceeds. When he is using the push method with the long string mop he proceeds from one end of the corridor to the other, moving the dirt down the corridor as he proceeds. If the amount of dirt becomes too heavy he may use the dust pan and pail to pick up part of it before reaching the end of the corridor. Since the corridors are usually swept during the day, he should be particularly careful not to create an excessive amount of noise and not to have the tools in the corridor during a change of pupil location between class periods. Corridors or entry ways may be swept with the brush before the mop is used.

Before starting to sweep the corridors he should clean out dirt from behind and under radiators and under bookcases or other places where dirt might collect. In sweeping the corridor with a brush using the stroke method he should avoid attempting to take excessively long strokes and setting the brush down in such a manner that he will leave a streak of dirt showing at the beginning and ending of each stroke. He should avoid the practice of knocking the end of the brush head on the floor to free it from dust.

Stairways

Probably no sweeping task of the janitor is more poorly done than that of stair cleaning. Janitors do not agree as to the best method of sweeping stairs. Many janitors make more noise in stair sweeping than in cleaning all of the rest of the building. Some janitors sweep stairs with a counter brush, sweeping from one side to the other and pulling the dirt from one stair down to the next step. This procedure causes the janitor to bend over in a rather tiresome position and usually calls for the use of a counter brush which is not well designed for moving a quantity of dirt. Some janitors clean the stairs with either a brush or mop while standing below the stair to be cleaned and pull the dirt down towards them. Other janitors stand above the stair to be cleaned and push the dirt below them. While standing below the stair to be cleaned does cause the brush to be used with a pulling motion, it places the janitor in a better position to see the area to be swept. It also puts him in a position to see whether or not any dirt is being left on the stair. The practice of standing above the stair to be cleaned makes it difficult for the janitor to see the area to be cleaned and also causes him to work on a level below his feet. From experience it seems that the most economical work is done by those janitors using a floor dust mop or brush and who clean the stair above where they stand, pulling the dirt from one side of the stair to the other and then pulling the dirt down to the next stair. There seem to be fewer bumping noises made in sweeping the stair and less dirt left on the stair. This procedure becomes somewhat complicated if the janitor finds an open banister on one side or on both sides of the stair. Oftentimes the presence of one banister will cause the janitor to use the sweeping tool in a left-handed manner or a manner opposite to that to which he is accustomed. Where open banisters are found on one side of the stair, the janitor can sweep the dirt across the tread to the other corner but where there are open banisters on both sides of the stairs he will find it necessary to pull the dirt from each end of the stair to the center where it may be pulled down on the next step. In cleaning stairs janitors should be particularly careful to get the dirt out of the corners and to avoid using sweeping compounds or other material that might stain the stairs. The use of sweeping compound may be necessary on certain stairs but not on those stairs that are sealed.

Gymnasium Units

Gymnasium units usually have treated floors with a built-up surface on top of the wood. This surface of hard finish should not be exposed to sweeping compounds or oils of any type. Most gymnasium floors can be swept or cleaned by the use of the long head dust mop. As stated previously, it may be necessary to clean this room each morning. Since gymnasium floors get rather hard usage from the effect of basket ball and other play, those floors which are older and which have loose boards may give rise to an excessive amount of dust coming from the cracks between the boards. If the floor is old and has cracks it may be necessary to sweep with a brush which may aid in cleaning some of the dirt out of these cracks. The highly polished surface of the gymnasium floor makes it essential that the janitor use a method in sweeping that does not leave any streaks of dirt across the floor. For this reason, even if he has used the brush to sweep up the dirt, he may find it desirable to use the dust mop to remove all traces of dirt or dust from the floor. The dust mop used on this floor should not have any treatment that would cause the floor to become slick. Although the janitor will probably mop the dressing rooms and toilet rooms adjacent to the gymnasium or in other parts of the building frequently, he may also find it necessary to sweep these rooms daily. The janitor is indeed fortunate who has the co-operation of his teachers and physical education director in keeping the clothing of the children, waste paper, uniforms and apparatus off the floor so that the floor may be swept with a minimum of effort.

Auditorium Units

In some instances auditorium units are equipped with movable seating. If this movable seating has suitable protection on the bottom of the chair legs to prevent scratching the floor, it may be moved about to permit sweeping the floor, as is done in classrooms with movable seating. The auditorium having fixed seats presents a different problem in sweeping. Many of the auditorium floors slope towards the front which makes it somewhat easier for the janitor in sweeping. In those states that require an open aisle back of the seats and an open aisle between each bank of seats and the wall, the sweeping problem of the janitor is somewhat simpler. As a rule he finds it desirable to sweep back of the back row of seats, sweeping the dust under the seats toward the front. He usually finds it necessary before sweeping the row of fixed seats to put down the seats on the row in front of the one to be swept. This becomes necessary because the back of the seat is farther from the floor when the seat is down ready for use than when the front of the seat is raised to provide passageway. Then carrying the brush in the method outlined under classroom sweeping, he proceeds to turn down the seats and sweep under each row as outlined above. If the aisle between seats is covered with a rug or carpet mat or other loose material he may find it desirable to roll this up before sweeping. If it is not easily removed it may be necessary for him to sweep the aisle separately from the space under the seats. In sweeping the auditorium the janitor should be careful not to raise dust which will settle on curtains, light fixtures and the walls. He should also be careful to avoid bumping the furniture or the seats with his sweeping tools.

Throughout the whole procedure of cleaning school floors it is anticipated that the janitor will carry the ever-faithful putty knife for the removing of gum from the chair backs, floors, and desks. It should also be understood that he must watch for loose seats, broken parts that might cause damage, or projections and splinters that might tear the clothing or hosiery of the children.

When the janitor has completed the cleaning of any floor he should look back over the area cleaned. If his task has been well done all dirt will have been removed from the floor. There will be no visible broom, brush, or mop marks. There will be no dirt in the corners or around the legs of seats or furniture. The floor should be clean enough that it will not soil the clothing of the children. When he leaves the room he will leave no tools or cleaning supplies in the room.

Chapter 6

Other Cleaning Duties

THERE ARE OTHER cleaning duties that must be cared for as the need arises. Toilet and shower rooms, door and window glass, blackboards and erasers must have frequent attention. Dust must be removed from seats and building trim. Room walls and furniture must be dusted.

Care of Toilet, Shower and Locker Rooms

It seems impossible to overestimate the importance of proper care of the toilet and sanitary facilities in a school building. The health of the children may be vitally affected by the lack of sanitary facilities in the toilet rooms. Proper care is important to the appearance of the building, to the morale of the school, and to the habits of the pupils. Many school buildings which are otherwise pleasing in appearance are often unattractive in and around the toilet rooms. Obnoxious odors, marked and unattractive walls, waste paper on the floor, drippings of dirty water and soap in the lavatories indicate a state of general neglect in many of the toilet rooms. It is important that the health of the school child be protected. It is also important that the child be taught, through proper methods and suitable environment, desirable health habits and bodily care. He should be provided a place where he may care for the needs of his body without being forced to enter ill-smelling, unattractive places. The building that has a dirty, odorous toilet room will probably be a dirty building.

Not all the responsibility for the care of the toilet room rests upon the janitor. In many school buildings there is no janitress and the janitor finds it impossible to enter the toilet rooms used by the girls between the hours of eight and five. Some buildings have only women teachers who cannot freely enter the boys' shower and toilet rooms. The responsibility for toilet room care should be shared by the janitor, the teachers, and the principal. The principal of the building should arrange that certain teachers have definite obligations at various hours for supervising toilet room control. Teachers having smaller pupils should instruct them on the use of the toilet room, on methods of flushing the stools, the use of supplies, and toilet room sanitation. Since the janitor is not authorized to punish children for infraction of local regulations there should be some arrangement whereby he may secure the cooperation of the teachers in eliminating toilet room waste and the writing on walls. It may be desirable for the janitor to be in or near the toilet room for boys at times during recess periods. Because of the conditions under which he works, it requires much tact on the part of the janitor to be able to secure pupil cooperation in the care of the toilet rooms.

The janitor should realize that a clean toilet room does not have obnoxious odors. He should understand that most toilet room odors arise from decaying or decayed fats and organic matter. Oftentimes this organic matter has lodged in crevices in stools or has adhered to dirty surfaces in the room or in the fixtures, thus permitting an odor to arise. Smooth impervious toilet room and fixture surfaces that are easily cleaned collect less of this waste than do rough surfaces. If the janitor does not have hard wall plaster or tile on the lower part of the toilet room he should cover the surface with enamel paint. Toilet stalls either of wood or of metal should be covered with a paint or an enamel that prevents the adherence of filth to the surface. Floors and ceilings should have smooth surfaces that are impervious to moisture and odors.

In many cases, the janitor will find it necessary to apply some finish to the floors and walls in order to give the protection desired. A type of fixture should be provided which does not have a rough surface to collect waste matter which may later cause odors. Light, and particularly sunlight, and ventilation are vital to toilet room sanitation. The janitor cannot depend on open window ventilation to provide the air movement needed in his toilet rooms. The toilet room vents should extend directly from the toilet room out through the roof so that odors may not be distributed to other parts of the building. These vents should be kept open.

It should be understood that toilet rooms do not provide the greatest service unless supplies are available. Many supplies, particularly paper towels and soap, are wasted in the toilet rooms. The janitor will probably not have control of the purchase of these supplies, but he does have control of the distribution. He sees the waste that occurs. He also realizes that this waste is generally caused by a few pupils and not by all the pupils. However, if the waste is permitted to continue by a few pupils, others get careless. The janitor cannot afford to deny all pupils the supplies needed in order to punish a few wasteful pupils. He may, in cooperation with the teachers, develop a plan whereby pupils are taught proper use of the supplies. If certain pupils persist in waste, he may then report them to the principal. The type of paper and the type of fixture become important factors in waste. Pupils often use three, four, or five towels when one would do. In many instances, an examination of the towel after it is used indicates that only a small part of the towel has been dampened.

It is apparent that in toilet room control the use of fixtures which permit the rolling off of quantities of paper seems to encourage wastefulness and leads to unattractive toilet rooms. During recent years the inner fold towel and toilet paper dispensers have come on the market. In many cases these dispensers were designed for one particular type of filler, thus obligating the user of the fixtures to purchase paper from one certain house. This type of fixture should not be selected. In general, if roller type fixtures are used they should be of a type that checks, thus preventing the distribution of extensive lengths of paper. Soap dispensers can be regulated so that they do not drip soap on the lavatories. Waste of any type, and dirty toilet rooms seem to bear a close relationship.

No set regulation can be developed for the cleaning of toilet rooms. Toilet rooms used frequently need to be cleaned more often than others. The general regulations are that toilet rooms should be kept clean. If this requires cleaning four or five times a day, they should be cleaned that often. Stools and fixtures should be kept clean. In some areas iron and other minerals in the water cause the fixtures to stain more quickly than in other areas. These stools should be cleaned more often.

Floors, Walls and Woodwork

Floors for the toilet room should be of impervious material. These should be smooth enough that they may be swept with a mop, or flushed with a hose as often as needed. There should be a drain in the floor to permit water to escape. In many cases this drain is through the floor urinals when such are provided. Floors should be swept daily and in most cases they should be mopped each week. The janitor should clean around all corners, around the fixtures that are attached to the floor, and any other place where dirt might lodge. Floor should be mopped with hot water which has been broken down with sufficient T.S.P. to make an efficient cleaning liquid. Some janitors use ammonia in the mop water, but the T.S.P. is generally preferred. It is often desirable to use a disinfectant in the mop water. Accumulations of dirt or waste matter should not be permitted on the toilet room floors. Scrubbing with hot water and a stiff brush may remove from corners and crevices dirt not reached in the mopping process. The janitor should not forget that fresh air is essential to toilet room sanitation. Windows may be left open at various times in order to insure a good supply of fresh air. Toilet stalls should be washed each week and door knobs, handles on fixtures, and other places where pupils may place their hands, should be wiped with a cloth which has been immersed in a disinfecting solution. Writing and marks on stalls and walls should be removed as quickly as possible. It is desirable that the walls be painted (unless the walls are of glazed tile) and that this paint be renewed as needed. There seems to be much more tendency for pupils to mark on dark finish than on an attractive light colored finish. Light fixtures should be kept clean and the whole room should be as attractive as it is possible to make it.

Drinking Fountains

Dirty and stained drinking fountains are unattractive and unsanitary. These should be cleaned frequently. Since acids should not be used on the fountains, rust and other accumulations are usually removed with a cloth and a mild abrasive. Thorough rinsing is essential.

Toilet Sanitation

As has been stated previously, many janitors attempt to cover up foul odors by other odors. The best provision for sanitation in the toilet rooms is cleanliness. Some disinfectants that are put in toilet bowls are oily and tend to cling to the side walls and may in turn collect accumulations of waste which cause odors. Deodorizing blocks and deodorizing crystals often are an indication of an odor that would not need to be covered up if the cause of the odor had been removed. Because of these facts, one of the best disinfectants for toilet rooms is some preparation like tri-sodium phosphate which will help dissolve the fats and make them easy to wash away.

Plumbing Fixtures

The janitor who has a first-class toilet room with suitable walls and adequate ventilation is fortunate. The janitor who has first-class toilet fixtures is also fortunate. The best toilet fixtures are of vitreous china. This china is impervious to most acids and chemicals. Enameled iron fixtures are subject to deterioration, thus exposing the iron to the action of the chemicals and to other materials that pass through the fixture. When the finish in these fixtures becomes rough it is almost impossible to maintain them in a satisfactory condition.

Toilet Stools

Toilet stools should have a large water seal. With the large water seal there is less chance for waste to contact and stick to the sides of the stool before it is washed out. As stated previously, the toilet stool that is of vitreous china may be cleaned with sodium bi-sulphate. A weakened solution of muriatic acid or T.S.P. in water may be used without damage to the stool.

There is a tendency for the stools to collect a coat on the sides and throat of the stool. This coating is the cause of many of the foul odors arising from the stool. This coating should not be permitted to collect and if it has collected it should be removed. Some stools that otherwise appear clean have a coating of dirt up around and under the rim. This should be removed. Some janitors practice using a hand mirror to get a good view of the under side of the rim. Loose stools should be reset in putty. No leakage around the stool should be permitted. The flushing device should be kept in proper order and so adjusted that the stool will flush readily without using an excessive amount of water. Toilet stool cleaning may best be done by two means. One is the use of a scouring powder of pumice, volcanic ash, or tripoli with water. In some instances some of these powders are mixed with T.S.P. or a small amount of soap in order to give a washing effect along with the abrasive action. Only a small amount of powder will be needed. The stool should be well rinsed after washing. A mild solution of muriatic acid or sodium bi-sulphate may be used to remove rust stains from vitreous china stools. As stated previously many of the bowl cleaning compounds have a muriatic base. These should be placed in the stool and permitted to stand long enough to dissolve the stains before washing the stool. On stools of enameled iron a mixture of T.S.P. and whiting or tripoli may be used. The janitor should use a stiff fiber brush that will reach down into the throat of the stool and up around the rim. He should not hesitate to use a cloth and his hands if necessary to clean the stool. Kerosene or heavy oils should not be used in stools. A plumber's friend, a suction pump, or a worm (snake) may be used to remove obstructions from the stool. The janitor should clean toilet seats at least once a week. After cleaning he should wipe them with a cloth on which he has sprinkled a disinfectant. He should remove cores from toilet paper or towel rolls as soon as empty so that pupils will not have an opportunity to throw them into the stools. Receptacles should be provided in the girls' toilet rooms for sanitary napkins and other waste. Teachers should teach the girls not to throw this waste material into the toilet stools.

Urinals

Urinals must be kept clean. Urinals of vitreous china may be cleaned by the process recommended for vitreous china toilet stools. Urinals of enameled iron may be cleaned with hot water and T.S.P. Iron stains and other accumulations may be removed by the use of a mild abrasive. In some instances it may be necessary to remove the strainer at the bottom of the floor urinals in order to clean the traps. Rough concrete or other porous floors near the urinals should be mopped frequently and scrubbed occasionally with hot water to which has been added some T.S.P. and some disinfectant.

The janitor should remember that frequent cleaning of all toilet fixtures will prevent the accumulation of stains and heavy incrustations. Lavatories and sinks should be washed as often as needed to keep them clean.

Cleaning of Glass

Glass is installed in school buildings for three purposes. It is used to admit light to the schoolroom, to protect the contents of certain cases from dust, and at certain places as a decorative feature. To a great extent, it fails in all three of these purposes if not maintained in the proper manner. The janitor in the school building is responsible for the care of the glass in the building. He should realize that dirty windows may shut out fifteen to twenty-five per cent of the light that normally would enter the room through the windows. He should also realize that dirty windows detract from the appearance of the building and that finger marks on glass in doors and cases are indications of poor housekeeping.

Time of Cleaning

The frequency of cleaning will depend to a great extent upon local conditions and use. In certain buildings where outside dust and smoke cause dirt to settle on the windows they may need to be cleaned often. Basement or ground floor windows close enough to the ground to permit dirt to splash upon them may need to be cleaned more frequently than other windows in the building. It is generally considered necessary to wash outside windows three to four times each year. The inside of the windows may need to be washed more often. Many janitors practice washing transom glass and the inside of the window panes monthly or more often if needed. It is often advisable to wash glass in doors and cases each week. The glass in doors and cases may be cleaned by wiping with a moist chamois skin. In areas where sand and dust storms are common it may be difficult to maintain glass in a satisfactory manner. The time of cleaning will depend upon local conditions, the use of the building, and the schedule of work for the janitor. Inside cleaning, if done properly and with the proper tools, may be done at almost any time the room is unoccupied. Outside window cleaning will, as a rule, be done at the time the janitor can be away from his other work in the building for a period of time. Many janitors form the habit of cleaning windows on holidays, during vacations or at the end of certain weeks throughout the year. In some cases, it is found desirable to clean the windows on one side of the building during one week end and those on the other side during the next week end. It is not feasible to attempt to clean the outside of the window panes during extremely cold weather.

Methods

There are many methods used for cleaning glass. There seems to be no one best method for cleaning glass panes of all sizes and in all locations. In cleaning large panes of outside glass, a few janitors use a hose or a brush and squeegee. This method is applicable to large plate glass areas, but is usually somewhat sloppy when applied to window panes. These methods are most easily used when windows are near the ground level. It is not easy to use a long handle squeegee on windows on the second floor. For these windows, many janitors use a cheese cloth for washing and then dry the windows with a hand squeegee. Although this method lets water drop on the sills, it is about as rapid as any method for the larger paned windows and gives satisfying results. The third cleaning method used on outside windows is the use of two cheese cloths, one for washing and one for drying. This process seems slow and the cloth may leave some lint on the windows. The fourth method, and one that is practiced by many janitors, is the use of cheese cloth for washing, with the chamois skin for drying. This method seems to be used by more janitors than any other method for outside glass.

Methods used for washing the glass on the outside of the building may not be practical for inside cleaning. The hose or the wet brush are not practical because of the amount of water that is permitted to run down over the sash and window stools. The two cloths or the cloth and the chamois may be used on the inside with satisfying results. Even the hand squeegee on the inside of the glass seems to permit too much water to be scattered over the trim of the room. Again on the inside the use of two cloths does not seem to be as satisfactory as the use of the cloth and chamois skin. The janitor should remember that the cloth is used for washing and the chamois skin is used for drying and polishing. Many janitors find it possible to do the work more rapidly and also find it necessary to run to the water pail less frequently if they fold the clean cheese cloth in several folds and then wet the cloth in the water. The fold of the cloth is then used to wash the first pane. The chamois skin, which has been wrung out and hung over the shoulder, is used to dry the pane. The cheese cloth is then changed so that another side of the cloth is available and the next pane is washed. The janitor proceeds in this manner until the cloth is too dry to use or until all clean sides have been used.

In all of the glass cleaning it has been found that rotary or circular movements take more time and do not produce as satisfactory results as do the vertical or horizontal strokes. Most janitors prefer to use back and forth (horizontal) strokes commencing at the top of the window making strokes from side to side and washing from the top of the window down. Janitors find it desirable to use a duster to remove the loose dirt from the windows before they attempt to wash. This makes it possible to use the same wash cloth for a longer period without cleaning. It will also leave less dirt to be washed down upon the window sash.

Glass in cases should be dusted frequently and washed as often as necessary. The janitor should watch glass in cases and in doors for fingerprints and grease marks. Washing case glass and door glass will be about the same as that for the inside of the windows, except that the doors will probably need to be washed more often. Transom sash may be cleaned by using the methods and tools recommended for the inside of the window panes.

Cleaning Agents

Many cleaning agents have been used in the cleaning of glass. Kerosene is not used extensively in glass cleaning, for many janitors now feel that the kerosene leaves a film of oil on the glass which will in turn collect more dirt. Some janitors use ammonia in the cleaning water. Ammonia does aid in making the glass clear, but it has a tendency to darken putty when in contact with it and for this reason is not in general use. Many janitors put some alcohol in cleaning water. This seems to give satisfying results and does aid in cleaning the glass. A few janitors still use some sort of powder in cleaning glass. Any cake or powder form of cleaner must first be spread on the glass and then washed or wiped off. Cleaning results with powder do not seem to be superior to the other methods and the amount of work is almost double. In addition, the powder tends to collect around the corners of the panes or to fly off in powder form, which makes other cleaning necessary. It seems to be a waste of time and effort to attempt to put something on the window which must later be taken off. There are a number of patented cleaning liquids on the market, and while these seem to work in a satisfactory manner, they probably are little better than preparations that can be made locally by the janitor. Smoke and soot form a gum that is difficult to remove. Many janitors now prefer to put a tablespoonful of tri-sodium phosphate in the pail of cleaning water before washing the glass. The T.S.P. aids in cutting greases and makes cleaning easier. There is no powder or solution in the water to collect on the window and if the solution is not made too strong, this preparation will not affect the paint or finish of the window sash or window stool. Paint spots on the glass may be removed with a knife or with an old razor blade. If the paint is hard and is difficult to remove, it may be softened with a small amount of turpentine.

In washing windows, the janitor should be careful not to have too much water on the cloths and should not allow water to run down over the sash or drip on surrounding surfaces. He should be careful to clean out all corners and to avoid leaving streaks on the glass.

Safety

He should also avoid taking unnecessary personal risks. No janitor should be permitted to stand on open window ledges without the assistance of some protective device when washing windows. If the janitor has windows that are arranged so that they may be turned with the outside in when cleaning, he may avoid taking unnecessary risks. However, if he does not have such features, it will be necessary for him to clean the windows from the outside. The practice of attempting to clean the outside of the panes by reaching up from the inside of the window is not satisfactory. For outside cleaning he should have a window jack which will reach through the window. This jack should have claws or hooks which permit it to be attached rigidly to the window sill. The outside platform should have a square area of six or eight square feet, sufficient to permit the janitor to move around on it and to carry the cleaning pails. It is desirable that the inside of the platform be tipped with rubber so that the bumpers or ends of the platform will not mar the finish of the window. It is desirable to have a platform with a surrounding railing. This gives added protection. Window jacks of this type with a collapsible railing may be purchased. However, the janitor who is handy with tools may be able to make a satisfactory jack for his own use. In addition to the jack, it is desirable that the janitor have a safety belt. This belt is usually three or four inches wide and should have heavy straps extending to the side of the window where the ends may be snapped into hooks. In addition to this strap, there should be a second safety feature in the form of a rope which will also attach to the hooks at the side. These hooks should be rigidly attached to the masonry and window frame and should be tested frequently to determine whether they provide the safety needed. For cleaning the windows on the inside the janitor will need a step ladder. It is desirable that this step ladder be equipped with a platform either at the side or top to hold the pails and other equipment that must be used during the cleaning process.

After the janitor has cleaned the glass he should pause to look back over his work, preferably from the inside out towards the light. Any streaks or spots should be removed. All sash and sills should be kept clean.

Blackboard Cleaning

Clean, attractive blackboards add much to the appearance of the schoolroom. Dirty boards with chalk scattered over the floor detract from the appearance of the room and are an indication of poor housekeeping practices, both on the part of the teacher and the janitor. In many schools the responsibility for blackboard care is not clearly established by the school officials. It should be understood that the cleaning of the blackboard is an obligation of the janitor. It should also be understood that it is the duty of the teacher and the pupils to keep erasers and pieces of chalk off the floor. As a rule, the teachers will have the blackboard erased before they leave the room each evening. However, since the janitor may wish to erase any marks left on the board, the teacher should place a "DO NOT ERASE" sign near any work to be retained. Although the teacher should be expected to give some attention to blackboard care, it is the duty of the janitor to complete the cleaning process.

Authorities do not agree on the procedure to be followed in the care of blackboards, either in the methods to be used or in the frequency and time of cleaning. The frequency of cleaning will depend somewhat on the use. In grade rooms where the boards have much use, they may need to be cleaned twice a week. In other rooms where the boards are used little, cleaning weekly or twice each month may be sufficient. The time of cleaning will depend upon the methods used.

Cleaning Methods

Some school officials still recommend that blackboards be washed with a mixture of water, alcohol, and kerosene. The alcohol may be harmful to the finished surfaces of manufactured boards. The kerosene, or any other oil, may make the board slick. If boards are to be washed, a small amount of T.S.P. or of vinegar in the water will probably give the best results. Where water is used, most administrators recommend that the board be cleaned with horizontal or vertical strokes of a bath towel folded and wrapped around a stick and used as a swab or laid along the forearm and used in the same manner. In these cases, the board is washed from the top down. If the board is somewhat rough, the use of a towel laid along the forearm seems to give more satisfactory results. The rotary motion of cleaning leaves streaks. The use of a sponge and water usually spills much water upon the floor and along the chalk tray. Any method of washing may soften the chalk (calcium carbonate) and binder leaving a film of this mixture in the pores of the board. Using large amounts of water to remove this film may permit water to run down back of the mouldings or to drip on the floor. While washing is not recommended as the best method of cleaning blackboards, it is understood that some boards will be washed. If the janitor does wash a blackboard he should wipe the board until no moisture remains on it or in the pores. This requires that he go over the board twice, but unless this is done washing may have more harmful effects.

During recent years a new practice of blackboard cleaning has been developed. This is what is sometimes known as dry cleaning. With this method, the blackboard is erased as for any other cleaning and then is wiped clean with a dry chamois skin. This process is recommended by the blackboard manufacturers and is considered effective by almost all janitors who have used it. If the chamois skin is taken out of the room before being dusted this method does not distribute the chalk dust in the air in the room. When using the chamois skin in cleaning the board it will not be necessary to clean the chalk tray until the board has been wiped clean. When using this process the teachers and pupils will use the erasers as usual and the janitor will do the cleaning with the chamois skin. With this process, the janitor does not have to carry pails of water and other cleaning appliances into the room.

General Care of Blackboards

It is essential that the janitor know the purpose and use of the blackboard. He should also know that excessive amounts of blackboard absorb light that may be needed in the room. If the room has more blackboard space than needed he may find it desirable to cover some of this space with tack board or fiber board. We speak of the board as "blackboard" while in fact many of them are not black. Some of the schools are using green boards. No one seems to know the best color for boards but in general the blackboard with a slight gray tint is better than an intense black color. The intense black board seems to provide too much contrast in color to make it easy for the child to visualize the words written on the board. For this reason, the board cleaned with a chamois skin and which has a rather gray-like color, seems easier on the eyes than do the boards that have been washed.

The janitor should know how to treat the boards. When the board is purchased and installed or after it has been washed (if ever) he should break it in before it is used for writing. In breaking it in he should cover the whole board with chalk by rubbing over it a piece of chalk held parallel to the board. When this is erased he has a smooth even appearing board. Future chalk marks are more easily erased.

Regardless of the type of board, it is understood that the board is effective only if it has a bite to rake off some of the chalk that is drawn across it. If the board becomes smooth or glossy it loses its bite. Chalk is composed partly of calcium carbonate held together with a binder. This binder is usually a glue. It is contended that when boards are washed the glue remaining on the board may be washed into the pores of the board, thus filling them up and making the board slick. Slick boards make writing difficult and present a glossy surface which reflects light into the eyes of the pupils. The effect of this glare and of other blackboard defects may seriously affect usefulness of the boards and may place strain on the eyes of the pupils. Old boards that cannot be resurfaced in a satisfactory manner should be replaced by new boards.

In the cleaning of blackboards the janitor should wipe the dust trays and leave the board, chalk trays, and erasers in a neat condition. The cleaning of chalk trays is made easier if the janitor has removable dust trays or if he has a vacuum cleaner. As a rule, the chalk tray is cleaned and wiped with a dry cloth which may be followed with a damp cloth if desired. Water should not be used frequently in the dust trays.

When the janitor has finished his work on the blackboard, he should stand back and view the board from the front and the side. If any streaks appear or if the board appears gummy, it should be recleaned. He should also make a hasty examination of the erasers that have been cleaned and of the chalk trays. If these remain dusty, his task is not completed and more work is necessary in order to make these facilities ready for the use of the teachers and the pupils.

Cleaning Erasers

The dusting of erasers is one of the most undesirable tasks of janitorial work. In too many cases, the dusting of erasers is left to pupils who take them out and beat them on the side of the house. While the pupils should give attention to housekeeping in the school, they are not obligated and perhaps should not be permitted to do the eraser dusting, at least under practices ordinarily found. The dust may be harmful to the respiratory tracts of many children. No one seems to be able to state how often erasers should be dusted. In rooms where they are used frequently they may be dusted each day. In other rooms they may be dusted weekly. Erasers that are used in rooms having a dust trough tray will not need to be dusted as often as other erasers.

Methods of Cleaning

There are several methods of cleaning erasers. Probably the best method is the vacuum system where the eraser may be passed over the intake or the suction of a vacuum system. Tests seem to indicate that these erasers are well cleaned. However, many janitors do not have vacuum cleaning systems and must use some other method. Almost every janitor can obtain one of the hand operated eraser cleaners. Some of these have rotary brushes and vacuum fans to take the dust away. These cause less dust and do better work than do most other types of cleaner. These should be equipped with fiber revolving brushes. Other cleaning methods are what might be termed hand methods. They include the use of a stiff brush, the rubbing of erasers together, the beating of erasers together, etc. None of them seem to be very effective but when the janitor has no other tools he may have to use one of these methods. In some instances janitors have erected a cleaning rack of hardware cloth on which they beat the erasers.

Although it is a generally recognized fact that fire box doors to the furnace should not be left open, this is often times the only spot that the janitor can have a draft to pull the chalk dust away from him while he dusts erasers. If this is true, and if the janitor has no eraser cleaning device, he probably would be justified in leaving the door open long enough to clean his erasers. He should have extra sets of erasers that he may leave clean erasers in the room when he picks up the dirty ones. He may then dust the dirty set and have them ready for replacement in other rooms.

Dusting

School buildings which are cleaned daily with vacuum cleaners, or those where the floors are cleaned with dust mops, will not have excessive amounts of dust spread into the air by the cleaning process. However, the dust from the outside air and from that used in ventilation will enter the room and settle on the walls and the furniture. This dust may become distinctly harmful to the health of the pupils, many of whom have respiratory weaknesses which may be irritated by the dust. Dust on the furniture or any part of the room detracts from the appearance of the room. No good housekeeper will permit this dust to remain on the furniture and on the various parts of the room. It is a part of the duty of the janitor to remove this dust. In many cases teachers and pupils keep dust cloths and dust a part of the furniture. While this may be good housekeeping practice for the pupils, and while there is no objection to their doing this type of work, this does not in any way release the janitor from his obligation to maintain a clean room, free from dust. The amount of dust accumulated will depend to some extent on atmospheric conditions, on the methods of cleaning the building, and on the condition of the clothing of the children. If their clothing is dirty and much dirt is tracked in, there is likely to be much dust in the room. If the heating system is of a fan driven type and is not equipped with a filter more dust will accumulate. Any method of sweeping that stirs the dust into the air may cause much dust to settle on the furniture. One of the tasks of the janitor is to keep this dirt out of the building. He will not be able to prevent the infiltration of dust through the ventilating ducts, but he can prevent the infiltration of dust and smoke through the heating plant (this applies particularly to a hot air heating plant). He can also provide foot scrapers and brushes where the children may remove the mud from their shoes before they come into the building. He may be able to secure the cooperation of the teachers in preventing pupils from carrying excessive amounts of dirt into the building.

Time

Most janitors do their dusting in the morning. However, the work schedule which permits the janitor to sweep classrooms during the day at periods when they are not in use may make it possible for him to dust a number of the rooms before he leaves the building each evening. This reduces the burden of morning dusting. Classroom furniture, entrance doors, door knobs, stair landings, and other places where pupils sit or where they may have their hands should be dusted daily. Cases, windows, window stools, and other places the pupil may touch should be dusted as often as needed. In many cases, these are dusted each week. More remote places, like the tops of picture moulding, ledges, the tops of bookcases, in and around radiators and Venetian blinds may be dusted monthly or five or six times each school year. Each janitor should set up a schedule of dusting for his own building. This schedule should be worked out with the principal in charge of the building. The teacher should understand that the janitor is to be permitted in the room at the time designated for the purpose of dusting.

Tools

Many different tools have been used in dusting. At one time, the janitor made extensive use of the feather duster which stirred up the dust but did not remove it from the room. During recent years, many janitors have used cloths for dusting. These, if used in a flipping method are little superior to the feather duster. If a cloth is used, some material like cheese cloth or cotton flannel is preferred. Old rags often have heavy seams, buttons, or hooks which may mar the surface to be dusted. The duster preferred by many janitors today is known as a sanitary duster. This is composed of a slip-on mitten to be used on the hand or on a wire frame. The head of this duster consists of heavy canvas into which are looped strands of cotton string. The head of this duster is usually ten or twelve inches long and the handle about the same length. The duster with the handle or head too long is somewhat cumbersome and difficult to use.

Methods

In dusting classrooms with fixed seats, it is desirable that the janitor go to the rear of the room and proceed up the aisle, dusting first the back of the desk next to him, then the top of the desk in front, and proceed to the next desk. Some janitors attempt to use a duster in either hand. In general the use of two dusters does not produce results that are satisfactory. With the sanitary duster not more than two sweeps across the desk will be necessary to complete the dusting. Various types of dusters are available for the purpose of dusting slats in Venetian blinds. Some janitors find it easy to dust the tops of exposed pipes and picture moldings with a duster made by inserting a long handle in the bottom of a short string floor mop.

No duster should be used after it becomes soiled. The janitor should have several duster heads for each handle and should replace each soiled head with a clean one as soon as it becomes dirty. Dirty duster heads should be washed in a solution of warm water and neutral soap and hung up to dry. Before the duster head is quite dry, a small amount of furniture polish or wax may be sprayed into the head. It will then be ready for use as soon as dry. Dust cloths may be maintained with a similar treatment. The janitor should carry a dust cloth even when he has the sanitary duster, that he may use it in corners and other places that cannot be reached easily with the duster head.

When the janitor has completed his work, he should look back over the room to see if any dust remains. He should frequently make a test with a piece of clean white cheese cloth or linen to see if any dust may be picked up on it from the desks or on other parts of the building. If dust is picked up on this cloth, the surface is dirty and should be redusted. Furniture, seats, and desks which remain dirty or dusty will soil the clothing and hands of the children.

The teacher should keep her desk clear so that it may be dusted. She should teach the pupils to leave their desks in a suitable condition for dusting. This means that books and pencils should be put away each evening. A few friendly conferences with the teacher will be of value in securing the cooperation desired.

Cleaning Classroom Walls and Ceilings

It is important that the classroom walls be clean and attractive. Soiled walls do not reflect light. They may cause rooms to seem dark and gloomy. Dirty walls are health hazards and are indicative of poor housekeeping practices.

Types of Surfaces

The work of the janitor in cleaning walls is made more complex by the many types of wall surfaces found in school buildings. These range from sand floated untreated plaster to glazed tile, unglazed tile, oil painted surfaces, those treated with a water mixed paint, linoleum, and those covered with cork or fiber board. This variety of surfaces makes necessary a number of cleaning methods. Some of these surfaces cannot be washed while others may be washed at will. On some of them only clear water may be used while on others a strong cleaning solution may be used.

Frequency of Cleaning

The need for cleaning will depend on the type of surface, the location, the use of the room, and outside conditions. In smoky areas or in buildings where smoke and dirt enter the room from the heating plant, cleaning should be done often.

The tools for wall cleaning will vary. A step ladder, sponges, pails, and clean water are essential. Cheese cloth or clean rags may be used. Brushes or mops are desirable. A dust mop, or a cloth spread over a floor brush may be used.

Adaptation to Surfaces

On glazed tile or similar surfaces a damp cloth will provide all the cleaning necessary. The use of mild cleaning compounds, however, will do little harm to these surfaces. Unglazed tile may be washed, but not so easily as the glazed tile. Some scouring or cleaning compound may be necessary for any oils that may be on the wall.

On marble surfaces clean water and a sponge will clean without harm to the polish. Strong cleaning solutions should never be used. Some janitors clean marble surfaces by applying a starch paste which is later removed carrying the dirt with it. This may mar the finish.

Untreated smooth or sand-floated plastered walls may be washed. In doing this the janitor should be very careful not to saturate the plaster which may absorb some of the water. In general, untreated plastered walls are washed only in order to remove accumulations of dirt before applying paint. Portland or Keene's cement plaster will stand washing better than will gypsum plaster.

Painted Walls

Until recently walls painted with water-mixed paint could be washed only when the old paint was to be removed and a new paint applied. Some of the newer paints of this type may be washed by using water with a mild cleaning agent. On these walls a detergent similar to T.S.P. is better than soap which may require rinsing to remove the soap. Oil paints may be washed without difficulty. In cleaning surfaces of this type only a mild cleansing agent may be used. A strong solution may dim the surface. The janitor should realize that each cleaning or washing removes some of the paint and that repainting is necessary at regular intervals. Many schools have developed a practice of painting one year, washing once during the second year. They wash again in the third year and repaint during the fourth year. In a few cases washing is done on alternate years after painting. Then if the walls are washed twice painting is done each six or seven years. This practice permits spreading the painting program so that a part of the rooms may be repainted each year. During recent years school boards have practiced placing a starch film over all new paint. This film remains until the first washing which opens up a fresh paint surface. The painted surface is then washed once more when dirty before repainting. This practice lengthens the life of the paint and provides attractive wall surfaces.

Other Surfaces

Linoleum wall surfaces may be cleaned with a damp cloth. Fiber board walls and ceilings cannot be cleaned by washing. Some of these surfaces and cork tackboard can be cleaned by rubbing with corn meal or some similar material. When possible, it is better to clean than to paint these surfaces, since paint may destroy some of the acoustical properties.

Cleaning Methods

Some janitors contend that there is less streaking if they start at the bottom of the wall and wash to the top. However, many janitors start at the top and wash down. The washing is usually done with a sponge which must be rinsed frequently to prevent streaking. The washing is done with perpendicular or horizontal strokes. Some janitors hold a second sponge in the other hand and follow the first cleaning with this to remove streaks. The removal of all sponge marks and streaks is important. The janitor should avoid having the sponge too wet. The dirty water should not drip on the floor or wood trim. The water must be changed frequently. Where a cleaning compound is used on a wall, the janitor should clean only a small space at a time and then rinse. Both of these regulations are important and should be followed.

Wood trim, baseboard, window stools, and doors may be washed as other painted surfaces. They should be wiped frequently with a moist cloth or a cloth treated with a good grade of furniture polish.

Chapter 7

General Care of the School Plant

THE JANITOR HAS many duties in caring for the school plant. He is responsible for the care of the yards, the electric service system, the window shades, and the flag.

Care of Walks, Lawns and Play Areas

Home owners know the value of well kept lawns and walks. More and more school officials are recognizing the value to the school system of well kept lawns and properly placed shrubbery. Many patrons seem to appreciate attractive school yards; oftentimes they obtain their most vivid impressions of the school by the appearance of the exterior of the building and the yards. For many citizens, the school yard and grounds represent the showcases of the janitor. Many school janitors make their school grounds the beauty spot of the neighborhood. In some cases, school grounds were laid out before the janitor took charge and in too many cases no plan was followed. During the years that the janitor cares for the grounds he can make changes and may eventually change the original design of the grounds. Attractive school grounds and yards don't "just happen." They are the result of careful planning and painstaking care. The yards, walks, and building locations should be so laid out that they lend themselves to planning. In general, it is desirable to have the playground to the side or rear of the building so that it is easier to maintain an attractive lawn at the front of the buildings. Walks and driveways should be laid out to accommodate traffic. Trees may be planted around the border or in certain selected areas away from the building. Trees should not block a view of the building from the main street or road. Neither should they be planted close enough to the building that their shade may cut off needed light in the building. Shrubbery may be planted in selected corners, along walkways, or driveways, and in many cases may be banked near the building. Hedges are attractive if properly cared for. If they cannot be cared for, it is best that they be destroyed, since unattractive and poorly kept hedges do not add to the appearance of the grounds. Where possible, walks should be laid in the nearest direct line of traffic for pupils. Heavy traffic on one particular street may make it desirable not to have walks leading to this section of the grounds. If it becomes necessary to locate play areas at the front of the building, they can be segregated from the building by walks, drives, or decorative shrubbery. Play areas should be laid out for the games played on the school ground. In many cases it will be necessary to provide special play areas including sand or sawdust boxes and teeter boards for the small children. In planning a school site, advantage should be taken of the slope of the ground. In some cases it will be necessary to build a slight terrace to prevent washing on steep slopes. In planning, it is desirable to know the location of sewers, drains, and of yard hose connections.

Planting

One of the tasks that will fall to the lot of the janitor is new planting or replanting of the trees, shrubbery, flowers, and grass on the school yard. In many cases, he will have little to say concerning the type of tree or shrub selected. In other cases, he will be given an opportunity to see what he can do in developing an attractive school yard. He should learn to make use of the plants adapted to his locality. Some trees, shrubs, and flowers are particularly adapted to certain areas in the United States. The lists given here include many of the plants adapted for use in the central part of the United States. The state Agricultural College is always of real help in such matters.

Trees

In general, trees should be selected that are native to, or which do well in, a particular locality. Honey locust and other trees which tend to spread rapidly through runner or root sprouts are not desirable. For rapid growth, the white poplar, sycamore, or silver leaf maple are considered desirable. However, these trees break in the wind, and for this reason have not found favor in school yards. Some of the trees liked for school yards are elm, hard maple, ash, and the various types of native oak. Trees should be planted at a depth that is approximately the same as that in which they grew before being dug up for transplanting. In general, the tree should be planted in a hole that is sufficiently large to permit a full spread of the roots that are attached to the tree. If the soil is packed, it may be necessary to loosen it, either by blasting or digging a large hole before the tree is planted. When planting the tree, the soil should be worked down around the roots. It is desirable to cut off a part of the top of the tree at the time of planting so that the leaves will not make too heavy a demand for food and water before the roots have had an opportunity to develop. In planting trees, the janitor should recognize the various needs of different trees. When a wide spreading shade tree is desired, the trees should be planted some distance apart. If a lofty stately effect is desired, such trees as the poplar or pine should be planted in clusters.

Shrubs

The type of shrub to be planted will depend to some extent on the location and the need. Shrubs are often used to mask unsightly places and to break the lines between the building and the lawn at the front. They should not be planted where they will shut out the sunlight from the classrooms. The type of shrubbery selected will depend upon the use and location. Some tall shrubs like lilac, mock orange, or snowball are often planted at the rear while the shorter shrubs are planted at the front. This intermingling of the shrubbery provides a more attractive bank. Shrubbery which grows eight or ten feet high should be planted five or six feet apart, while some of the medium height shrubbery, such as Japanese Rose, Spirea, and red dogwood, may be planted three or four feet apart. Some of the low growing shrubbery, such as Japanese Barberry, may be planted two or three feet apart. The method of planting will depend somewhat on the type of shrubbery. As a rule, shrubbery used in banks should not be set in rows, but in a rather haphazard fashion with the smaller shrubs at the front. Privet, when used as a hedge, may be set in trenches which places it in a straight row and makes an attractive hedge. It is desirable to scatter a small amount of humus in the trenches when planting. Vines which are related to shrubbery are often planted along old fences or stone walls to mask them from view. The planting of vines around the school building to climb up the walls helps provide an attractive wall, but there is some question whether the practice is good.

Flowers

Many school janitors do not know how to care for flower beds. Some of them have never grown any flowers. The average janitor will do well to depend upon the advice of the florist in the planting of flower beds. He does need to know that flowers are usually planted in beds or along borders. As a rule, sporadic planting of flowers over the yards is to be discouraged. He also needs to know that certain flowers are classed as annuals and are reproduced from seed. Some of the most popular seed annuals for school yards are poppies, snapdragons, sweet peas, and dahlias. In order to get early spring color, many schools set out beds of bulbs during the months of October and November. Popular bulbs for school yards are narcissus, tulips, jonquils, and crocus. Some of the popular perennial flowers, that is, those that do not need to be planted annually, are the peony, larkspur, chrysanthemum, and iris.

Lawns

In planting and designing school lawns, one of the most important factors is a suitable seed bed. Many school yards are composed of fresh dirt from excavations and have a bed of broken concrete, plaster, and brick which makes it difficult to establish a suitable seed bed. Before planting it is necessary that the bed be thoroughly pulverized and that it contain enough humus to support the growth of the plants. The most common grasses for school yards are Kentucky blue grass, red top, white clover, and Bermuda grass. A grass that forms a complete sod should be used. Weeds are inclined to grow more rapidly than the grass, and nurse crops are often planted with the grass. The type of nurse crop depends on the time of sowing. Lawns are usually seeded early in the spring or in late fall. The nurse crop should not be heavy or rank enough to shade the grass crop that is to follow. The nurse crop should be removed after it has served its purpose. The grass should be given a chance to develop. In developing and planning school lawns, the basic requirements are plenty of humus and moisture. If fertilizers are used, it is probable that some nitrogen fertilizer, such as ammonium sulphate, cotton seed meal, or a complete mixture, will be needed.

Care of Trees, Shrubs and Lawns

So many factors are involved that only a brief description can be given here.

Tree Care

The practice of cutting off the heads of trees every three or four years is not recommended by experts in the field and should not be attempted by an inexperienced worker. It may be necessary to do some pruning of the trees. If this is done, attention should be given to the prevention of crotches that may split. Attention should also be given to the removal of old snags or stubs of limbs. It will be necessary for the janitor to provide water for the trees in many cases. Both the trees and the grass under them compete for soil water, and a lack of water may hinder their growth. Trees that are located in crowded areas or with sidewalks around them sometimes do not get enough air and water. In these cases it may be necessary to sink a tile from the surface down to the roots in order to provide both water and air. Trees are subject to a number of diseases and pests. Some of these pests can be controlled by sticky bands around the trees; others by burning out the nests, and still others by spraying. The treatment will depend on the type of pest.

Shrubbery Care

In general, the care required for shrubs will be cultivation and the supplying of plenty of water. The shrubs which grow in clumps need little pruning. If there is a need for pruning, cut out some of the old wood so that the young shoots may develop near the base of the plant. Honeysuckle and quince send out many shoots from the base, and pruning of these new shoots may be necessary. Snowball, barberry, and spirea are usually left in their natural state while shrubs like hydrangea, hedge, and dogwood are often trimmed. The time of trimming shrubs other than the hedge is not very important. Most janitors find it desirable not to prune until after the blossoms have fallen. Hedges are usually pruned three to five times per year, depending upon the growth. In pruning, the hedge should be lined up by the use of string until the desired shape is obtained. Then it may be maintained in this shape. If the janitor is not familiar with the methods of pruning, he should obtain outside assistance until he has learned the principles to be followed. Occasionally it is necessary to spray certain shrubs and hedges for diseases. Privet and other hedges in use are susceptible to winter kill. Some janitors now mulch these hedges during the winter with leaves or straw, removing this in the spring before the first cultivation of the shrubs.

Lawn Care

The care of lawns often proves one of the most difficult tasks of the janitor. Many lawn grasses are particularly susceptible to drouth conditions. The root systems are limited, and where the lawns are mowed frequently, the mowing prevents the building up of plant resistance. In addition, the lawns are subjected to damage from pests, such as moles, ants, and worms. They are often infested with noxious weeds. Many janitors may spend a summer developing a lawn, only to have an excellent crop of dandelions next spring.

After the lawn is first sowed, the janitor will probably find that some spots are bare. He must recultivate and reseed these spots, being careful to provide good seed, free from weed seed. After the lawn is started, he will find it necessary to mow as needed. Before mowing the lawn, it may be necessary to roll the lawn. When mowing a new lawn, the grass should not be cut too close to the ground. Later, mowing will depend upon weather and soil conditions. If the janitor has a large area to cover, he probably will have a power mower. He should mow under the shrubs and along the walk to give the whole yard a neat appearance. He should fill trenches and drains before mowing. The yard should never present an unsightly appearance because of the lack of care. The addition of organic matter will increase the water holding capacity of the soil and make it easier to cultivate. The organic matter may be supplied by hauling a good black dirt to the site or by adding fertilizer. New soil should be free from noxious weed seeds.

Weeds and Pests

The types of weeds that grow will indicate some of the soil conditions. For instance, sorrel often indicates a sour soil. In caring for the lawn, the janitor will find it necessary to trap moles, to use oil or some other agent to kill ants, and he may find it necessary to put out poisoned mash to kill worms. In each case, the remedy will depend on the type of pest. Some of the most common lawn weeds are dandelions, buckthorn, plantain, sheep sorrel, knot weed, and crab grass. Some weeds are deep rooted and stand upright. Some of these are kept in check by mowing. Other weeds like crab grass have a tendency to creep along the ground and to reproduce from the point where the joints make contact with the ground. Weeds like the dandelion produce a seed that is wind carried. Hence, the elimination of the dandelion in the yard supervised by the janitor may have little effect if the neighbors grow a good crop of seed. Many patented killers, including ammonium sulphate, crude oil, and other materials, have been developed for the killing of weeds. In most cases, the killing agent also destroys the grass. In a few cases, a spray or a squirt gun is used to apply the killing solution directly on the weed. For many weeds, digging is the best method of elimination. This is true of the deeper rooted weeds, but is not effective unless all the roots are destroyed. Constant care and attention, as well as some pride in its appearance, are essential if the janitor is to develop and maintain an attractive school yard.

Yard Cleaning

He must prevent an accumulation of waste paper around the building and other places in the yard. He may find it desirable to place waste paper containers at various points in the yard and near places where pupils may collect during the fall months to eat lunch. He should make a daily round of the yards to pick up loose paper. Janitors have found that the use of a pointed stick or a stick with a nail at the end and a sack to be hung over the shoulder provides about the best method of collecting paper from the yards. It may be necessary to remove leaves from the yards. This may involve raking the leaves into piles and having them hauled away. Leaves should not be burned on grass spots.

Walks

One task that is with the janitor all the year is the care of walks. During the summer time he will find it necessary to make some repairs on various walks. It may be necessary to trim around the walks. A hoe with a straight shank or a specially developed spade may be used to trim the sod back from the walks in order to provide an attractive appearance. The janitor should remove snow and ice from the walks as soon as possible. As a rule, he can remove the snow before it becomes trampled with the use of a snow shovel or pusher he makes for that purpose. If the snow and ice develop so rapidly that they cannot be removed and if the walks become slick, he may use salt to melt the ice. Some janitors use sand on icy spots. This does aid in preventing slipping but it also provides a place where sand is picked up on the feet and carried into the building to cut the floor finish. The use of cinders or sand is sometimes objectionable for this reason. If they are used, an ample supply of brushes and brooms should be provided that this sand may be brushed off the shoes before the children come into the building. Some janitors provide tow sacks and lay them on the walks that become slippery. These seem to be of some value. The janitor should be watchful and should repair walks as soon as he finds broken places. He should also be careful to protect from the hazards of slick walks. While the school district probably will not be liable for damage from injury from walks, the janitor should take all possible care to prevent injuries arising from bad walks.

Care of Light and Electric Service

During recent years there has been a great increase in the electric current used in the school buildings. The demand for more illumination and an increased demand for power for fans, heating units, pumps, lifts, potato peelers, dishwashers, soldering irons, and power machines for industrial shops has multiplied the current consumption many times. Because of the nature of electricity it presents a number of potential hazards to both people and property. Most light current is brought to school buildings with a voltage of 110. Power current may be

220 to 440 volts. While pupils, teachers, and janitors are acquainted with the use of electricity, few of them exercise sufficient care in its use. The janitor as building custodian has an obligation to help conserve electrical energy, to protect against electrical hazards, and to aid in securing adequate illumination from the electric lights in use.

Wires and Fusing

Many of the older buildings were wired before the present janitor came on the job. Some of these wires are too small to carry the present load. The increased consumption of power has added to the overloading. In some cases, the old wiring and the newer extensions are not properly installed. Some of the wires are insulated with a poor grade of rubber with no protective braid to add strength. Much of the old knob and tube work is not installed properly and the wires have sagged until they are in contact with combustible surfaces. When wires are overloaded they tend to become hot. In order to give protection against this resistance and heat, fuses are placed in the line. These fuses are designed to serve as weak spots in the line. They are supposed to offer less resistance than the rest of the line and to give way before the line becomes too hot. Oftentimes a short in the line or an overload may cause these fuses to blow out. When this happens several times, some janitors may replace the blown fuses with heavier ones. This practice closes the weak (fuse) gap and throws added resistance back on the line, but when an overload again occurs, the line may become hot and a fire may be the result. All fuse panels should be marked, showing the size of fuse to be used in each line when installed. If these panels are not marked, the janitor should seek the advice of a competent electrician and mark each fuse socket. The janitor should *never* use a heavier fuse than that designated for that particular line. Neither should he wire around the fuse or place a coin back of a fuse to prevent a break at that point. The lines in each panel box should be marked, showing the room or lights served by each line. Many janitors keep extra fuses and a flashlight on hand. If the fuse panel box is properly arranged, one or two extra new fuses may be left in the bottom of the panel box to hasten replacements. Cartridge fuses are often used for power lines. Before attempting to replace these, the janitor should throw the switch connecting that line. He should use a fuse puller to dislodge the old fuse. The newer fuse and switch panel boxes have what is known as a dead face front. This is arranged so that pupils and janitors cannot come in contact with any wires when the box door is open. Doors to the older exposed type of boxes should be kept locked to prevent possible hazards from these sources.

Extension Cords

The janitor should be careful in the use of extension cords. Light fabric wrapped cords should never be used in places where they may become moist or wet. For these places heavy rubber insulated cords with cage protectors over the lamp, such as those recommended for garage repair shops, should be used. Portable extension cord lamps should be equipped with a hanger that they may be attached to some object when used in making temporary repairs. Extension cord lamps should be for temporary use and should not be used for permanent lighting. In no case should extension cords be hung over nails or tied around water, gas, or steam pipes. All splices in extension cords should be securely taped. Tieing knots in extension cords in order to shorten them is bad practice.

The use of cheap extension cords for temporary lighting is hazardous. This is particularly true of some of the Christmas lighting. The use of these poorly insulated lights should be prohibited in all school buildings. In many school rooms temporary decorations are suspended from the light fixture. In some cases these lights are of the old drop cord type where the weight of the fixture and the lamp are supported by the cord. The fact that these cords swing from side to side may cause the cord to become worn at its connection with the upper outlet until the wires are exposed. When this occurs a short may be the result. Any flimsy decoration connected with this light can lead to a fire.

Heavy Duty Units

The janitor should know that electrical heating units build up a considerable amount of resistance. Some of these units such as electric irons, glue pots, radiant heaters, stoves, and soldering irons may be left turned on when not needed, using costly current, and developing possible fire hazards. For this reason, all electrical heating units should be equipped with a pilot light connected in the line. This light should be so arranged that it shows red when the heating unit is turned on for use. Heating units or any heavy power units should never be connected with a cord or pull chain. These are not heavy duty outlets and may arc when called upon for heavy duty. In fact, heating and heavy duty units should not be connected to ordinary suspended light sockets. They should have direct connections or should be connected with heavy duty wall plugs.

Large motors are usually equipped with starting switches. Some of these are designed to kick out if for any reason the resistance is excessive. Where possible the janitor should ask that such switches be installed and should use these starting switches. He will thus avoid probable contact with exposed switches.

Repairs

The janitor should be careful in his use and care of electrical equipment. Open and dusty motors throw off sparks that may start a fire in shavings and other combustible materials. He should avoid forming a ground for some faulty connection. This hazard is greater if he is in contact with metal piping or if he is standing in a wet place. The janitor is often called on to make minor electric repairs, to splice wires, or to locate new outlets. He should not attempt these repairs unless he knows how to do the work properly. On the other hand, many janitors find that if they do not make these minor repairs some less skilled pupil or teacher does attempt to make them. It may be better for the janitor with some training and skill to do minor repair work than to have the work improperly done. Many janitors have developed the ability to make adjustments in the public address, bell, clock, and other low voltage electric equipment in a satisfactory manner and at a saving to the district.

Electric Lighting Service

One of the tasks of the janitor is to assist in protecting the health of the pupils. Adequate controlled illumination is a distinct factor in the protection of the eyesight and consequently the health of the pupils. The janitor usually has no control over the original installation of classroom lighting. There are many factors in lighting efficiency over which the janitor does have some control. Most lighting circuits are laid out to carry and use 110 volt current. The fuses and wires from the panel boxes to the lamps are limited in the load they will carry and the lamps they will serve. When overloads are placed on any circuit there is a dimming of lamps and a loss in efficiency.

Lighting Principles

There are certain basic school lighting principles that the school janitor should know. He should know that light in stairways and in other places where danger may exist will reduce the number of accidents. He should know that ample controlled illumination makes rooms more cheerful and speeds up school work. On the other hand, glare from glossy surfaces or from bright lamps in the child's line of vision may be tiresome to the eyes. He should realize that a major part of the light falling on the desk of the pupil is reflected light. This reflection comes from the walls, ceilings, and other surfaces in the room. Black or dark surfaces like blackboards do not reflect much light. Dirty floors, walls, and ceilings reduce the possible reflection and cause a greater consumption of current if the room is to be properly lighted. Pupils should not be required to face the light. It is better if the light comes from the side and above. There should be no shadow on the desk. In locating school room seats the janitor should so place them that the pupils have natural (day) light coming from the left.

Lamps and Their Care

Better diffusion of light is obtained in the average classroom if several lamps (luminaires) are used. Many of the better schools now install six lamps in the average classroom. These lamps should be located above the normal line of vision of the pupils seated in the room. In practice these lamps are usually located about nine or nine and one-half feet from the floor. Since the inner side of the classroom is the darker area it is desirable that the inner row of lights be on a separate switch that these lights may be turned on when the outer row or rows are not needed. It is desirable to have this light come from above and slightly to the rear of the pupils. The front row of lights is not at the front of the room.

Types of Lamps

An open bulb provides an intense illumination and a bright spot immediately surrounding the lamp. To provide better illumination and to prevent eye injury, these lamps are usually encased in some type of diffusing globes. One of the most common types is the enclosing white glass. These lamps are usually known as semi-direct lights. Since the use of lamps that are too large may cause these diffusing globes to be too bright for the eyes of the pupils, the janitor should know the size of globe used in each. It is recommended that the following limits be observed. For a 14 inch diffusing globe, a lamp or bulb of not over 150 watts; for 16 inch globe, not over 200 watts; for 18 inch globe, not over 300 watt lamps should be used. The dimensions of the diffusing globes represent the total crosswise or horizontal spread. A second type of lamp is the indirect lighting fixture. This fixture has an opaque bowl and throws the light against the ceiling where it is to be reflected down to the desks.

Care of Lamps

The semi-direct or white glass lighting fixtures throw a part of the light on the ceiling and walls from where it is reflected on the desks. Dirt that has accumulated on or in these fixtures may reduce their efficiency by half. Dust will get inside these globes and prevent a complete diffusion of light. The indirect fixtures throw the light to the ceiling. These fixtures are usually open at the top and dirt settles in them. All these light fixtures must be kept clean. The janitor should wipe out the bowls of the indirect fixtures often. He should remove and wash fixtures as often as needed. For this purpose, he will need a step ladder and other tools similar to those used in window washing. After washing, the fixtures should be fastened securely to the fitter or hanger. There must be no danger of their falling when pupils are in the room. Care does not end with washing the lamps. Walls and ceilings must be kept clean if the schoolroom lighting is to be satisfactory and economical.

Bulbs that have been in use for some time become dark and lose their efficiency because the filament gradually dissolves and is deposited on the bulb. They should be replaced. This replacement is not a difficult task in classrooms where the lamps are not far from the floor. In auditorium and gynasium units the task of replacing lamps or of washing fixtures is more difficult. In some of the newer buildings the whole fixture may be lowered to the floor for replacements or for cleaning. In some of the new gymnasium units the fixtures are so arranged that they may be serviced from above. There is now on the market a combination suction cup mounted on a long pole that makes it possible to replace high lamps from the floor. This instrument is equipped with a trigger that releases the suction cup after the new lamp is set.

Control of Current Consumption

The janitor does not have control over the amount of electrical energy consumed. Yet he is often required to turn out lights not needed. In some instances the building is equipped with keyed switches which only he can operate. This practice requires that the janitor watch each room to determine just when and how many lights are needed. This control is not economical since the janitor cannot watch all rooms at all times. Another practice is to permit the janitor to pull fuses controlling rooms where the teacher is wasting current. It seems better to instruct the teacher how to use and to enforce teacher control of lights and window shades than to deprive pupils of needed light as a retaliation for teacher negligence. It seems desirable to provide suitable switches in the room convenient to the teacher, and located on the knob side of the doorway. It is possible for the janitor to conserve current by turning out lights in vacant rooms and by adjusting window shades before the room is occupied.

Records

The janitor should make a record of meter readings and of the current used. It probably is desirable that he make the readings at or about the same time the meters are read by the service company. Power and light readings should be recorded separately if so metered. The following is a sample of a record sheet kept by some janitors. Readings are taken monthly and the amount of current used is determined by subtracting the present reading from the previous one.

(Sample)

BUILDING____________________

DATE	LIGHT METER		POWER METER	
	Reading	Current Used	Reading	Current Used
3–10–40	15270			
4–10–40	15375	105		

Care of Window Shades

Window shades are provided for the purpose of shutting out or breaking up the direct rays of the sun. However, the shades should not shut the daylight out of the classrooms. Several types of shades have been used in an attempt to secure the desired results. The older filled green or dark cloth shades shut out too much light. When the shades with a heavy filler check or crack they present an unattractive appearance in the room. The heavy duck shades also shut out a great deal of light. Venetian blinds when dirty fail to reflect much light.

Cleaning Shades

The janitor has a real problem in attempting to care for all of the window shades in the building. Dirty shades shut out light. Spotted or discolored shades are unattractive. Window shade cords break and must be replaced.

Many of the modern cloth shades can be washed. For this purpose they should be removed from the rollers and washed in a neutral soap solution. Some of the newer shades can be cleaned by wiping with a moist cloth. Care should be exercised to avoid streaking the shades when cleaning in this manner. After the shades are washed they should be dried before being attached to the rollers. Faded spots and streaks are difficult to remove. When they are bad it is probably wise to replace the shades. Frequent dusting of the cloth shades will prevent some of the accumulation of dirt. Venetian blinds should be dusted frequently. A soft brush may be used for this purpose. If no brush is available, a cloth may be used.

Control of Shades

Many teachers insist on pulling the shades down to cover about half the window, regardless of weather conditions or the amount of electric current consumed. The janitor has no control over this practice. Many building principals overcome this practice by instructing teachers in the control of shades and by forbidding the use of window drapes. They also instruct the janitor to raise (retire) all shades on the west side of the building each morning before school opens and to raise those on the east side of the building during the noon hour. The janitor should keep all shades in good condition with the springs properly tensed and all cords in good repair.

Care of the Flag

Our national flag is an emblem of our national and individual liberties and should be treated with respect. The school should always be able to furnish an example for the community with regard to the proper methods of displaying the flag. In some schools the responsibility of caring for the flag is assigned to the janitor. Frequently, through carelessness or ignorance, school children may violate the flag code, and it is important the janitor be definitely informed.

1. The flag should always be in good repair. A torn, ragged, or dirty flag should never be raised. When the flag becomes unfit for display it should be burned in the furnace. It should never be left lying around, or kept with the waste or wiping cloths.
2. The flag should not be flown during rainy or stormy weather. If the weather becomes stormy during the day the janitor should see that the flag is taken down.
3. Generally the flag is raised at the beginning of the school day, and is lowered at the close of the school day. By all means the flag should be lowered by sunset, and should never be left up during the night.
4. Of course the flag should always be raised with the blue field uppermost. Yet nearly every year each school has the experience of having the flag raised "upside down." Remember that the flag in that position is a sign of distress. Carelessness in this respect is certain to expose those responsible for the flag to a great deal of ridicule.
5. The flag should be kept folded when not in use. The Boy Scout plan for doing this is an excellent one. When the flag is raised it should never be permitted to drag on the ground. As it is lowered it should be caught in the arms and not allowed to touch the ground.
6. When a flag is displayed flat on the walls it should be hung with the blue field to the flag's own right. As an observer would see it, the blue field would always be to the left.

7. The flag should never be used as drapery over a desk or a speaker's stand. At no time should anything be placed on the flag.
8. The flag should not be used as a ceiling covering, or as a covering for a pillow.
9. In parades it should be carried on a staff, and should never be carried in flat or horizontal position. It should never be draped on a float or a car.
10. Bunting should be used for decorative purposes, draping a float or a car. The blue in the bunting should be at the top.
11. No other flag or emblem should be placed above our flag.
12. When the flag is to be flown at half mast (half way up the pole) it should be first raised to the top of the pole, and then lowered. On Memorial Day it should be flown at half mast until noon, and then raised to full mast until sunset.
13. When the flag is displayed on a staff on a speaker's platform, it should always be on the *speaker's* right, and the audience's left.
14. When the flag is displayed on a staff and is placed on the floor with the audience (not on the speaker's platform), it should be on the audience's *right*.

Chapter 8

Safety in Schools

Prevention of Accidents

THE JANITOR DOES not plan the school buildings; neither is he legally responsible for the safety of the school pupils or the school property. On the other hand, the janitor can probably do more than any other individual to provide greater safety in the school building and on the school grounds. There are so many possible hazards that it is difficult for the janitor or the teachers to guard against all of them. In many cases the teachers and principals have not made a study of pupil and property hazards. This often throws much of the burden of protection on the janitor. This may be desirable. He is the man in a position to know hazards and to do something about them. In addition to the elimination and prevention of hazards, the janitor must learn to cope with pupils, many of whom get a thrill out of taking a risk. The janitor will realize that in most states the school is not financially responsible for damages from injury. However, this does not justify negligence in pupil or property protection. The paragraphs following will point out many of the hazards in school buildings. More detailed outlines and methods of repairs will be discussed in section 17 on maintenance and repairs. The broad scope of the subject "safety" makes it impossible to cover every item. Hence, the discussion given here is in the nature of a summary of present knowledge and practices that contribute to pupil and property safety in school buildings.

Records of accidents, injuries, and property loss indicate that hazards might be grouped into those applying to the janitor in his work, those applying to pupils individually and in groups, and to fire hazards. Those applying to the janitor usually arise from some such cause as explosion, scalds or burns, falls, and carelessness in the use of tools. Those applying to pupils usually arise from falling, slipping, running into sharp corners, or from falling objects such as statuary. Other pupil hazards arise from electric shocks, poison, or fire. Property loss is usually caused by fire, tornado, explosion, theft, or carelessness.

Janitor Protection

It is generally understood that the janitor who is not careful in protecting himself and who is not careful with his tools and in his methods of work, may also be careless in the protection of pupils from various hazards. The janitor should avoid exposing himself to unnecessary risks. His tools should be in good repair and properly stored. Being careful may consume time, but it is better to be careful than crippled. The janitor should not attribute his injuries to bad luck, but rather to poor judgment. Some of the cautions that the janitor may observe for his own safety are:

1. Fix all ladders solidly before mounting. See that rungs and steps are solid.
2. Keep tools in racks arranged for them. Have all sharp ends of the tools protected.
3. Use a vise, not the hands, to hold materials for screw driver and chisel.
4. Wear heavy soled shoes when doing work that might injure the feet. Old thin soled shoes or tennis shoes are not suitable for this purpose.
5. Use a block to shove short pieces of wood into the saw or planer. If the material slips, a finger may be saved.
6. Use a safety belt and/or platform window jack when washing the

outside of the windows. He should remember that he is working for a public organization and that injuries arising from carelessness are not good publicity for the school.

7. Do not wear gloves or loose clothing around machinery such as pumps or fans, where moving machinery might catch on this clothing.
8. Do not use gasoline to start fires, and kerosene only sparingly, and never on hot coals.

Hazards from Slipping and Falling in Building

Many of the accidents that occur are from falling and tripping in and around the school building. While it is true that children should be and probably are taught not to run down stairways, it must be remembered that the child is full of life and that he does not realize what dangers might be involved. As a consequence, the janitor should endeavor to eliminate hazards which might cause pupil injury in and around the building. One sign that the janitor should post in his work room is "PAYING THE LIGHT BILL IS LESS PAINFUL THAN PAYING FOR ACCIDENT INJURIES." He should realize that plenty of light is one of the best means of preventing accidents. This applies particularly to stairways and to dark corners where pupils and teachers might be injured. Many of the accidents in schools arise from slipping or falling or from contact with rough surfaces. Some of these accidents are harmful to children. Some are harmful only to clothing. Some of the things the janitor can do to protect the pupils or the teacher and their clothing are:

1. Plane off all floor splinters or replace the boards.
2. Fasten bolts and seats in the furniture so that there is less danger of falling.
3. Remove splinters in seats and chair legs with file or sand paper, to protect hosiery.
4. Pull out or drive in protruding nails.
5. Leave no mops or pails in corridors when pupils are passing.

6. Place tape under corners of loose rugs to prevent slipping.
7. See that all hand rails are securely fastened.
8. Reset loose stair treads and nosings.
9. Shield sharp corners.
10. Remove cases and other obstacles from pupil line of traffic.
11. Have exit ways and exit doors opened or unlocked so that the pupils may open them easily at any time when the building is occupied.
12. See that doors swing out with the line of traffic.

Playground

Many pupils are injured each year on the playgrounds from falling and tripping on rough surfaces and on defective playground equipment. Pupils may be injured by slipping on walks. The school property usually has walks around it. In many cases city ordinances require that these walks be protected as well as the walks on the school grounds. In order to reduce the number of accidents of this type the janitor should:

1. Pick up loose nails and boards with nails in them.
2. Keep man-hole of coal pit covered.
3. Remove ice and snow from the walks. If this snow cannot be removed the hazard may be reduced by putting sawdust or salt on the walk.
4. Fill ditches and holes in the playground.
5. Use only smooth wire in wire fences for the school yard. Barbs are more effective but also more dangerous. Repair holes in walks.
6. Put away yard scythe, sharp picks, and any other sharp or cutting tool.
7. Shield teeter boards to prevent catching fingers at the center support. It is also desirable to put blocks under the ends of the teeter so that the children will not catch their legs under them.
8. See that all swings and horizontal bars have good and sufficient supports.
9. Remove rocks from under horizontal bars and horizontal ladders.
10. Place rubber bumpers on swing seats.
11. Remove poison ivy, nettles, briars, thorn bushes, and poison berries from the school yard.

Hazards—Special Rooms

There are many potential hazards in the school boiler room, in the laboratories, the home economics department, in the shop, and in the toilet and shower rooms. In many cases teachers and pupils are not aware that these hazards exist. A number of pupils are injured through boisterous play in the shower rooms and around the swimming pools. Other accidents may occur from carelessness in the use of blow torches or Bunsen burners, and from certain chemicals in the laboratories. It is not possible for the janitor to prevent or eliminate all of these hazards but if he makes a study of them he can take precautions to reduce the possible hazards or to eliminate some of them. Some precautions that the janitor can take are:

1. Watch all gas heaters for fumes. Flexible hose contacts should be permitted only between the shutoff cock and the burners. Even then, a rigid connection is preferable.
2. Watch gas for possible leakage. Gas purchased from service companies usually has in it a malodorant that a leak may be detected easily. All canned gas purchased in pressure tanks should also have in it a malodorant.
3. Have fixed racks for acid carboys.
4. In chemical laboratories keep a woolen blanket to use in smothering possible fires in clothing or elsewhere.
5. Treat tops of chemical laboratory tables to make them acid resisting.
6. Have all machine guards in shops fastened securely.
7. Remove rubbish from around power machines. Eliminate slick floor conditions from around power machines.
8. Keep boiler room clean. Have fire doors free acting. Do not block fire door openings.
9. Watch boiler steam pressure, also water level in boiler. Even "popping off" of the boiler has been known to give alarm to pupils in the building.
10. Pick up soap in shower rooms.
11. Remove all obstacles that might cause tripping around swimming pools.

12. Regulate hot water flow in showers and laboratories. Burns from hot water are painful and should be avoided.
13. Place hand rails on ramps for swimming pool.

Hazards from Electric Current

The electric service in the school buildings creates many potential hazards. Teachers and pupils generally become accustomed to the use of electricity and do not realize the dangers that may be present. Janitors are inclined to forget that the presence of water on the floor may cause him to be a grounding connection between the electric current and the floor. In order to reduce some of the possible electric hazards the janitor should:

1. Keep electric connections tight. All open face panel boxes or switches should be locked.
2. Eliminate electric switches around showers. Locate switch in a place which may be kept dry.
3. Shut off electric current before making repairs or replacing fuse.

Miscellaneous Hazards

A number of school accidents occur from causes which may be attributed to carelessness or lack of precaution. Some of these accidents result from falling objects and others from broken glass. There are a number of precautions that the janitor can take to eliminate this group of injuries. He should:

1. Pick up broken glass.
2. Keep glass in door panels tight to reduce probable breakage. Remove broken glass from windows and doors (This problem is eliminated to a great extent where safety or wired glass is used).
3. Remove statuary that cannot be fastened to insure against falling.
4. Make secure all pictures, urns, and vases.
5. Reset loose parapet wall copings, cornices, and brick on flues. If they cannot be reset, they should be removed. Possible property damage from the removal is less important than probable pupil hazards.

6. Adjust door checks to prevent slamming that might catch fingers.
7. Remove snow from sloping roofs unless snow guards are provided. If the snow cannot be removed, place guard fences around the danger areas until the snow on the roof has melted.
8. Remove large icicles from the eaves. If this cannot be done, place guard fences around the danger area.

Life Protection

In addition to the duties mentioned in the protection against these hazards, the janitor has definite obligations in attempting to protect the health of the pupils. Precautions against health hazards from poor maintenance of fountains, lavatories, stools, and electric lights were discussed under different headings. The janitor should make it a fixed rule to provide ample protection in case of panic. It seems desirable to restate that "EXIT DOORS SHOULD NEVER BE LOCKED AGAINST EGRESS WHEN PUPILS ARE IN THE ROOMS OR BUILDING." This is applicable to all school rooms. It is particularly applicable to auditorium and gymnasium units where large numbers of people may congregate.

Property Protection

The janitor also has obligations in protecting district property against loss, excessive wear, and too rapid deterioration. One loss that occurs frequently around school buildings is that of theft. The janitor can aid in reducing this loss by locking doors at night and by fastening windows and other possible means of entry to rooms and areas where theft is most likely to occur. It should be the duty of the teachers to lock laboratories, laboratory store rooms, shop units, tool rooms, offices, libraries, storerooms for athletic equipment, and commercial departments where typewriters and other machines are kept. If the teachers are instructed and taught by the principal to lock these rooms, the janitor can in a rapid examination before leaving the building determine if these rooms are locked. He can also check exterior doors before leaving the building. As stated previously, the janitor will have a set of keys for all doors in the building and *these keys he should not lend.*

In some cases the janitor is called upon to watch the building during the evening when special programs are held in the building, or on such occasions as Hallowe'en. (Many schools have eliminated Hallowe'en misdemeanors through school supervised activities.) In some of the schools the janitor is made a special policeman with authority to hold or detain miscreants or vandals. There are some advantages in the janitor being given the authority of special policeman, but there are some disadvantages. He probably is not trained as a policeman, and is not in a position to carry out the usual duties of a policeman.

The janitor should be alert to prevent deterioration of the building and of the school property. Broken furniture should be removed at once. Broken gutters should be repaired. Disconnected downspouts should not be permitted to dump the water at a place where it may enter the wall. When the janitor can make repairs that protect the building, he should make them. At times it may be necessary for him to make temporary repairs. At other times it will be necessary for him to report the need to a superior official. He should also report loss through breakage or theft immediately.

Fire Prevention in School Buildings

If schools were wholly of fire resistive construction, and if no people were in them, fire loss would not be a serious problem, but school buildings are not wholly of fire resistive material and even if they were, they have combustible supplies and materials in them. Those in charge of school buildings should know the danger from school fire, not only to the lives of the pupils, but to the property. Proper methods in caring for a building will reduce the potential fire hazards and proper attention given to protective measures and exit facilities will reduce the possible pupil panic that sometimes ensues when a fire alarm is given. Since the school janitor has charge of the building, and since he is the one person who has frequent contact with all parts of the building, it seems that he is best trained and best fitted to eliminate some of the hazards causing school building fires.

If the janitor is to help protect these buildings from fire loss, he should know something of the nature of fire. He should realize that practically all fires start in a small way and could be put out before they do damage. Most janitors know that fire is a form of rapid oxidation. They also know that fire cannot occur or continue unless three factors are present. The fire must have air to support combustion; it must have material for the fire to consume; there must be sufficient heat to bring the material to the kindling point. These three items are part of every fire hazard check.

Fires cause many losses in school buildings each year. A part of this loss is in property values. When property is destroyed by fire, that material is wasted. It may be replaced by new materials, but the old material and the old values are gone. Even if the building is protected by insurance, fire entails losses. In addition to property loss, there is always the possible loss of life and injury to pupils. This, of course, is far more important than the property loss. Another loss that may occur in some of the older school buildings is that of records. It is almost impossible to replace records destroyed by fire. The possible loss and the danger to life resulting from fires makes it essential that school administrators, teachers, and janitors join forces in preventing fires and in reducing fire losses and hazards.

One of the best means of reducing fire loss is to construct buildings of fire resistive materials. This practice is not always feasible because of cost. A second measure of reducing fire loss is to get the pupils out of the building as quickly as possible. Getting the pupils out of the building involves adequate exit facilities and proper exit practices. It is necessary to have adequate facilities for both regular and emergency purposes. The third measure of reducing fire losses is a plan for the extinguishment of fires that do occur. Each of these preventive measures are discussed here.

Fire Prevention and the Janitor

The janitor can do much to reduce the possibility of fires. One of the first things he should learn is that cleanliness aids in fire prevention. The second thing he should learn is that eternal watchfulness is essential in order to keep down an accumulation of fire hazards. After he has located the hazards he is in a position to take the proper steps to eliminate a large number of them. For the purpose of clearness, the possible hazards are grouped under several headings, including those from building structure, furnace room, electric wiring, natural causes, basement and attic areas, special units, roofs, and from careless housekeeping.

Dangers from Building Structure

In many cases, the janitor will have had no part in planning the building. He cannot be held responsible for the fire hazards occurring because of faulty structure or poor planning. He can in many cases reduce the hazard arising because of the poor planning. In some instances, he can make alterations or additions that will reduce the hazard. It is desirable that all furnace rooms have fire resistive walls and ceilings. In some instances where these units were not made fireproof, the janitor has improved the situation by installing asbestos lined ceilings or by placing metal shields in such a way that they reduce the possible hazard. In other cases, hazardous ventilating ducts in combustible partitions and floors have been closed and a different type of ventilation known as corridor ventilation has been installed by the maintenance force. Building planners sometimes fail to protect openings like dumb-waiter shafts or scuttle holes to the attic. The janitor may reduce the hazard by providing a sheet metal cover for the scuttle hole lid or by installing a cover of two inch planks. In order to reduce the hazards arising from the building structure the janitor should:

1. Keep scuttle hole closed.
2. Keep fire doors closed or set with fusible link.
3. Close storage space under stairways or other places where they might create fire hazards.

Furnace Room Hazards

The furnace room furnishes one of the most dangerous places for the origin of fires. Records that are available indicate that the furnace room is one of the hot spots of the building. The fact that it is used for a heating plant creates some fire hazard. As stated previously, the furnace room is not always sufficiently segregated from pupil areas. The location, together with the use of the room for storage purposes, makes it one requiring frequent attention from the janitor if fire hazards are to be eliminated or reduced. Some furnace room practices which help reduce fire hazards are:

1. Moving out rubbish and waste. The furnace room is not a good store room.

2. Removing all combustibles from near the furnace. This applies to coal bins, waste paper boxes, or other fixed or movable materials.
3. Have suitable containers for ashes. Paper or wood boxes are not suitable containers and should never be so used.
4. Watch the furnace that the fire does not get too hot. Cracked furnace walls or a furnace that is too hot may cause a fire.
5. Gasoline is never used to start fires. Kerosene is used only sparingly and never applied to hot coals. If kerosene is used, soak stick in the kerosene and then apply the match to the stick. Kerosene should not be poured directly from the can or container on the fire.
6. Watch water level in boiler. Explosions resulting from semi-dry boilers may create fires. Even automatic controls need to be inspected.
7. See that steam lines, boiler pipes, and smoke pipes have proper clearance between them and any combustible materials. If this clearance is not available, provide protection by suspended sheet metal between the pipe and the combustible material so that air space will be on either side of the sheet metal and so that the sheet metal will not contact either the pipe or the combustible material. If possible, lay a sheet of asbestos on top of the sheet metal.
8. In banking fires, do not leave the doors open, particularly if there is any combustible material in the boiler room that might be ignited by flying coals.
9. Inspect smoke flue frequently. Cracks or holes in the flue may lead to fire loss.
10. Watch adjustment of oil burners. Oil running over into the fire box creates hazards.
11. Use extreme precautions in lighting gas fires.

Electrical Fire Hazards

Because of the nature of electricity it offers many possible fire hazards in school buildings. The fact that so many people have become accustomed to the use of electricity and the fact that so many of them know little about it adds to the danger that may be incurred from misuse of electric current and electrical appliances. Electric current represents or is energy. If properly controlled, there is little hazard but if too much energy is carried on wires or through connections that are not properly adapted to carry this load, the wires may become hot and cause a fire. Poor connections, overloading, overfusing, worn out and broken wiring, and misuse are probably the most common causes of electrical fires. Records indicate that electric wiring is responsible for a substantial number of school fires. There are a number of ways in which the janitor can reduce the danger from electrical fires. Some of them are:

1. Avoid causing wires to heat from overloading or overfusing.
2. Watch for bare or exposed wires resulting from poor splices, from contact of the wires with some abrasive surface, and from decomposed insulation. If the wire inlets have no drip loops, water may run down the wires, causing the insulation to rot.
3. Discard broken extension cords.
4. Move any combustible materials some distance from open type motors that might throw off sparks.
5. Equip all irons, other heating units, and soldering irons with automatic pilot light which shows red when the unit is in use.
6. Avoid putting radio and clock wire in same conduits with power currents.
7. Use only rigid connections for heavy duty outlets.
8. Remove fuse boxes and open lamps from laboratories where combustible chemicals and gases may be present.
9. Check picture booths for exits and for automatic door closing devices.
10. Inspect rheostat control of dimmer bank for resistance and heat development during use.

A janitor can, by watching and checking the items just mentioned, do much to prevent possible electric fires. He can also reduce the possible hazards by:

11. Supervising or advising against Christmas decorative lighting.
12. By seeing that exit lights are in working order and on when building is in use at night.
13. By checking switches frequently to note conditions and to see that there is no arcing.

Spontaneous Combustion, Exposure, Lightning

Certain combustible materials have a tendency to oxidize at room temperatures. This is particularly true with certain oils and to a lesser extent with coal. If this oxidation proceeds rapidly enough, heat is generated to the point that ignition follows. The danger of ignition is greater if there is little air movement to cool the materials and to carry off the gases that may be generated. This oxidation and the ignition that follows is termed spontaneous combustion. Oil and paint soaked rags are particularly susceptible. When spontaneous combustion occurs in coal bins it may be possible to check it by soaking the coal with water. This, however, does not remove the cause. As the water is removed the trouble may return. In many cases it will be necessary to move the coal.

School buildings are susceptible to fire hazards from lightning and from exposure. Some lightning protection may be obtained by the installation and maintenance of lightning rods. This is particularly important in the protection of tall smoke stacks. Other hazards may arise from exposure from other buildings, from bonfires, or other fires outside the building. The janitor can assist in eliminating fires from these sources by:

1. Putting all oily rags and mops in tight metal containers.
2. Watching coal bins for spontaneous combustion.
3. Making secure all lightning rod connections and by extending ground connections to moist earth.
4. Using incinerator for burning leaves and papers.
5. Having hose or pails of water ready when bonfires are lit.
6. Reporting probable hazards from neighboring sheds or buildings.

Basement and Attic Areas

Basement and attic areas are the starting points of a large number of our school fires. In older buildings with high gable roofs the attics are often used as a store room for holiday decorations and other combustible materials. In addition, many buildings have old wiring in the attic from which the insulation has rotted away. Smoke flues often extend up through the attic and sparks passing through flue cracks may start fires. Basement areas are also often used as storage rooms for paints, oils, and other combustible supplies. In most cases these areas are entered only occasionally. Waste paper may collect and disintegrate or be cut up by mice to become a veritable tinder box ready for the spark. In these somewhat secluded areas, fires that start may gain considerable headway before being detected. In order to reduce the fire hazards from these sources the janitor should:

1. Store no combustibles in these areas.
2. Destroy, not store, highly inflammable materials like scraps of crepe paper and flimsy decorations.
3. Store paints, oils, and other inflammable materials in fireproof cases or closets.
4. Burn or bale waste paper.
5. Remove all rubbish.
6. Keep all store rooms clean and visit often.
7. Burn junk.
8. Check wiring in attic for exposed wires and for contact with joists.
9. Examine attic flues for cracks and holes.

Hazards in Special Units

Shops

Because of the nature of the work done in shop units, a number of fire hazards are created. Some of the most pronounced hazards arise from the use of glue pots, open motors, blow torches, gas engines, forges, and from certain activities such as painting. The presence of shavings and sawdust add to the possible hazards. In many cases, the instructor should be held responsible for these hazards. Other hazards arise from the lack of dust bins and suction fans. The janitor can:

1. Place protective insulation under glue pots.
2. Blow dust out of dirty motors.
3. Remove shavings and sawdust.
4. Provide insulation for walls and ceiling of finish room, and fireproof cases for paints.
5. Keep all gasoline in cans bearing an approved Underwriters label.
6. Oil shaft bearings to avoid hot boxes.
7. Place fireproof floor under forges, provide cooling vat.

Home Economics and Cafeteria Units

The presence of stoves for cooking, greases, and electric irons help make fire hazards in these units. Some of these hazards seem inherent in the nature of the work done, however, the janitor can eliminate some of the worst hazards by:

1. Installing a shield between hot plates and the tables under them.
2. Placing shield under coal and kerosene stoves.
3. Providing metal box storage for matches.
4. The installation of protective pilot lights for all irons and electric heating units.

Laboratories

The storage of chemicals and the use of motors add to the possible fire hazards in laboratory rooms. The fumes from some chemicals are quite inflammable and may ignite with the first spark. Bunsen burners carelessly used may set fire to tables. In order to reduce these hazards the janitor may:

1. Install gas tight electric lights.
2. Provide fireproof earthen jars for waste.
3. Provide wool blanket for smothering fire.

Auditorium and Dressing Room Units

The combustible nature of stage scenery and the storage of stage scenery and costumes in dressing rooms often make fire traps of these areas. The large amount of current used for stage lighting and faulty resistance coils in dimmer banks may add to these hazards. Picture booths are not always properly installed, ventilated, or protected. To some extent the janitor can reduce the fire hazards arising from these causes by:

1. Frequent inspections of wiring and dimmer banks.
2. Removal of rubbish from dressing rooms.
3. Installing fusible link drop shutters and door closers in picture booth.
4. Keeping exits open and exit lights turned on when the room is in use.

Roof Hazards

The roofs of school buildings collect leaves which ignite easily. Roofs of combustible construction, particularly those with old wood shingle surfaces, are the source of many school fires. The janitor should:

1. Remove leaves from valleys and gutters.
2. Make frequent inspections to see if live sparks and cinders have made dark burned spots on the roof.
3. Advise principal or superior officer of hazards found.

Careless Housekeeping Practices

Hazards arising from careless housekeeping practices are indefensible. The janitor who knows his job and has a pride in it will have few or no fires arising from poor housekeeping. Accumulated dirt or rubbish and fire hazards are boon companions. Lack of attention to details may cost the loss of property values and perhaps even the lives of pupils. If the janitor does not care, he should be replaced by one who does. If he does not know, he should make an effort to find out how to reduce the fire hazards in the building. He should know that:

1. Matches should be kept in metal mouseproof cases.
2. Smoking if permitted should be done only in protected areas.

3. Quantities of gasoline or naphtha are not needed in the building.
4. All waste should be removed from the building. This applies particularly to rags and paper.
5. Gas leaks may cause serious explosions.
6. Broken plaster may admit fire into secluded places where it is difficult to extinguish.
7. Broken windows should be repaired.
8. Waste cans for paper and other rubbish may prevent fires.
9. Cleaning floors with gasoline is dangerous and should never be permitted.
10. Fire prevention requires eternal vigilance.

Getting Pupils Out of the Building

Despite the usual fire prevention measures, fires may occur. Hence, it is desirable that school officials have well developed plans to get the pupils and teachers out of the building quickly and with the least possible danger to them. To this end school officials should plan for building evacuation and practice same until pupils become familiar with the method of leaving the building. The task of planning and conducting fire drills belongs to the principal and teachers. However, the janitor does play an important part in building evacuation in case of a fire. In fact, since the janitor may often be in a position to be the first one to notice a fire, the safety of the children may depend much on his action.

One of the first things for a janitor to do when he locates a fire is to determine whether he can put it out immediately. If so, he may extinguish it. If he cannot put it out at once, he should sound the fire alarm. Some school regulations require that a janitor sound the alarm even after he has extinguished the fire. It is desirable that average and small sized buildings be equipped with a mechanical gong fire alarm system that can be operated from any floor and that will sound on each floor loudly enough to be heard at all times. If an electric system is installed in the building it should meet the same requirements and should be wired in conduits separate from the power and/or lighting current. All fire bells or gongs should be different in tone and volume from the class bells. It may be well to have established a bell code indicating whether any exit is blocked.

After sounding the building alarm the janitor should notify the city fire department if one is available. His later actions will depend somewhat on the location and nature of the fire. If the fire is still small he may return to try to prevent spread. If it is located in a spot where it may be cut off by closing doors, after pupils are out of this area, he should close these doors. He should remember that pupil safety is more important than property protection. In any well established plan of evacuation he will have specific duties assigned him. If he does not have a definite assignment he may find it advisable to check to see if any pupils remain or if any need help in getting out of the building. As outlined elsewhere all doors will be unlocked for egress and will have safe stair and hand rail facilities. He should remember that panic in the janitor breeds panic with the pupils.

No janitor can expect to render the best service in fire protection unless he has planned ahead for such occasions and unless he has made some study of fires and their extinguishment. He should know the various types of school fires; their methods of spreading, and the hazards involved.

Classes of Fires

There are three or four major types of fires that may occur in school buildings.

Class "A" Fires—These include those of wood, rubbish, paper, cloth, coal, asphalts, and other comparatively slow burning materials.

Class "B" Fires—This class includes rapid burning materials such as oils, paints, varnish, kerosene, gasoline, and linseed oil.

Class "C" Fires—This class includes fires around motors, generators, hot wiring and other electric equipment.

Class "D" Fires—These include fires in automobiles, busses, and trucks. They often become a combination of a flashing fire from a volatile gas accelerated and intensified by oil covered machinery.

Fire Extinguishment

The janitor needs to know the principles of combustion and of fire extinguishment. He should know that heat, combustible material, and oxygen are necessary for any fire. Remove either of these and the fire dies out. It is not generally possible to get close enough to the fire to extinguish it by removing all combustible material in the burning area. However, this is a practice often followed in subduing leaf or grass fires and most janitors are familiar with the method of raking an open path ahead of leaf or grass fires. A second method of putting out fires is smothering or cutting off the supply of oxygen. This is the method used in putting out fire with a blanket or sand. The third method of extinguishment is to cool or chill the material to below the kindling point. Water is the universal agent for this purpose. However, a few fire extinguishers have a chemical in the water to aid in reaching the cooling point (for fire) more quickly.

Fire Extinguishing Agents

Although he may never have to use them, every janitor should know the various fire extinguishing agents and the types of fire extinguishers. The most common extinguishing agent is water. In general, this agent is used to cool the combustible material below the kindling point. On some oil or gasoline fires water may float the lighter oil on top of the water and cause the fire to spread. The skilled janitor or fireman may be able to use his thumb or some object to form a hooding spray from the stream of water and cut off the oxygen, thus smothering the fire. In an emergency this is not recommended for a janitor who has not practiced this form of extinguishment. Sand or other non-combustible powders may be used to extinguish small oil fires. They are not of much value for oil fires in deep vats. Since a fire must have air, certain chemicals that form a non-volatile gas will shut off the supply of air thus smothering the fire. Carbon-tetrachloride and carbon dioxide are two chemicals often used for this purpose. These should be applied in a small stream or spray at or near the base of the fire.

Fire Extinguishers

Many schools are now equipped with fire extinguishers. Some have questioned the value of fire extinguishers in promoting pupil safety, contending that all pupils can be removed from the building safely if a fire is small enough to be put out by an extinguisher when first detected. Without attempting to evaluate this contention we do know that fire extinguishers properly cared for and used may save a school building and its contents from destruction. Proper care involves proper placement, protection from freezing for various types, occasional testing or checking, and for certain types recharging at regular intervals. The location will depend on the arrangement of the building. In general certain extinguishers should be located in known hot spots such as the boiler room, shops, and laboratories. One regulation often recommended is that no one should have to travel over 100 feet from any place in the building to reach an extinguisher.

Standpipe and Hose

This system is good for Class "A" fires. The hose is usually an unlined fabric hose about one and one-half to two inches in diameter. It is of more value if connected to a four inch main. The hose should be folded in racks so that it may be used quickly. It should be inspected monthly and tested yearly.

Sprinkler Systems

A few schools are now installing an automatic sprinkler or spray system. These are set off by heat and are particularly valuable for secluded hot spots like attics, basement storage rooms, finishing rooms, or closet spaces. Little care is needed other than to provide water pressure and to prevent freezing.

Soda-acid Extinguishers

These extinguishers usually come in two-and-one-half gallon sizes. The body of the can (container) is filled with a strong soda water solution. In the top just under the lid there is a bottle of sulfuric acid fitted with a weighted cork. In operation most janitors carry the can by the top bail or handle held in the right hand while the left hand holds the bottom of the can. On approaching the fire the can is inverted. The cork of the acid bottle falls out and the resulting chemical action from the acid and soda water forms a pressure to throw a stream twenty-five to forty feet. This type of extinguisher is effective on Class "A" fires. Its action comes primarily from cooling. Before use the can should be hung or set up in a place where pupils will not turn it over. When it is once turned over it must be refilled. Since it is subject to freezing it should be protected against temperatures below 32° F. Ready made refill charges can be obtained through supply houses. In many cities the local fire department will refill free of charge. The janitor can make up his own refill charges using water, sulphuric acid and bicarbonate of soda (bulk). The acid bottle in the top is marked to show the amount of acid to use. About one to one and one-half pound of soda will be required for two and one-half gallon extinguishers. Mix soda and water and fill container to mark (which is about eight inches below top). Each of these extinguishers should bear a tag showing date of refill. They should be refilled yearly. (Note, they are conductors and should never be used on fires around electric motors or electric wires.)

Foam Type Extinguishers

These extinguishers are usually filled with water, a solution of aluminum sulphate, and sodium bicarbonate, plus some foam making ingredient. Like the soda-acid extinguisher this one is used by inverting. It is subject to the same care and protection in preventing against freezing and overturning while in storage. It works principally as a smothering agent but because of the water content has some cooling effects. It is best for Class "B" (oil) fires but has some value on small Class "A" fires. Not good on electric fires.

Carbon Tetrachloride Extinguisher

This extinguisher comes in various sizes. It is worked by the hand pump in the end. It is good for small Class "C" or electric fires since the material is a non-conductor. It is also valuable for Class "D" fires and is standard equipment in many busses. It does not freeze easily. It should be tested frequently to see if it is filled and in working order. A supply of the liquid can be kept on hand for refilling. It has a smothering effect and should be aimed at the base of the fire.

Carbon Dioxide Extinguisher

This extinguisher has a cylinder filled with carbonic acid gas liquid under pressure. The liquid when released forms a sort of carbon dioxide snow. This has some cooling effect but works principally by smothering. This type is particularly adapted for use on Class "B" fires. The carbon dioxide is a nonconductor; hence, this extinguisher is quite good for Class "C" fires. It is also good for Class "D" fires. The extinguisher is operated by releasing a valve. Since this extinguisher is filled under pressure the filling must be done at a factory or shop where the pressure is available. The contents are not subject to frost damage.

Force Pump Tank Extinguisher

This type of extinguisher furnishes an ever ready supply of water for use on small fires. The pump is operated by hand. The water contents have a cooling effect on the burning materials. The water contents should be protected from freezing, otherwise, no other special care is required.

Other Extinguishers

There are some other extinguishing agents and extinguishers. Some of them are promoted by manufacturers or sales agencies. At times efficient extinguishing agencies are recommended for a use for which they are not adapted. The janitor can determine whether an extinguisher is adapted for the needs of his building by examining the Underwriters label. This approving label tells for what use this particular extinguisher is recommended. While there may be some good extinguishers not bearing this label, the label is evidence that the extinguisher has been tested and approved by competent judges.

Characteristics of Hand Fire Extinguishers

Type of Extinguisher	Adapted for Use On: Class "A" Fires — Wood, Textiles, Rubbish & Slow Burning Materials	Class "B" Fires — Oils, Paints, Varnish, etc.	Class "C" Fires — Electric Machinery Switchboard Generators, etc.	Class "D" Fires — Automobiles, Trucks, Motorboats, etc.	Method of Operating	Principal Extinguishing Effect
SODA ACID Must be kept in heated cabinet if installed in places subject to freezing	The best available in buildings and places not subject to freezing temperatures	No	No	No	Invert. See instructions on extinguishers	Cooling or wetting down the burning materials
FOAM Must be kept in heated cabinet if installed in places subject to freezing temperatures	Must be kept in heated cabinets in locations subject to freezing	Yes Very Good	No	No	Invert. See instructions on extinguishers	Blanketing or smothering also some cooling effect
TETRACHLORIDE If proper charge is used will not freeze in temperature at 40° below zero	No	No	On small fires only	The best available	Hand pump action or compressed air—see instructions on extinguisher	Blanketing some cooling effect on very small fires
ANTI-FREEZING This type of extinguisher when properly charged will not freeze in temperatures at 40° below zero	Very good	No	No	No	Invert. See instructions on extinguisher	Cooling or wetting down of burning materials
LOADED STREAM This type of extinguisher when properly charged will not freeze in temperatures at 40° below zero	Very good	No	No	No	Invert. See instructions on extinguisher	Cooling or wetting down of burning materials also fire-proofing effect
PUMP TANKS Water or with calcium chloride added depending on lowest temperature likely to be encountered	Yes	No	No	No	Hand pump action	Cooling or wetting down of burning materials
CARBON DIOXIDE or CO_2 GAS This extinguisher will not freeze	No	The best available	The best available	Very good	Manually operated valve or valves. See instructions on extinguisher	Blanketing also some cooling effect
DRY CHEMICAL OR DRY POWDER EXTINGUISHER	No	Very good	Very good	Yes	Manually operated valves. See instructions on extinguisher	Blanketing or smothering

Maximum Reach of Stream or Extinguishing Agent	Method by Which Pressure Is Created	Rated Liquid Capacity or Amount of Extinguishing Agent	Chemicals Employed	Nature of Principal Extinguishing Agent	Quantity of Principal Extinguishing Agent Produced	Underwriters Rating
40 Ft.	Chemical reaction	2½ Gallons	Bicarbonate of soda water and sulphuric acid	Liquid Soda Solution	2½ Gallons	A 1
40 Ft.	Chemical reaction	2½ Gallons	Aluminium sulphate bicarbonate of soda and foaming agents	A mass of bubbles filled with carbon dioxide gas	Approximately 20 Gallons if properly charged	A 1, B 1
40 Ft.	Hand pump action or compressed air	1–1¼–1½ and 2 Qt. also 1 Gallon	Special liquid with components added to depress freezing and to avoid corrosion	Liquid fire gas produced when vaporized by heat of fire	Quantity variable depending on amount of liquid coming in contact with fire	See Underwriters label on extinguisher
40 Ft.	Burning of safety fuse	2½ Gallons	Calcium chloride special grade safety fuse cartridge	Liquid calcium chloride solution	2½ Gallons	A 1
40 Ft.	Chemical reaction acid mixing with anti-freezing solution	1–1¾ & 2½ Gallons	Special acid and special anti-freeze solution	Liquid special alkali metal salt solution	1–1¾ & 2½ Gallons	See underwriters label
40 Ft.	Hand operated double action pump	2½ & 5 Gallons	Plain water or a solution of calcium chloride	Liquid Calcium chloride solution	2½ & 5 Gallons	See underwriters label
10 Ft.	Compressed gas which expands many times its volume when inliberated	4–7½ 10–15 25 pound sizes	Compressed liquid carbonic acid gas	Inert gas which resembles snow when liberated from cylinder temp. about 110° below zero	Quantity variable depending on conditions	See underwriters label
12 Ft.	Compressed gas	20 pounds	Specially treated Bicarbonate of soda and compressed gas	Inert gas and white powder	Quantity variable depending on conditions	See underwriters label

In using extinguishers the janitor should know the effect desired. Smothering type extinguishing agents are effective in close spaces where there is no strong current of air to bring fresh oxygen to the fire. For this reason, automatic bomb type smothering extinguishers are not of great value in large attic areas. In use this extinguishing agent should be directed at the base of the fire. Water or other cooling type extinguishing agents may be applied directly to the burning materials. A handy chart prepared by Captain H. C. Ousley of the Missouri Inspection Bureau is shown on the accompanying pages. This chart describes the types and uses of fire extinguishing agents. A copy of this or a similar chart should be pasted on the wall of the workroom of each janitor.

The janitor should make frequent building inspections to locate the fire hazards and to check the condition of the exits, the fire escapes, and the fire fighting equipment. In many school districts the officials of the local fire department will assist the janitor in his study of fire prevention and pupil safety. In some cases local school officials, the janitor, and a member of the local fire department make an annual inspection of the school building to study fire hazards and safety facilities. Some school officials use the "Self-Inspection" blanks prepared by the National Board of Fire Underwriters, in checking fire hazards, with satisfying results.

A number of schools have fire hazard and exit safety check forms for local use. In some of the janitorial training schools janitors are taught the methods to be followed in making building inspections. They are also taught how to remove many hazards. Most of these periodic inspections cover occupancy hazards. The building structure hazards are generally covered in the annual inspection.

The sample check list or inspection blank which follows can

Check List of Fire Hazards and Exit Facilities in Schools

________ DISTRICT	________, 19__
________ BUILDING	CHECKED BY ________
________ TYPE OF SCHOOL	APPROVED BY ________
________ ENROLLMENT	

(Check lists should be made in duplicate, one copy retained by the checker and one copy turned to the office. Fill blanks by checking "√" in proper column. By comparing last check with previous ones it is possible to determine the improvements made.)

	SATISFACTORY	FAIR	NEEDS ATTENTION
I. Exit facilities................			
1. Doors....................			
A. Open out............			
B. Unlocked when building occupied.........			
C. Panic bolt operation..			
2. Exit lanes..............			
A. Obstructions..........			
B. Stair hand rails......			
C. Slick places on stair or in entrance........			
3. Window, screens open out, easily..................			
4. Fire escapes.............			
A. Rigid, accessible.....			
B. Free from ice........			
C. Windows, wire glass..			
5. Exit signs and lights...... Glass intact, lights o. k. ..			
II. Fire alarms and fire fighting facilities....................			
1. Alarms..................			
A. Type...............			
B. Accessible...........			
C. Condition...........			
D. Fire department connection............			
2. Fire fighting facilities......			
A. Hose, location and condition............			
B. Wool blanket in laboratory............			
C. Fire extinguishers.... Type—adapted to need................			
Number............			
Location...........			
Chemical recharged in last 12 months.....			

Check List of Fire Hazards and Exit Facilities in Schools

	Satisfactory	Fair	Needs Attention
III. Hazards from outside			
1. Combustible structures near			
2. Other outside hazards			
IV. Heating plant and furnace room hazards			
1. Furnace			
A. Cracks			
B. Smoke pipe protection			
C. Combustibles near			
D. Overloading			
2. Steam boiler			
A. Pressure control			
B. Automatic cut-off			
C. Protected steam lines			
D. Water level			
3. Fuels			
A. Coal bin inspection			
B. Remote cut-off gas or oil			
C. Segregation of fuel			
4. Smoke flue, cracks			
5. Fire door, operation			
6. Furnace room practices			
A. Ash storage			
B. Gasoline in room			
C. Starting fires			
D. Banking fires			
E. Rubbish in room			
V. Roof and attic openings			
1. Roof			
A. Leaves in gutters and valleys			
B. Condition of roof			
2. Attic			
A. Rubbish			
B. Flue leaks			
3. Building openings			
A. Waste in ducts			
B. Scuttle hole closed			
VI. Electric hazards			
1. Wiring			
A. Rigid connections			
B. Switches—arcing			
C. Wires protected			
D. Extension cords			
E. Wires, size			
F. Overloading			
G. Fusing			
2. Motors protected			
3. Dimmer bank			

Check List of Fire Hazards and Exit Facilities in Schools

	Satisfactory	Fair	Needs Attention
4. Picture booth			
5. Pilot lights			
6. Hot plate protection			
VII. Storage			
1. Closets			
A. Location, use			
B. Condition			
2. Supply rooms			
A. Type of materials stored			
B. Frequent inspection			
3. Special storage for combustibles			
A. Waste paper			
B. Paints and oils			
C. Floor waxes			
D. Oily rags and mops			
E. Gasoline			
VIII. Hazards in special rooms			
1. Shops			
A. Glue pots			
B. Waste and rubbish			
C. Forges			
D. Paints and oils			
2. Auditorium			
A. Dressing room storage			
B. Picture booth protection			
3. Cooking rooms			
A. Stoves			
B. Gas connections			
C. Hot plates			
4. Laboratories			
A. Stone waste jars			
B. Lights shielded			
IX. Miscellaneous and housekeeping hazards			
1. Use of incinerator			
2. Lightning rod connections			
3. Housekeeping practices			
A. Gas leaks			
B. Waste cans			
C. Matches, storage			
D. Smoking			
E. Rubbish in the building			
F. Broken plaster			
G. Use of volatile oils			
H. Waste cans			
Comments:			

in most cases be filled out by the janitor. However, local school officials should assist in making a check of the hazards at least once each year.

Fire Protection No Job for a Lazy Janitor

It is realized that the duties and obligations of the janitor outlined here are quite numerous. They may be burdensome for a swivel chair janitor. However, the alert, energetic, janitor will want to know more about his job. He will want to be able to demonstrate the fact that he is a specialist in building care and management. It is sometimes difficult for the local janitor to know the things he should do to promote safety in his school. Many janitorial schools now provide courses for training janitors in fire protection, and in the elimination of hazards in the school building and on the grounds. If the janitor can provide proper protection for his building and the people in it he will have, in addition to the appreciation of his patrons, the satisfaction of a job well done.

Chapter 9

Developing a Planned Work Program

In chapter three the part of the administrator in the development of a work program was outlined. In this section attention will be given to the duties and obligations of the janitor in developing a work program. Although many custodians admit the need for a system of work, only a few of them do anything about it. Some of these men feel that the administrators do not appreciate the many obligations and duties of the janitor. This complaint may have some basis. The administrators are busy people and may neglect the janitorial force until something goes wrong. They have too often accepted both good and bad work without comment. A part of this lack of appreciation and understanding is a carry over from the days when janitorial selection on the basis of sympathy or friendship made it difficult to secure and retain competent men.

During recent years many changes have been made. More and more the janitor is becoming a trained worker. As a trained worker he strives to improve the status of his position and the quality of his work. Janitors should not expect teachers and administrators to grant them high appreciation and standing until the janitors have proved themselves worthy. Only by their own efforts in demonstrating their skills, abilities, and knowledge with results obtained can the janitors expect to obtain the appreciation they should merit. Changes in the standing of the janitorial force are coming. In too many cases, the janitor still is a worker with his hands and fails to demonstrate that he has a plan and program of work. Some men may be called "good fellows" or "hard workers" and yet not gain much recognition as building maintenance specialists. The man who is going somewhere should have a destination. He should have a plan. This plan should be laid out in steps so that he can see progress as he goes forward. He should also have a checking device to determine what progress he is making and the things he expects to do. He should have something tangible to show to his superior officers. To this end, a work schedule is of prime importance.

Making a Work Schedule

There are so many factors involved in the making of a work schedule that it is difficult to lay down any set rules or plans. The type of school organization and the administration of the building maintenance program are the determining factors in schedule development. In some instances, there will be a superintendent of buildings and grounds who will collect requisitions from the janitors and group them into one master requisition to be sent to the purchasing officer. This man can assign men to various jobs and recommend men for demotion and promotion as well as plan the work for smaller repairs and outline procedures for various tasks. He keeps all personnel, payroll, and attendance records, makes the annual report, and acts as contact agent between janitors and other school officials. He hears and evaluates complaints, and develops a training program for apprentices and men in service. In other schools where no superintendent of buildings and grounds is employed, the janitor in a building may have to perform all these duties in some form or other. The janitor has a dual responsibility.

If a superintendent of buildings and grounds is employed, it is probable that the janitor will be under his supervision in repair work, for the quality of his work, and to some extent for the procedure. On the other hand, he will be under the supervision of the principal for his relations with the school, and for those activities that contribute to the welfare of the school. In addition to this, many janitors are subject to the call of the teachers for transferring material, cleaning up after sick children, and for various minor duties or chores. These add to the difficulty in developing a schedule of activities which would make best use of the available time of the janitor.

Buildings and Ground Conditions

If all buildings were of equal size and located in similar areas, schedule making would be comparatively easy. One building may have fourteen rooms yet not be large enough for two janitors, while another building of six rooms will require a full time janitor. It is obvious that the loads will not be comparable, yet if the board of education is to secure a good man for each job, reasonable salaries must be paid and these cannot be based wholly on the amount of work done. In many buildings of thirty to fifty rooms it is easier to divide the work so that every man will have approximately the same load. Maintenance methods vary with the age of the building. Old worn floors are much more difficult to maintain than are some of the newer smooth surfaces. Even the height of the building may make a difference in the total load. It is obviously easier to care for rooms on the same level than when the janitor must carry his supplies up and down stairs. The location of the building is also a factor. Site variations play an important part. Some playgrounds are muddy and permit pupils to bring in quantities of dirt which have a deteriorating effect on the floors and which make it difficult to maintain a clean building. The size of the site, the number of ornamental shrubs, the amount of lawn to mow, the number of walks to clean, and the amount of hedge to be trimmed must be considered in establishing the janitor's load and in making out a schedule of activities. Special rooms like laboratories, cooking rooms, cafeteria, and shop units, cannot be grouped with regular classrooms in establishing time unit measures of the work of the janitor. These factors must be considered in planning the schedule.

Many conditions inside the building also become important factors in time allotment for the janitor. The type of heating plant, the location of the heating plant, and the type of fuel used may make a great difference in the time required each day for temperature control. Obviously, the janitor having an automatic oil burner or even a stoker with automatic temperature and ventilation controls has a far different problem than has the janitor that shovels coal and who may have to carry out ashes and cinders in pails up narrow stairways. The type or location of the radiators may also be important since it requires more time to clean under radiators set close to the floor than under those hung on the wall or enclosed in cabinets. The number of plumbing fixtures and the type of fixtures should be given consideration in planning the daily and weekly activities. If consideration is not given to these factors, it is probable that some of the work will be neglected. The amount of bulletin board and blackboard space, the size of the window panes, the type of finish on the woodwork and floors, the amount of nickel and brass to be polished; and facilities for storing wraps for children may be important factors in time allotments for janitorial activities. It is impossible to make a schedule of activities for a janitor in a building until these building conditions are taken into consideration.

Tools and Supplies

In some buildings janitors have more tools than they need. In others, about the only tools the janitor has are those that he brings from home. The type of tools and supplies provided must be given consideration in the development of a work schedule. The cleaning tools range from the old corn broom through a list including brushes, dust mops, scrub brushes, scrubbing machines, sanitary dusters, and radiator brushes, to a complete vacuum cleaning system. In attempting to set up a work load of similar areas for men using different types of cleaning tools, one should consider the time element involved in obtaining satisfactory work with the different tools. Some janitors spend hours in dusting erasers by some crude method while other janitors clean forty to fifty erasers per minute by some approved method and with a satisfactory tool. The type of metal and wood working tools usable for repairs will make a substantial difference in the time required to do minor repair jobs. Likewise, the difference in time in the use of a power lawn mower and the small hand lawn mower may determine whether or not the janitor must spend most of his summer months in lawn mowing. In addition to the tool variation, the type of chalk used in the building, the type of detergents, and the type of floor seal and floor wax will make a difference in the time required for the various activities.

Organization of the School

In setting up any work schedule for a building in a large system, it is necessary to consider such factors as the age of the pupils in the building, the organization of the school, the demands of the teachers, and the local building regulations. Tests have indicated that it requires more time to sweep under small primary seats than under seats used for high school students. On the other hand, auditorium units with fixed seats require more time than do similar areas with movable seating; however, the time required for moving the flexible seating should be considered. As has been stated several times, the work of the janitor is for the purpose of maintaining satisfactory plant facilities for the school program. Variations in methods of teacher control may make a big difference in the requirements upon the janitor's time. In many cases, he is obligated to perform many tasks that are in another building performed by teachers. In some cases the janitor is required to remain in the toilet room for boys during the morning and afternoon recess intermissions. This one activity may consume daily thirty to forty-five minutes of the janitor's time. In other cases, the janitor is requested to watch that children do not destroy shrubbery or other school property.

School housekeeping should be a cooperative activity, where teachers encourage pupils to assist in maintaining an attractive building by keeping paper off the floor and by refraining from marking on the walls and destroying property. If pencils and books are left on the floor and stickers are pasted on the blackboard, the janitor must remove them and must have time allotted for these duties. The local school regulations concerning the after hour and out of school use of playgrounds by children may determine the time that the janitor is permitted to lock up the playground equipment and the toilets before going home. The fact that many schools do not have a room designated as a lunchroom may make a difference in the cleaning duties throughout the building. Teachers may request that their room be kept excessively warm. In other cases, teachers stay a long time after school to do work. A plan must be developed regulating closing practices and room entry for cleaning. There must be a definite regulation concerning the amount of the janitor's time teachers may consume with requests for various errands and chores. The amount of record keeping and report making made necessary by local board regulations will play an important part in the allotment of time to various activities for the janitor.

Setting Up Time Requirements

One of the first considerations in setting up the time requirement in a work schedule is the total time to be allotted for janitor work. In most cases the janitor expects to remain in the building as long as necessary to do the work. The janitor should not be expected, however, to come to the building at 4:30 or 5:00 o'clock in the morning and then to stay at the building until 8:30 or 9:00 in the evening in order to close it after some practice periods or after some public meeting. Regardless of whether the janitor is working at hard labor all of the time he is in the building, he should not be expected to stay on the job fifteen or sixteen hours per day. It is true that in many cases local administrative practices make these long hours necessary. It is also true that in many cases proper cooperation between teachers, administrators, and the janitor and a system of janitorial work make it possible to eliminate the long hours. If it is not possible for the janitor to do his work in a reasonable number of hours, more help should be provided. If it is possible for him to do them in a shorter number of hours and he, by dilatory practices stretches these hours out, he should be reprimanded or released. There have been many measures used in attempting to set up a janitor schedule. Some of these are square feet of floor area, the amount of yard area, the number of pupils in the building, number of rooms, and the area of the yard. The various factors involved make it difficult to establish the load of the janitor on any one of these measures. If the janitor has only cleaning work to do then one can determine the square feet of floor area of treated floor surface that he may be expected to clean per hour. But when he must care for certain plumbing fixtures, when he must devote some time to the care of the heating plant and to yard care, the square foot of floor area measure loses much of its value. The same is true of practically any other general measure.

The method which seems to offer the best measure is what may be called a unit time measure. This measure is established by the janitor by actual trial. First, the janitor makes up a list of various activities and duties. This list cannot be made up until he has been on the job some time. He notes the number of times per day or per week that each different task recurs. By checking, he soon determines the time required for each of these tasks. After noting the number of times this task must be done each day or week, he soon is able to determine the total daily or weekly time required for this particular activity. When he has determined the amount of time required for each activity during the week, he is in a position to develop a tentative schedule of activities. However, this schedule cannot be developed until he has set up the total load. This means that he must allot some time for emergency activities, and for ever recurring tasks which must be done weekly or monthly. It probably will be wise for the janitor to set up a chart on which he may mark for several days the amount of time required to do a particular task.

How to Set Up a Schedule

There is no need for some of the excessively long hours of service. There are many ways in which these long hours may be reduced. Extra help can be employed for evening duties.

Teachers should be told that the janitor must be permitted to clean classrooms during the day so that he may not have the bulk of his work piling up after four o'clock in the afternoon. In large buildings it may be desirable to arrange to have one man on night duty to serve as a watchman and to do cleaning tasks that were not reached during the day.

The janitor will have to take the initiative in setting up his own schedule. With the background outlined above showing time required for various tasks, the number of times each week that different tasks must be performed, and the number of occasional tasks that arise, he is in a position to determine the time required for routine activities. Then if he gets a schedule of classroom usage he can determine what time is available for cleaning various rooms and units. With this information he can work up a tentative schedule. This tentative schedule should be kept within the general board regulations both as to time and as to cleaning practices. This tentative schedule should be presented to the superintendent of buildings and grounds and to the building principal for approval. They should have time to study the proposal and to approve. After approval, copies of this schedule should be made out, one for the janitor, one for the office of the principal, and one for the office of the superintendent of buildings and grounds. The principal should then notify teachers that certain rooms should be available for cleaning at certain periods of the day and that the janitor should be permitted in these rooms for cleaning at this time.

Developing the Schedule [1]

In addition to developing time requirements for various duties the janitor will need to make a tabulation of the various

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[1] Viles, N. E. "Administration of Janitorial Service," *Proceedings Tenth Annual Meeting*, National Council on Schoolhouse Construction, p. 91–93.

tasks to be done. One of the important steps in the development of a work schedule is to list the tasks to be done on the basis of frequency. A partial list for one building is outlined here.

I. Some of the tasks which should be performed daily:
   1. Care of heating, ventilating, and mechanical apparatus.
      a) Start fires in morning.
      b) Bank fires at night.
      c) Replenish fires as needed.
      d) Inspect thermometers, steam gauge, and water glass.
      e) Clean grates and ash pit.
      f) Wet down ashes.
      g) Start and stop ventilating fans.
      h) Clean boiler flues.
      i) Inspect pumps, drains.
      j) Turn off lights not needed, particularly when leaving building for the day.
      k) Start and stop pumps and motors.
   2. Cleaning:
      a) Sweep (or clean) each classroom and office.
      b) Sweep corridors and stairs (as often as needed).
      c) Inspect and clean fountains, lavatories, and stools.
      d) Dust classrooms, desks, tables, chairs, window sills, cases, shelves, office furniture, doors, and hand rails.
      e) Clean locker rooms.
      f) Sweep walks near doors.
      g) Clean furnace room.
      h) Mop toilet room floors.
      i) Pick up paper and trash from grounds.
      j) Remove marks from walls and walks.
   3. Miscellaneous:
      a) Burn waste paper.
      b) Check supplies in toilet rooms.
      c) Lock and unlock outside doors at specified times.
      d) Provide chalk and other supplies needed in rooms.

II. Some of the tasks that will be done weekly:
   1. Dust radiators.
   2. Blow down boiler.

3. Clean walks on and around yards.
4. Clean blackboards.
5. Wash glass in doors and cases.
6. Clean and mop special rooms.
7. Clean all erasers (may be more often for some rooms).
8. Clean floor brushes, mops, dust brushes, and other tools.
9. Inspect building for fire hazards.
10. Secure supplies from stock room.
11. Inspect all motors, pumps, and engines to see that they are properly oiled and in good condition.
12. Mop composition and masonry floors.
13. Clean all chalk trays (more often if needed).
14. Clean door mats.
15. Wipe or wash door knobs and hand rails.
16. Inspect playground apparatus for broken parts.

III. Tasks to be done bi-weekly or monthly:

1. Clean glazed wainscot on walls.
2. Dust pictures.
3. Scrub where needed.
4. Wash windows on inside.
5. Polish brass or other polished surface.
6. Read meters and report to supervisor or principal.
7. Report to superior officer things he should know about the plant.

IV. Tasks that will be done two or three times annually:

1. Receive and check supplies.
2. Make seat adjustments.
3. Mow lawns.
4. Care for shrubbery, flower beds, fences, and hedges.
5. Make minor repairs.
6. Remove snow and ice from walks.
7. Move desks, supplies, scenery, and pianos.
8. Clean up after sick children.
9. Care for plants, aquariums, and grounds during vacations.
10. Assist during fire drills.
11. Receive and store coal.
12. Rake leaves in fall, remove fallen branches.
13. Remove dirt from walks after rains.
14. Open closed sewers, downspouts, stools and urinals.

15. Report leaks or breaks that need attention or that must be repaired by someone else.
16. Supervise pupils in toilet rooms upon orders from principal.
17. Be present when building is open for evening meetings unless an assistant is employed or unless excused by principal.
18. Open lockers for pupils upon request.
19. Keep records required by officer in charge.

In making up a schedule of work for each day, week, month, or year, arrangements should be made to include each day or week some of the tasks that recur at infrequent intervals. A time should be allotted for each routine task with some time reserved for emergency tasks. Those responsible for making schedules should remember that certain tasks must be done at specified times each day. A satisfactory plan often followed is to make up a skeleton schedule and after a little practice, study, and experimentation to fill in the details. A part of a sample skeleton daily schedule for one building follows:

1. On reaching the building each morning make a hasty inspection for losses, damages, or fire hazards.
2. Test water gauge, open fires, and examine pumps.
3. Start recirculating fans (if any) as soon as heat is available.
4. Complete dusting of desks, hand rails, and furniture.
5. Check supplies in toilet rooms.
6. Unlock doors at designated times.
7. Check all rooms and radiators to see that room temperature is properly regulated.

After school opens for the day the work of the janitor will vary according to the demand and local regulations from day to day. In some schools he will be required to raise the flag and to unlock playground apparatus. In other schools certain pupils or teachers are assigned these tasks. During the day his work should be so arranged that he can sweep the corridors, repair seats, or do other odd jobs as per his schedule and as the need arises. It is usually desirable for him to start cleaning classrooms as soon as these rooms become available in the afternoon. After school closes a definite schedule of room cleaning may be followed if the principal will notify teachers that a certain room is to be cleaned at a specified time. The weekly schedule will include such tasks as the cleaning of mops, brushes, and door mats, and the washing of door knobs. A majority of these tasks may be worked into the daily schedule. A few tasks such as the cleaning of blackboards or the mopping of floors may be done Saturday morning. The common tendency to leave too many tasks until Saturday morning should be avoided in making work schedules.

The schedules for the month or for the year will include many tasks that may be included in the daily work program. Other tasks must be done as the need arises. Meters should be read at the time they are checked by the service company. Windows may be washed on the inside on Saturday morning. The walls of one or two rooms may be dusted during the week without interrupting the regular program of work. The availability of extra sets of erasers and of cleaning tools makes it possible for the janitor to have a fresh supply ready for use when needed.

Janitorial Records and Reports

The average janitor has a dislike for records and reports. He feels that his is a working, not a bookkeeping job. This feeling has probably had something to do with the lack of progress made by some janitors. The janitor must use his head as well as his hands if he is to be of the greatest value to the school. He should be a skilled workman with a plan. This plan will be of more value to him and others if he has tangible written proof for others of certain of his activities. All business organizations have some records. The school plant represents a considerable investment and records of maintenance are essential.

The janitor does not know when he may be forced by illness or accident to be off the job. Records should be available to give his substitute information on supplies and on plant care. There will be times when the gas, water, or electricity must be shut off quickly. There should be a chart showing the location of these cut-off valves or switches. Records of supplies needed, of goods received, of tools available, of jobs to be done, and of fuel received should be kept. These essential records should be kept up to date.

Types and Amounts of Records

It is not always possible to separate records and reports. Certain reports when filed become records or will be transferred to a permanent record in the office of the principal or that of the superintendent of buildings and grounds. Records and reports should be as brief as possible. They should not be complicated. In many cases the forms can be so developed that the janitor can fill them out by checking or by filling in numbers or single words. Record forms should be uniform in size. One set can be made up in half page sizes and the others in full page size. It is a mistake to attempt to keep records on scraps of paper. These may be lost, and if not lost are difficult to file because of variations in size and because they have no identifying marks. Record forms should be printed or mimeographed. In most cases three or four copies will be needed for the various vendors and offices. These should be made up in colors. A plan similar to the following is used in many places. First or white copies go to the office, blue copies go to the vendor or delivery agent, and the pink copies are retained by the janitor as his record. Carbon paper should be used to make these copies. The copies retained by the janitor should be filed in permanent boxes or cases in chronological order for each form. School officials should realize that the janitor is a busy man and should limit his record making to essential features.

Information Sheet

When a substitute janitor is working, certain information may be needed in a hurry. The janitor should make up a sheet showing this information. One copy should be placed on the wall of his work room, one copy should be filed with the principal, and one filed with the superintendent of buildings and grounds. A sheet similar to the following is often used.

Form 1

Information Sheet

.........................Public Schools

.........................Building

................, 19....

....	....	....
Janitor	Home Address	Phone number

Fire Dept. Tel. No. ..... Business Office Tel. No. .....

Location of: Fire alarms ....

Fire Doors ....

Fire extinguishers ....

Water cut-off ...... Gas cut-off ...... Electric cut-off ......

Inventory Record

Some time during the year, probably near the close of the school year, the janitor should make up an inventory of district owned janitorial supplies and equipment on hand. This record will serve as a check on supplies used and to some extent as a basis for future needs. There are two forms which are used frequently. The more simple forms show a record of supplies and equipment now on hand. In order to check use one must refer to purchase orders and to inventories of the preceding year. The other form often used shows the amount on hand at first of year, the amount or number purchased, the amount used during the year, and the amount now on hand. Separate forms should be provided for equipment and supplies. Printed or mimeographed forms save time and are more practical if supplies and equipment are standardized. Blank spaces should be provided for articles not shown on the list. The copy of a form is shown here. When used only for checking or inventory purposes all but one or two columns may be left blank. When completely filled, it provides a continuing record.

Form 2

Inventory

............................Public Schools

............................Building

Filled in by ...., 19....

Loose Equipment

Number on Hand Last Report	Article	Number Received During Year	Number Used Up or Worn Out	Number Now on Hand	Condition
1	*Snow Shovel*	*1*	*0*	*2*	*One fair, one much worn*

It is quite important that the janitor have a record of the supplies used during the year. The differences in quality may make it necessary for the janitor to use trade names. If the supplies used are standardized this record will be simplified. Quantities will be recorded in pints, quarts, gallons, pounds, cases, yards, or feet. In making up these forms in the main office the names of the articles can be inserted with spaces left blank for the janitor to fill in other articles. It would also be possible for the office to fill in the columns showing carry over from last year and the quantity received. In either case, the janitor should check these quantities with his own records.

Form 2 A

Inventory Record

..............................Public Schools

.............................Building

Filled in by ...., 19....

Janitorial Supplies

Quantity on Hand Last Report	Description of Supply	Quantity Received During Year	Quantity Consumed	Quantity Now on Hand	Remarks as to Value of, Need, or Recommendations
2 cases	*9 x 12 folded paper towels*	*10 cases*	*11 cases*	*1 case*	*Too soft*
" "	" "				
2 gal.	*.... Penetrating floor seal*	*20 gal.*	*18 gal.*	*4 gal.*	*Satisfactory*

These forms need be filled out only once each year.

Supply and Equipment Requisitions

Many of the progressive schools now use some form of a requisition blank. If the school has a regular form of requisition these will be used by the janitor. If none are available he may find it necessary to have forms made up in the business office. If supplies are budgeted he may need to carry forward the

Form 3

Requisition

.... Public Schools

.... Building

Requested by ...., 19....

Please deliver the following supplies / equipment to this building:

Number or Quantity	Description	Remarks
2 gallons	*Liquid hand soap*	*None*

Approved by ....
Prin. Supervisor
Delivered date ....
Refused " ....

Original allotment this article .....
Last balance due " " .....
This request " " .....
New balance " " .....

balance of his yearly allotment of that particular article. In some cases the business office will report balances. In sending in requisition forms the janitor should turn in *two* blanks so that one may be returned to him with the goods. If the requisition is not honored one copy should be returned to the janitor with denial or refusal noted. His record should show disposition of request. In school systems where a central store room is maintained the requisition may go first to the principal or the superintendent of buildings for approval and then to the store room keeper. In districts where a central store room is maintained it is customary to keep most of the supplies in the central store room and to make general deliveries weekly or monthly. In other schools enough supplies to last one semester or one year will be delivered at one time. The local practice will determine the amount of material to be requisitioned at one time. The sample requisition form shown on opposite page may need to be changed to suit local regulations.

If the bottom part of this requisition showing balances is used it limits each requisition to one article. In many small systems this part of the requisition is omitted. The local regulations and practices will determine whether *balances available* should be carried forward.

Record of Goods Received

After supplies are requested the janitor should have a record of the amounts and type of supplies delivered. In many cases where there is no central store room the janitor will be responsible for receiving freight, express, or local deliveries of books, fuel, and various other supplies. In order to protect the district he should make some record of such deliveries and the condition of the goods received. A sample record form for this purpose is shown here. As with other forms one copy should be retained by the janitor, one copy sent to the principal or supervisor in charge, and one copy to the delivering agent. The janitor should not sign company receipts for goods which are damaged or short in count unless such deficiency is noted on the receipt.

Form 4

Goods Received

..........................Public Schools

..........................Building

From .... Delivered by ....
Company or store room

Number or Quantity	Name or Description	In Good Order	Damaged or Short
3¼ tons	*........lump coal*	X	

(Any acceptance of broken containers or damaged goods subject to later adjustment)

Signed...........................
Janitor

(If damaged, either do not accept or note damages)

Repairs and Job Sheets

In some schools the janitor is required to maintain a record of requests for repairs that he cannot make and a time record of the men making these repairs. He may also be required to report special tasks. Some of these records are quite valuable. In large school systems where a roving maintenance squad is maintained some form of job repair request is essential. If no repair force is maintained and the work is done by private companies or individuals employed for that job, the school officials may wish to know the type of work done and the time required. In either case, the janitor is best qualified to check on the time consumed. In no case should this report keeping be permitted to become burdensome to the janitor. In the smaller school systems a part of these reports may not be needed. Samples of some of the forms now used are shown here.

Form 5

Job or Repair Request

.... Public Schools

.... Building

Requested by ...., 19....
Janitor

Type of Difficulty or Repair Needed	Location	Remarks
Sewer line choked	*Somewhere on grounds on north side of building*	*Needed at once as toilets are flooding*

Form 6

Job Report

..........................Public Schools

..........................Building

Reported by ...., 19....
Janitor

Nature of Job Done	Work Done by Company or Individual	Time Consumed	Results Obtained
Opening closed sewer	*Brown Co., A. J. Brown working*	*4½ hours*	*Satisfactory*

The janitor can use the same form to show some task that he has performed by inserting self in the proper column to show who did the work.

Local conditions and regulations may make it desirable for the janitor to keep a number of records on pupil activities and on the consumption of water, gas, or electricity. In some schools he obtains a report of temperature readings in the various rooms. Some of these protect him from later criticism and others serve as a check on meter readers.

Service Meter Records

The janitor should make a record of meter readings. It is desirable that he read the meters at the time they are read by the service company. While the janitor cannot be held responsible for excess usage, his records may be of value in checking consumption. Samples of various meter record forms are shown here.

Form 7

Water Meter Record

..........................Public Schools

..........................Building

Reported by ...., 19....
Janitor

Reading Last Month	Reading This Month	Amount Consumed This Month	Amount Consumed Same Month Last Year

Similar forms except as to headings may be used, Form 8 for electric current and Form 9 for gas consumption.

Reports on Pupils

While it is a generally recognized fact that janitors should not punish pupils, they are sometimes required to report glass breakage, or certain rule infractions by pupils. Naturally, the janitor wishes to reduce his reports to a minimum but for self protection some reports may be necessary. If the janitor has a record of such accidents or infractions he will not need to depend on memory alone if later investigations become necessary. The sample form shown here may be used for breakage, accident or rule infraction.

Form 10

Report of Breakage, Accident or Rule Infraction

..........................Public Schools

..........................Building

Reported by ...., 19....

Name of Incident	Done by	Time	Remarks
Broke 2 window panes—Room 27	*James Brown and others*	*4:30 Tuesday October 21, 1939*	*Playing ball on school grounds after school*

Temperature Records

In many cases teachers complain that their rooms are not heating. Sometimes the janitor is sure that the rooms are hot enough. At other times he wishes a record to show the lack of heat at certain hours of the day. It is difficult for him to visit these rooms each hour because of the danger of disturbing class activities. A record kept in the room by the pupils is often more convincing to the teacher and less trouble for the janitor. While it is not recommended that a complete record of room

Form 11

Room Temperature Record

................., 19....

............................Building

............................Room

............................Month

At the hour designated show in the proper column record of the temperature indicated on the room thermometer. Days listed are for the first, second, third, and fourth weeks of the school month ending ...., 19.....

Day	Hours When Record Is Made and Temperature at Time					
	9:00 A.M.	10:00 A.M.	11:00 A.M.	1:00 P.M.	2:00 P.M.	3:00 P.M.
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						

temperatures be maintained of all rooms, an occasional record may at times be valuable. The room temperature record shown here is for one month. The blank space is filled in at the hours designated by some pupil monitor appointed by the teacher. Pupils are usually glad for an opportunity to do this. The record is usually tacked on the bulletin board and is taken down at the end of the month.

It is desirable to have some record of the time certain floors were treated, walls painted, or other improvements made. It may also be desirable to have some record of the type and quantities of materials used. In some cases these reports may be made on Form 6. There are so many different improvement tasks that a separate report form for each may not be necessary. As a rule, these forms are made up as needed and to fit the local demand.

Stock Room Records

The records and reports outlined here do not cover stock room control. Such forms will probably be developed by the business office. It is not wise for the janitor to permit record-keeping to take up too much of his time. He should keep some records and the forms outlined here may be of value to him in his record keeping.

Office Records

In a modern school system there should be some central office records of the janitor and his work. There will also be some records of supplies and equipment used. The janitor has no part in preparing these records and forms. The central office should keep a complete personnel record of each janitor showing time of employment, salary, vacation periods, health record, and absences. Attached to this there should be a rating sheet or a record of achievements and failures. It is to be presumed that these records will be developed in a fair manner. The janitor should realize that these records are of value to him. In too many cases good work goes unrewarded and poor work is forgotten because of a lack of accumulative personnel records.

Chapter 10

School Floors

Types and Cleaning

In a modern school building one may find many types of floor surfaces. The janitor may have had no part in selecting the floors in his building, but he may have some voice in selecting new floors for additions or for replacement. It is essential that the janitor know the qualities needed in floors. He should know the composition and characteristics of various flooring materials that he may care for them properly. He should realize that floors having slick surfaces are not desirable around shop machines, that hard non-resilient floors are not satisfactory for playrooms, that bare cement or other masonry floors are not suitable for classroom use, and that certain areas like library units need soft floors.

Flooring selected for any school use should have the following characteristics.

1. It should be adapted to the use for which that particular room was designed. In certain areas this will include attractiveness.
2. It should be sanitary, easy to clean, and non-absorbent of odors and water.
3. It should be relatively safe from slipping, with a smooth uniform surface, free from cracks.
4. It should be durable and wear resistive.
5. It should be reasonably economical, both as to original cost and as to the cost of maintenance.
6. It should provide the resiliency needed for the purpose for which it is used, yet have sufficient rigidity to provide a safe stable floor.

School floor surfaces may be divided into four general types based on construction. They are wood, masonry, composition, and cloth. Here is a brief description of each type.

Wood Floors

Wood floors are generally thought of as either hard or soft wood floors. However, there are many variations. In addition to these variations, there is a difference in the manner of seasoning that may play an important part in maintenance. Poorly seasoned woods may continue the drying and seasoning process after they are laid. This may cause shrinkage that leaves dirt-catching cracks between the floor boards. The seasoning process that once required months and much care is now done in a few hours. If poorly done, the janitor is faced with difficult maintenance problems. Although wood floor boards stop growth when cut from the forest, the cells retain the ability to expand or contract with the presence or absence of moisture. This tendency may lead to warping and makes it necessary to protect the floors from all possibilities of water impregnation.

Hardwood Floors

Probably the most common wood used in hardwood floors is maple. Maple floors are adapted to many school uses. The northern hard maple is a dense wood, and is provided in about three grades. The better grades are white in color and free from knots. Good maple floors may, if properly protected, outlast the building. Good maple cleans easily and polishes under wear. It is resistive to indentations. The better grades of maple bear the mark of "M.F.M.A." indicating the approval of the Maple Flooring Manufacturing Association. Floors of soft maple are laid in some school buildings. They seem to have few if any advantages over other soft wood floors.

Oak floors are used in many schools in the central part of the United States. The oak provides a hard floor that resists wear. It is darker in color than the maple. When the oak is quarter sawed it presents an attractive appearance. Because of the porous nature of the oak it is usually necessary to fill these floors before applying the finish. Some oak has a tendency to splinter along the edges if not treated. This makes it less desirable for use in gymnasium and playroom floors. Oak floors take a good finish and provide attractive floors.

Two other woods that are used extensively in certain states are beech and birch. These are dense woods that wear well and are attractive in appearance. These take the same treatment recommended for maple and oak.

Softwood Floors

Of the softer woods, pine, fir, and spruce are most used for school floors. These do not wear as well and are more susceptible to stains than are the hard woods. If laid with the flat grain exposed these floors are inclined to splinter and sliver. Adequate treatment reduces this tendency to some extent. The vertical grain or quarter sawed boards present an attractive appearance and wear fairly well. Even with the vertical grain flooring there is a tendency for the softer wood to wear out leaving ridges of the more dense layers. Preservation and surface treatment are essential if these floors are to be maintained in an attractive condition.

During recent years, floors made of wood block have been installed. One such floor is made of short lengths of blocks set on end. These blocks are usually of pine and present an attractive appearance. A new pecan wood block has recently been introduced. These floors are often used in gymnasium and shop units. Those set in mastic must be guarded against dampness or they will buck up as did the old wood block street pavements. The other block floor is made up of short floor boards fastened into squares and laid horizontally. They may be laid in mastic over a concrete base or may be nailed over other wood floors.

There are also a number of pressed wood floors on the market. Most of these are made from sawdust or a form of wood pulp made by steaming and exploding wood chips. The pulp is tied together with a cement or glue under pressure. These floors are usually laid in blocks. They present an attractive appearance and take the usual wood treatments. The binder is susceptible to and may disintegrate from the effects of certain chemicals.

All wood floors contract and expand with changes in the moisture content of the surrounding air. This action often brings difficulties for the floor maintenance department. If the floor does not have expansion facilities the boards may buckle or cup. This action is often evident on large gymnasium floors where the edge expansion joints are some distance from the center of the floor. Unless moisture is kept away from the floor and/or ventilation provided, the resulting cupping often makes it difficult to maintain a satisfactory floor finish.

Masonry Floors

There are many masonry floors but they can usually be grouped into three classes; natural stone, manufactured stone, and clay products such as tile. While not suited for use in classrooms and in playrooms these floors do have a place in school buildings, particularly in corridors, stairways, shower, and toilet rooms. These floors lack resiliency but if properly surfaced do have good wearing qualities.

Natural Stone

The natural stone most often found in school buildings is marble. It is used for lobby and corridor floors and for stairways. The marble coming from Vermont usually has a smooth dense texture, while the Tennessee and Georgia marble often has a granular texture. Marble has a composition similar to that of limestone and is subject to damage from acid, strong alkaline, and abrasive cleaners. It wears well but because of the difficulty in obtaining the same hardness in all pieces may show small depressions or holes from the effect of wear. Careful treatment is necessary to preserve the beauty of marble floors.

Travertine is a porous straw colored stone found in some of the western states. It hardens when exposed to air and makes an attractive floor. It absorbs stains and does not resist wear as well as marble.

Slate floors are seldom used in school buildings and are not recommended for schools.

Manufactured Stone

The most common artificial stone floors are concrete, terrazzo, and magnesite; however, rock asphalt may be classed as manufactured stone.

Concrete

In addition to its other uses in the building structure, concrete serves as a subfloor for wood, mastic, linoleum, and terrazzo floors. It is also extensively used as a floor surface in corridors, on stairs, and in toilet rooms. It is perhaps the most common masonry floor round in school buildings. Concrete is made up of a mixture of rock aggregate, sand, and cement. The quality of a concrete floor depends on the mixture, the composition, the curing, and the finishing process. If the floor is made of the proper proportions and is finished and cured properly it should show little blooming (dusting), checking, spalling, or pitting. If a concrete floor is not cared for in a proper manner it may become ugly and rough with many surface checks and pits or holes. If it once starts to wear, dust will float in the air and grit will be carried to other finished floor surfaces. Natural concrete floors are not very attractive and architects now provide a coloring compound along with some metallic hardener to give the surface an attractive tint and a sheen. The composition of concrete makes it susceptible to action from any acid cleaners. It is also injured by strong bleaching agents and oils.

Terrazzo Floors

The terrazzo floor is probably the most attractive of all the artificial masonry floors. It is composed of a surface of marble and granite chips embedded in cement. After the floor is laid it is ground down to a smooth polished surface. With the proper blending of chips and a good binder a durable attractive floor can be produced. It offers many possibilities in color combinations. This floor is laid over a cement or a cement and sand base and a good bond is not always obtained.

Many of the terrazzo floors split and crack. Cleaning water carrying cleaning compounds enters these cracks and helps to expand the joints. The marble chips contain calcium as does the cement and as a result the terrazzo is susceptible to disintegration from acids. Strong alkaline cleaners may cause terrazzo to dust and pit. Terrazzo is also subject to efflorescence and blooming. Because of these tendencies it is desirable to use a hardener or seal as on concrete. Unless these are applied properly they make the floor sticky or slick.

Magnesite Floors

Magnesite floors are composed of magnesium oxide mixed with fillers and binders such as cork, marble chips, and sawdust. These floors are sometimes colored when laid. A chemical is added to hasten the set. Sometimes trap rock and sawdust are combined in the mix. These floors may be trowelled over another floor or may be purchased in a block (tile) form. They have about the same characteristics, such as blooming and susceptibility to acids, as do the concrete floors. These floors are less resistant to wear than is concrete and have not been used extensively in school buildings.

Tile Floors

Tile floors have for many years been used in lobbies and entryways where a decorative effect is desired. Because they are easy to clean and are resistive to uric acid they have been used to a considerable extent in toilet and shower rooms. There are several types of tile used in floor construction. The ceramic tiles provide a hard impervious surface. They come in colors and make an attractive floor. The faience tile are designed by hand and have a rough surface. They are used primarily for their decorative effect. The glazed (twice burned) and the unglazed tile are used for many floors. They come in various shapes and during recent years have been used rather extensively for stair risers and treads. These tile may be of a natural color or may be colored in making by use of the proper metallic oxides. The color is fixed and there is little fading. Another tile that has much use is the red quarry tile. This tile is cheaper than the others but gives equal service although it is not quite as attractive in appearance.

The tile floors seem more uniform in texture than are the different slabs of stone used in stone floors and the floor shows less wear. The tiles have a surface that resists the effects of ordinary cleaning compounds. They are easily cleaned. The ceramic and faience tile are usually laid in small blocks. The red quarry tile, often used for corridors, is usually laid in larger blocks, square, triangular, or hexagonal in shape. Tile floors are slightly alkaline and may effloresce if not treated. The quarry tile may become dull in color if not treated. The weak point in tile floors is usually in the seam or joint. The grouting or cement is subject to deterioration from acids and alkalies. If the grouting or binder gives way the tiles becomes loose. Tile floors may turn brown from the effect of iron stains.

Crystallization

All masonry floors are subject to deterioration from crystallization. This fact is often overlooked by janitors. Strong cleaning salts (some alkalies) when used in cleaning may enter the pores in the floor. If not washed or rinsed out they remain in the pores. As they dry they tend to crystallize and exert a powerful force on the sides of the pores as they contract and expand. At the next washing they are again dissolved and if allowed to remain repeat the process over and over.

Composition Floors

The demand for resilient floors which are both attractive and durable has led to the development of a number of composition floors such as rubber, linoleum, cork, and mastic or asphalt. Each of these floors has certain properties adapting it for use in some part of the school building.

Rubber Floors

The rubber floors are composed of a vulcanized rubber and some filler. The filler may be either mineral or organic matter. Some of these floors are of the same material throughout and some have cushion backs of softer materials. Experience seems to indicate that the solid pieces wear better and last longer. These floors come in blocks or in wide strips like linoleum. They are usually quite resilient and silent, and are popular for use in corridors or libraries where quiet floors are desired. The soft rubber strips do not permit much slipping. They do not creep or wrinkle as do lighter materials and hence are often used for sloping aisles in auditorium units. Rubber tile are usually glued to a concrete base but the rubber strips may be loose. Rubber floors are wear resistive but are subject to damage from sunlight and air which may oxidize the rubber. They are also injured by oils and abrasives. They resist water but washing with soap may cause disintegration. They may also be damaged by any wax containing a spirit solvent.

Linoleum

The linoleum floors have been used in school buildings for many years. The linoleum floor coverings generally used in school buildings are known as battleship, inlaid, and printed linoleums. One of the chief ingredients of linoleum is oxidized linseed oil, hence, the name. Battleship and inlaid linoleums also include cork, resin, and some coloring material. All of these are pressed into and tied with a burlap backing. As a rule the battleship linoleums are gray, green, or brown in a solid color. The inlaid linoleum is similarly made except that there is a color pattern. There is also a cheaper linoleum with an asphalt base, this is not generally used in school buildings.

Linoleum floor coverings may be obtained in blocks or in rolls, but the roll form seems to be more commonly used in school buildings. The linoleum floors absorb little moisture. They are not very resistant to abrasive action and should be surfaced with a material that may be replaced easily if traffic lanes appear. Most linoleum floors are rather easily indented by chair legs and heavy furniture; however, they are not as susceptible to temperature changes as some of the mastic floors.

Linoleum floors should not be cleaned with a strong alkaline cleaner, nor should they be subjected to a spirit float wax. These floors can be cleaned easily by the use of a neutral cleaner. They are resilient and silent, hence, are liked for classroom and library use. Some schools also use them for corridors. They seem to give best service when laid over a smooth concrete or other masonry surface. They may be laid over a wood surface, if a heavy paper is placed between the linoleum and wood. However, there seems to be some danger of rotting the wood under the linoleum.

Cork Floors

Cork floors are often found in library and kindergarten units. The cork may be obtained in tile form or in rolls. Each type is glued to the underfloor. The cork flooring is composed of cork chips pressed and bound together with a binder. The floor will deteriorate if any cleaning agent which may dissolve the binder is used. These floors usually come in tan or brown colors. These floors are resilient and quite durable if given proper protection. They may be sanded lightly or buffed with steel wool. They absorb moisture and stains. For protection they should be treated with a light application of water emulsion wax or other substance that does not reduce too much the resiliency or the acoustical properties.

Mastic and Asphalt Tile Floors

The term mastic or asphalt floors is applied to both the poured (trowelled) and the composition tile floors. The chief ingredients of these floors are asphalt, with a high melting point, and a filler of asbestos and/or other mineral. The trowelled mastic once had wide use. However, the floors wore out in traffic lanes and were hard to patch without showing the patch. Most of the asphalt floors laid today are in tile form. These tile come in a variety of solid or marbleized colors. They offer many possibilities for borders and for decorative effects.

The asphalt is not much affected by moisture and the tile are usually laid in a moisture resistant cement. For this reason these floors are preferred over linoleum for damp ground and basement floors. The older tiles were soft and showed many indentations from furniture legs. The newer tile are harder and not so easily indented. Intense heat will cause the tile to soften. The tile are also susceptible to extreme dryness. Because of this tendency many janitors find it necessary to mop or moisten tile floors above the ground to prevent them from becoming dry and brittle. These floors are rather hard when dry or when coated with a wax loaded with gums. They will also become slick when treated with heavily gummed waxes. They are susceptible to damage from oils, gasoline, or naphtha. They should not be subjected to oils or a wax with a spirit solvent. Strong alkalies may cause the color to fade but this tendency is not so pronounced in the newer tile. If one tile is damaged it is easily replaced by the janitor.

Cautions for Composition Floors

The composition floors should be laid over a smooth solid base. If the base is rough, it is impossible to secure a good bond and the roughness shows up through the composition floor covering. Composition floors should not be laid over a wood base. They dry out and show the lines of the floor beneath. Asphalt tile may crack when laid over wood. Composition should not be laid over green or poorly cured concrete. When this is done the composition floor often becomes soft and is easily marked and indented by the furniture.

Rugs and Carpets

Rugs and carpets are not generally used for schoolroom floors. However, many school janitors have some cloth or rug coverings in office units, restrooms, and in other parts of the building. It is not necessary for the school janitor to make an extensive study of rugs, but he should know something of the composition of rugs so that he will be qualified to care for those found in his building. Most rugs have a wool base, bound together by a backing or inner web of wool, jute, cotton, or linen threads. Rugs are generally known by the name Axminster, Wilton, Velvet, Brussels, and Ingram, each of which is slightly different in type of construction and weave. Most of the rugs used in school buildings are what is known as loop-pile-weave with the piles forming the wearing surface. Some of these rugs, particularly the Velvet, Wilton, and Axminster, have a pile or nap that will flatten down with the pressure of furniture and foot treads. This flattening may cause an apparent variation in shade and the effect is more noticeable on the plain colored than on the flowered rugs. Frequent turning of the rug to bring the wear in different spots may reduce the effect of traffic wear and the flattening of the piles. All rugs are subject to deterioration from any agency which may injure the cotton, linen, or wool fabric, or that may affect the color and sizing.

No floor sweeping compound should be used on the rugs. The corn broom should be barred, and the sweeping brush used on waxed or oiled floor should not be used on the rug. The best cleaning method seems to be the use of the vacuum cleaner. If a vacuum system is not available, the rug should be cleaned by the use of a hand sweeper. The janitor should avoid the use of water or other liquids on the rug without the advice of one trained in rug care. In many cases, the use of liquid cleaner by an uninformed maintenance force has removed the sizing from the rug, thus permitting it to become limp and to wrinkle on the floor.

It is not possible to secure the type of floor desired if the supporting members do not give sufficient rigidity and strength to prevent springing or sagging. Any floor that vibrates as pupils walk across it may sooner or later have small cracks to catch dirt. On the other hand, good school floors must be so designed that in addition to the rigid support they have a surface that is not too hard for schoolroom use. After securing rigid construction it is desirable to select a surfacing material suitable for use in each particular room. Regardless of the type of material used, the floor cannot be expected to give the best results unless it is given proper care.

Cleaning School Floors

For many years little attention was given to school floors. Treatments given, if any, bleached the wood or permitted the building up of accumulations of dirt and oils to make the floors dark and unattractive. Floors represent a considerable part of the cost of school buildings. They play a most important part in the appearance of the building and particularly of the school room. They are the part of the building most used and oftentimes the part most abused. Good school plant floors properly maintained don't "just happen." They are the results of proper construction and proper care. In most cases the maintenance janitor is not consulted on the type of floors installed in new buildings. He must adapt his maintenance methods to the type of floors in the buildings. When he has an opportunity to advise on floor replacement, he should consider adaptability, durability, and ease of maintenance. He plays an important part in maintenance. Proper floor care involves much study and a considerable amount of work. Many school administrators have not had an opportunity to study the principles of floor maintenance. Until recently, school janitors learned what they could about floors by a trial and error or experience method and by absorbing information given them by agents of various supply companies. These methods were somewhat wasteful of time and often confusing. The alert, wide-awake janitor of today realizes that he must be something of a floor expert. He realizes the importance of attractive floors to the appearance of the school and to the school itself. He knows that floors cost money and that neglect over a short period of time permits floors to deteriorate.

Adequate Floor Maintenance

If floors are to be maintained in a good condition at an economical cost, they must be given a suitable surface. Rough floors wear more rapidly than smooth floors. Certain chemical compounds will harm floors. Some floors will discolor from the use of oils, others from acids, and others from strong alkaline treatments. The janitor who knows floors will not permit accumulations of dirt, will not use cleaning preparations that mar the surface, or allow them to deteriorate from lack of care. In the following discussion of floors, the term "conditioning" floors will mean the setting up of new floors, putting them in shape for use. The term "reconditioning" floors will mean setting up of old floors, either by resurfacing or otherwise, to make them suitable for use. The term "maintenance" will mean the current treatment that maintains the surface set up in the conditioning or reconditioning activities. The term "cleaning" may refer to daily cleaning or to periodic cleaning by mopping or by scrubbing. School floor care and preservation may be more costly if the janitor does not know the type of maintenance best suited for each particular floor. The janitor should have some record of his maintenance costs and have a well developed plan showing which floors are to be reconditioned each year and showing how long certain treatments stand up under the wear in that particular room or rooms.

Scrubbing and Mopping

There is a distinct difference between the terms "scrubbing" and "mopping." Scrubbing as used here refers to a scouring or to that activity that is necessary to remove accumulations of dirt. It is often stated that scrubbing involves the use of some chemical action to help wet the floor and much elbow grease to loosen the dirt from the floor. On the other hand, mopping might be termed damp sweeping. Mopping is not done for the purpose of removing accumulations of dirt but to remove dust films and small amounts of dirt that may collect on floor surfaces. In neither case is it possible to set up a schedule of frequency for mopping or scrubbing for all floors. At one time, floors were scrubbed monthly. Today floors are scrubbed only at rare intervals when it is desirable to change the type of finish or to remove old accumulations of dirt that cannot be removed otherwise. In many schools, it is a practice to mop marble, tile and terrazzo floors weekly, although some janitors mop these floors more frequently in dirty areas. Most treated floors of wood or composition are never scrubbed unless it is necessary to remove the old treatment. Some treated floors, particularly those of masonry, are mopped twice a week.

Floor Cleaning Compounds

Under previous sections, some mention was made of various cleaning compounds for floors. It seems desirable here to show the application of some of these cleaning compounds to the floor. Floor cleaning compounds might be grouped into about three classes; the abrasives which clean by friction, the chemicals which clean by dissolving or by chemical action, and soaps or other material of the soap family which aid in wetting the floor and also in loosening the dirt. The janitor should understand that either of these three cleaning agents may be valuable on certain floors while on other floors each or all of them may be harmful. Abrasives are of value only for scrubbing. There is always a danger that the abrasive will be too harsh and that it may scratch the floor. Some authorities recommend the use of abrasives that will pass a 100 mesh screen but which will not pass a 300 mesh screen. Most abrasives are made of such elements as volcanic ash, lava, tripoli, and fine sand, or bone meal. In general, the less harsh abrasives like tripoli, lava, calcium, soap stone, or volcanic ash are to be preferred. Ground bone is sometimes used but it seems to break down and get gummy under pressure and heat. There should be little free alkali in the abrasive but there may be some soap in order to make it easier to rinse the dirt off the floor. Abrasives are never used in mopping and not always in scrubbing. Some acids are used to clean spots off the floors in various places. There are a number of instances where the acids may be of value in removing spots from floors. The janitor should be careful in the use of muriatic acid or oxalic acid. The stronger acids may attack the grouting around the chips in the terrazzo floors and may attack the marble chips. Acids may also attack the mortar used around tile floor sections.

The chemicals most often used in floor cleaning are the alkalies such as sodium hydroxide, potassium hydroxide, and ammonia. The alkaline solutions aid in wetting the floor and the dirt on the floors but they may also be harmful to the floor surface. Strong salts or alkalies if put on marble will help to clean it but that part which remains on the floor may crystallize when dry and as it crystallizes it exerts pressure that may in time cause pitting or chipping. Strong alkali such as lye may burn wood surfaces and cause them to turn red. A small amount of alkali, properly administered, will help break down the hardness in the water and will help precipitate certain sulphates in the water, thus aiding the water to wet the surfaces to be cleaned. Janitors sometimes add a mild alkali like tri-sodium phosphate to the water, a small amount at a time, until they determine by feeling when the water is slippery or slick. By measuring the amount used, they then have an idea as to the amount required for the same amount of water later. However, the janitor will need to know that the hardness of the water may vary with the season, even in the same location. Judiciously used, alkalies may be a great benefit in cleaning.

Water and soap are universal cleaners for floors. Even soaps may be strong enough to injure the floors. As a rule, the janitor feels safe in using neutral soap or one containing a small amount of alkali. There are many floor cleaning compounds on the market. Most of them have value. On the other hand some of them contain ingredients that are distinctly harmful to certain floor surfaces. The janitor should know the composition of the material placed on his floors. In many cases he can prepare his own cleaning compounds.

School officials should select scrubbing compounds with care. They should understand that some floors are seldom scrubbed, and that certain other floors are scrubbed only when wishing to remove old finish before retreating. In many cases these old finishes may be removed by the use of steel wool and scrubbing. In general, strong alkalies and coarse abrasives should be used only in extreme cases. Floors and floor conditions vary and it is difficult to set up any one procedure applicable to all floors. Some janitors set up a scrubbing schedule similar to the following:

I. General:
   1. Water.
      a) Use hot water.
      b) Break water with T.S.P. until it is slippery.
      c) Apply water to only small area at a time.
      d) Pick up old water, rinse.
   2. Abrasive.
      a) Use mild abrasive.
      b) Apply friction.

II. Old rough floors:
   1. If covered with oil and grime.
      a) Apply abrasive on dampened floor.
      b) Add water soap solution alkaline until water feels slippery.
   2. Old floors, dirty but no oil.
      a) Use mild abrasive.
      b) Use neutral soap.

III. Treated wood floors:
   1. Scrubbing compound will depend on type of floor treatment.
      a) On spirit solvent wax use T.S.P.
      b) Use mild abrasive.
      c) Use neutral soap.

IV. Masonry floors:
   1. Concrete.
      a) If rough and very dirty use treatment recommended for dirty wood floors.

b) If smooth use mild abrasive, neutral soap, and small amount of T.S.P.
c) Avoid use of acids or strong alkalies.

2. Terrazzo, tile.
   a) Use treatment recommended for smooth concrete.
3. Marble.
   a) Clear water, can break slightly with T.S.P.
   b) Small amount of neutral soap if used wisely and if rinsed off.

V. Linoleum and asphalt:

1. Can mop, but scrubbing seldom needed.

A small amount of pine oil can be added to scrub water if desired. Rinsing is essential. Practically the same cleaning compounds with the exception of the abrasives are used in mopping; however, much less soap is used in the mop water.

Scrubbing Tools

One of the best scrubbing tools is the electric scrubbing machine having a fiber brush. These machines come with cylinder or disc brushes. When using the disc brush most janitors prefer the single disc. Few men seem to care for the tank mounted over the brush. In addition to the scrubbing machine, scrubbing brushes will be needed. One of these should be a small hand brush with square corners to be used where the large brush does not reach. The other may be a long handled brush used for similar purposes. These should have fibers stiff enough to be used as a friction agent in removing dirt. It will also be necessary to have at least two pails, one for hot scrub water and one for rinse water. It will be desirable to have a squeegee, the size depending upon the floor area to be scrubbed, and a pick-up pan. The pick-up pan is one with the hump at the edge which permits the water to be pushed up into the pan without running back on the floor. It will also be desirable to have one pick-up mop to be used in picking up water in places where it cannot be reached with the squeegee. The janitor should remember that scrubbing is most easily done with hot water, since hot water of about 150 degrees aids in dissolving greases. The squeegee should probably be about 16″ long of three-ply flexible rubber. It should be attached to a light metal frame in order to permit rapid use.

Mopping Tools

The mopping tools will be somewhat different from those used for scrubbing. The mops are usually about twenty to thirty-two ounces in size. While the size should depend on the man, it is usually understood that light mops are time wasters. The mop handle should be about the same height as the man using it. The janitor should learn how to use mops. It is desirable for him to trim off loose strings on the mop. He must remember that a dirty mop is useless. He should know that a mop is primed by soaking it before it is put into use. When he is through using the mop, he should rinse it and hang it up with the handle down. This permits the mop to spread out and dry more rapidly. The selection of a mop will be largely up to the janitor. Linen lasts longer than cotton, but may not have as much absorbency. In general, wear and absorbency are not compatible.

It will be necessary to have at least two pails for mopping; one for dirty water and one for rinse water. It is also desirable to have screens that fit in the bottom of the pail so that any dirt that is dropped into the pail may pass through this screen and be out of the way of the mop when it is dipped. The janitor can make a screen of this type. The screen should be a little smaller than the size of the bottom of the pail. A mop wringer should be attached to the pail. The squeezer type wringer seems to give best results. The size of the squeezer should be adapted to the size of the mop used. For mopping large areas, some janitors prefer to use a small truck on coasters with both pails on this truck. Some janitors use a large truck with a tank on it. The tank is good for mopping large areas, but it is difficult to move up and down stairways.

One cannot measure the number of tools needed by the number of men working in the building. In large buildings where several men are employed it is not necessary to allot so many tools to each man. However, in smaller buildings where only one man is employed, a full equipment of mopping tools is essential. All tools should be properly cared for. Mops should be washed and rinsed. Squeegee heads should be wiped clean and hung up. Mop pails should be cleaned after each use.

Mopping Methods

As stated previously, mopping and scrubbing are two different procedures. Methods of mopping will vary with the type of room, the equipment, the condition of the floors, and the tools available. It is not easy to mop classrooms with fixed seats. Where possible, it is better to move the seats. Rooms of this type are usually swept or cleaned daily with a process that does not involve the use of a *wet mop.* If it becomes necessary to mop a classroom with fixed seats, it is desirable to start at one corner of the room and to mop one aisle at a time. The usual mop swing cannot be used in rooms of this type. In general, janitors find it preferable to mop certain floors like marble and terrazzo frequently. The reason for mopping these floors is to remove light applications of dust and dirt.

The first step in mopping is to have clean water. It is desirable to have two pails. If necessary, the water may be softened by using a small amount of tri-sodium phosphate or neutral soap depending on the surface material to be cleaned and the condition of the water. The wet mop is dipped in the water and wrung out until it does not drip. The janitor then proceeds with his mopping, holding the mop in such a shape that he can get a full swing of the mop of 2½′ to 3½′ on either side of him. In mopping, he usually walks backward, taking one step at a time as he completes his stroke. The mop should be held so that the janitor has full swing of his arms. Some janitors hold the top of the mop handle with the left hand and furnish the power with the right hand. The mop should be moved in continuous motion with no pause at the end of the stroke. However, the mop should not be jerked so that water will be flipped off the end of the mop. The janitor should be careful not to brush the mop against the furniture or the baseboards. He should remember that dirty mops will not clean floors; that the mop should not be too wet, and that the water should be changed as often as necessary to keep it clean. The wet mop is not a scrubbing tool.

Scrubbing Methods

Scrubbing as used in this discussion refers to the removal of accumulations of dirt. The removal of this dirt usually involves some energy or friction and the use of chemical liquids that help to remove the dirt or loosen it from the floor. It is almost impossible to satisfactorily scrub a room having fixed furniture until the furniture is moved. However, with modern day maintenance, scrubbing is seldom done in any rooms. When scrubbing becomes necessary in a classroom it is usually desirable to start in a corner some distance from the door and to scrub a small area at a time. In most cases scrubbing involves the use of abrasive powder. If this powder is put into the water, it usually settles to the bottom and does little good as an abrasive in scrubbing. Hence, most janitors prefer to dampen the floor with water which may or may not be given a chemical treatment, depending on the need and on the type of floor. The abrasive powder is then sprinkled on the floor and the scrubbing brush is applied to loosen the dirt. After the dirt is loosened, it is desirable to pick up that which can be picked up with the squeegee and pick-up pan. This part of the floor that has been scrubbed is rinsed to remove the powder, the chemical, and the dirty water before starting to scrub a new part of the floor.

In scrubbing, the janitor will need one pail for scrub water and one pail for the rinse water. Under no conditions should he neglect the rinse. This is important on any floor. It will be necessary for the janitor to use clean water, both for his scrub water and for his rinse. After the water becomes dirty it should be changed. Scrubbing does not necessarily involve soaking and he should avoid using excessive amounts of water. He should be careful to clean all corners. Scrubbing can be done more easily with the use of a scrubbing machine. These machines are equipped with a heavy fiber brush which applies the friction necessary to remove the dirt. Even where a scrubbing machine is used it will be necessary to use a hand brush or a long handle fiber brush to remove the dirt from the corners. In scrubbing the janitor should be careful in the selection of cleaning compounds. Strong alkaline or acid cleaners may do harm to the floor surfaces. He will need to select his cleaning compound to fit the floor to be cleaned. He may need to scrub to remove certain accumulations of gummed waxes and oils.

Dry Cleaning

Dry cleaning involves the use of steel wool and is done without any application of water. The steel wool machine is used for more purposes than for cleaning. In one respect it replaces the old burlap bag on the feet of the janitor or on blocks which were once used for buffing floors. The steel wool machine may be used for cleaning off old wax or chipped varnish. However, the machine may not be effective on some varnished finish. One of the most frequent uses of the steel wool machine is that of buffing off old wax finish. Oftentimes, the old seal and finish must be removed before the new finish is applied. The steel wool for these machines comes in various grades. The coarser grade used for cutting off varnish is usually Number 3 or Number 4 wool.

When the steel wool machine is used to assist in applying finish it is first used to remove the old finish and to level off the nap of the wood that may have been raised with the cleaning process. In this case, the floor must be swept before the seal is applied. After the seal is applied and has set for a short time the buffing machine may be used to buff the seal into the floor. After the second coat of seal is applied, a buffing machine may be used again to set the seal. The buffing machine is also used to give a finish to waxes that are not self-polishing. It may also be needed for waxes which are built up with a soap and water content. The water dries out, leaving the lighter soap on top of the wax. There is also some possibility that when water gets on the floor the soap may unite with the water, making a solvent for the wax underneath, thus causing it to loosen its bond with the floor. When a wax like this is used the buffing may remove the soap finish before it gets wet.

The dry cleaning process has some advantages in that it does not add water to harm the floor. It can also be used to buff the floor filler which is usually made up of the dust from sanding and a good seal. The use of the buffing machines gives a sheen to the seal or wax and aids in preventing slipperiness. The buffing machine usually uses wool in grades of Number 3 down to Number 0 for floor finishing. This wool may be purchased in pads or in long rolls. Either type may be used successfully. The long roll is usually cut in strips and used on the bottom of a special brush or disc applied to the scrubbing machine or on special cylinders made for this purpose with certain steel wool machines. In any attempt to use steel wool the janitor should be careful that the wool does not knot and ball up, thus causing the machine to cut the finish in grooves.

Chapter 11

School Floor Maintenance

Satisfactory and economical school floor maintenance can best be provided on floors that have been properly conditioned. The floor expert uses the term "conditioning" in describing the preparation of new floors for use. He uses the term "reconditioning" when referring to the renovation of old floors. The school janitor should know how to prepare or condition, floors. He should be familiar with the procedures in sanding, scraping, buffing, oiling, sealing, and waxing floors. He should know the maintenance practices and procedures best adapted for the various types of floors. He should also know how to vary his floor treatments and maintenance practices for the various schoolrooms or units since the different school activities and room use calls for different floor maintenance practices.

Conditioning and Reconditioning Floors

There has been much improvement in floors since the time when the footing in enclosed spaces was only the natural dirt. These floors did have one good quality. They were resilient and not hard to walk on. They had little else to recommend them. In our changing from the dirt floor we have developed some types of floors which may be among the most attractive features in the room or rooms if properly cared for. The new floors demand a different type of treatment. Two changed demands for floor service are somewhat opposite in nature. We desire floors that will resist wear for a long period of years, and which will at the same time take a surface treatment giving the proper luster or sheen. On the other hand, we want floors that are somewhat elastic or have a little spring so that they are not too hard on the feet of the people walking on them. We also want floors that are not too noisy. If it were not for these last two requirements we could put masonry floors everywhere. In order to get life in the floor we try to put in floors with good wearing qualities; then we attempt to use treatments that will build a temporary surface in and on the floor in order to give the appearance and the degree of softness desired. The type of treatment then, must depend on the floor. In general, the surface treatments range from none to scrubbing, oiling, sealing, or sealing and waxing.

Obtaining a Smooth Floor Surface

One of the first steps in floor maintenance is to obtain a smooth surface. Smooth surfaces look better and wear longer than do rough surfaces. Sanding, scraping, or buffing may be necessary in order to obtain the surface desired.

In sanding, a part of the floor surface is cut away with an abrasive sandpaper. New wood floors are usually sanded before being put into use. There was a time when all sanding was done with sandpaper fastened to the bottom of heavy block or brick weights. This method did improve the surface but it was extremely slow and could not always be controlled. Today sanding is usually done with a sanding machine which has a disc or drum covered with sandpaper and driven by a gasoline or electric motor. Many of the larger schools own sanding machines while others rent or borrow the machines when needed. The janitor who does his own sanding should learn how to use the machines. He should know that the machines should be run over the floor at regular speed to avoid digging holes in the floor or burning the wood fiber. He should also know the drum or disc speed desirable when using the various grades of paper. The coarseness of the paper will depend on the type and condition of the floor and the job to be done. The paper generally used ranges from Number 3 which is coarse to Number 00. On rough pine floors he usually starts with Number 3 paper and changes to Number ½ to Number 0 for finishing.

There is some difference of opinion, relative to the movement of the sanding machine. On rough floors most janitors find it desirable to run the machine diagonally with the boards in making the first cut. Some janitors run the machine crosswise of the boards in making the first cut. There is danger that the cups in the board may be cut deeper by the inexperienced operator when running the machine crosswise of the boards, thus leaving a surface of humps and hollows. Running the machine in a diagonal line across the boards seems to aid in removing the cups. After the rough spots have been removed the finer paper may be used and the machine run lengthwise of the boards. When the janitor has finished he should have a smooth floor that does not show scratches and marks from the paper. The drum sanding machines can be purchased with drums of various sizes. These run from about seven to about twelve inches for school use. The disc type machines usually have a grinding disc of from about 13½ to 15 inches. On convertible machines it is desirable to have several pulleys or adjustable gears that permit a change of speed when using the machine for various purposes. Many schools that are not able to purchase a separate sanding machine do purchase convertible machines and then use them for light sanding jobs. In using a machine of either type the janitor should remember that they are run at a comparatively high speed. All bearings should be of a type that will stand hard usage. They should have adequate protected lubricating openings. These bearings should be properly oiled. Dust should not be permitted to collect in the bearings or in the motor.

Sanding is often one of the necessary steps in reconditioning old floors. The janitor should study his floors to determine whether sanding is feasible and practical. Some of the older floors are so badly worn that sanding is not feasible. Others have exposed nail heads that tear the sandpaper. Sanding is done to smooth rough floors and to remove old varnish or oil finishes. In removing heavy varnish it is often necessary to use a Number 3 sandpaper, and it may be necessary to reverse the motion of the machine so that the roller turns upward against the edge of the cut. This aids in avoiding gumming up the paper with the old varnish. Usually it is not necessary to use a coarse paper in sanding old maple or oak floors unless the boards are badly cupped. A fine grade of paper is also used in sanding cork floors. Sanding is one of the effective means of removing surface coatings of oil from old floors. Never cut any floor deeper than necessary to get smooth surface.

On some floors where the edges of the boards stand up above the rest of the floor, it may be necessary to remove these high spots by scraping before sanding. It is impossible to reach all corners and edges of the floor with the sanding machine. The janitor will find it necessary to use the hand scraper to smooth these rough spots.

The term buffing applies both to conditioning and maintenance procedures. The buffing machine is used to remove the nap from wood floors before and after initial treatments have been applied. The buffing machine is also used to smooth and set wax finishes after they are applied. The buffing machine which is usually a steel wool machine is also of value in conditioning certain floors. It is used to remove rough spots or deteriorated surfaces from asphalt or rubber floor surfaces. It may be used to remove old applications of seal, varnish, or oil from smooth floors.

Oiling

Many years ago the schools copied from the neighboring housekeepers and scrubbed the school floors frequently. Since scrubbing did not hold down the dust and involved a lot of labor, janitors tried to combine utility and labor saving by putting oil on the floors. Oil treatment did not seem bad so long as only light applications of a light oil were made and so long as frequent scrubbing took up the old oil. However, some janitors felt that the oil was a cure for all floor ills and soaked the floors in oil, much of which remained on the surface and made the floors gummy. Dirt collected on this oil and became imbedded in it. Then as new applications of oil and dirt were applied and accumulated the floors became black. They absorbed light that was brought into the room. They soiled the clothing of the children. They were unattractive and unsanitary.

A part of this difficulty arose from the types of oils used. Oils for school room floors may be a vegetable oil such as linseed or tung oil, or a mineral oil with a paraffin base. The tung oil and linseed oils do serve as wood preservatives and also aid in holding down dust. However, each of these is costly and somewhat difficult to obtain in a natural state, hence, few schools ever use pure linseed or tung oil. The linseed oil has a tendency to come up and oxidize, making the floors somewhat dark. The paraffin oils have gum in them which may collect on the floor and catch dirt, thus making the floor dark. The lighter the grade of oil the more penetration it has into the wood and the less tendency it has to gum up on the floor.

The janitor should understand that there are two types of floor oils. One is a cleaning oil composed primarily of kerosene and creosote. This oil is highly inflammable and is rarely used in school buildings. The penetrating oils contain paraffin, turpentine, and other ingredients such as pine oil.

Application of Oil

Oiling is not generally recommended today for school floors, yet it is recognized that there are instances and conditions that might make oiling desirable. On some old floors which are in a condition that prevents sanding and smoothing for waxing or sealing, an application of oil may be about the only possible means of dust holding. Even then, floors should not be oiled in one room if this room is close to the other rooms with sealed and waxed floors for the pupils will carry the oil from one room into the room with better floors. Where oiling is done, all old oil should be removed before the new oil is applied each year. The old oil should be scrubbed or scraped off the floor so that none of the dark residue remains. When the new oil is added, only a thin coat should be applied. This may be applied with a mop or spray. Oil should not be poured on the floor and left to soak in. A mop may be dipped in the oil and then rung out comparatively dry so that only a thin film of oil is applied to the floor. After the oil has been on the floor for a short time, another mop should be used to take up any that may have collected in drops. If a janitor uses a spray he can apply the oil more easily and perhaps in a better manner. The spray should deliver a fine mist of oil to the floor. Under no conditions should the spray nozzle be high enough in the air to permit the oil to spray on the desks and seats. In either method of application there is no need to apply the oil to the edges around the baseboards since this part of the floor does not get any wear. It may be possible for the janitor to make light applications once or twice during the year, using the spray or the mop. Oil is not often used on hard wood floors, but is used on floors of soft wood. Oil is not a preservative and may actually do harm to the wood floor. Oil should not be applied on asphalt tile, linoleum, or masonry floors. In applying oil the janitor should use only a thin oil. Light applications on clean floors are less objectionable than the heavy applications over old oil and dirt.

Sealing Floors

There are so many different problems involved in sealing and treating floors that special sealing for terrazzo and concrete will be considered separately. The word seal as used in this section refers primarily to the sealing of wood floors. There are two general types of wood floor seals; penetrating and surface seals. Each of these treatments has its place in school buildings. The janitor should understand that seals have a distinct purpose and that mineral oils are not classified among the sealing agents. The purpose of sealing is primarily to support the grain of the wood and to make it impervious to the entrance of water and other deteriorating agents. The materials forming the basis of the seal are usually oils like tung or linseed oil. The seal must fill the wood cells and form a basis for other finish. Bakelite, luxite, or copal gums are often made a part of the seal in order to give sheen and finish. This is particularly true of surface seals.

Surface Seals

Surface seals are often used on gymnasium floors where wax applications are not practical. They also make a good furniture finish. These seals have more gums than the penetrating seal. At one time copal gums were used extensively in seals. Copal gums have a tendency to turn dark and are not used as much now as bakelite. The bakelite content of a seal will depend somewhat upon the use desired. If not enough gums are included, the seal may not have the sheen and finish desired, but if too much of the gum is used, there may be a tendency for the seal to crack and peel from the floor. The finish obtained from a good surface seal is somewhat like a lacquer or varnish finish. It is costlier but stands up better, however. The surface seal for the gymnasium should not powder or turn white or gray in color. It should dry in about two hours and should harden in about twenty-four hours. It should resist friction burns from rubber shoes. It should resist alcohol and mild caustics and should provide a hard non-slippery surface. It should be light in color and should give good footing for rapid gymnasium activities. The solids of a good seal should not separate from the liquid when the seal is permitted to stand.

Penetrating Seals

The penetrating seals are used for different purposes. They are primarily an undercoat serving as a basis for surface treatment. In wood, the penetrating seals help support the grain and become almost a part of the wood structure. While it is difficult to get deep penetration in hard woods, the deeper penetration does wear longer and protects the wood against other impregnations. For this reason, the penetrating seal should be made thin. Tung oil is one of the basic ingredients of the modern penetrating seals. The penetrating seal is usually put on in two coats. The first coat gives the greater part of the penetration while the second coat bonds to this and in turn furnishes a bond for the surface treatment to be placed on it. The penetrating seal should dry in about thirty minutes. It is usually applied with a lambs wool applicator. About all that the wood will take is applied to the floor. The floor should be clean and dry before applying. The janitor should use different mops for sealing and waxing. The lambs wool applicator heads do not cost much and can be cleaned after use.

Janitors can sand the top coating off oiled floors and by sealing immediately can hold down the old oils. This method of sealing seems to give better results than to attempt to seal over washed or scrubbed surfaces. If the floor has been washed it should be thoroughly dried before any attempt is made to seal it. In sealing porous woods like oak it may be necessary to use a filler first in order that the floor will not absorb excessive amounts of the seal. Sealed floors treated with a penetrating seal do not provide the complete treatment necessary for classroom floors. If the seal is left exposed, dirt collects on it and in a short time the floor must be retreated. It is more economical to cover these floors with a thin application of floor wax which catches and holds the dirt and which can be removed along with the dirt. A new wax coating may then be applied. If this practice is followed frequently, resealing will not be necessary.

Waxing Floors

When wax is placed over an undercoat of preservative seal the wax helps to protect the under finish and to hold the dirt. The wax does provide an attractive floor finish and if properly cared for gives a color that does not absorb excessive amounts of schoolroom light. There are several bases for wax preparations. One of these is beeswax which is not much used in school floor waxes. A second one is ceresin. Carnauba is probably the most popular base for school floor waxes. This is derived from a Brazilian palm. Other ingredients, such as potassium, turpentine, ammonia, borax, soap, triethanolamine, mineral oils, or gasoline are used.

The waxes come in two general forms; paste and liquid. The paste is not often used in school buildings. The liquid wax comes in two types known as spirit float or spirit solvent and water emulsion wax. The spirit solvent wax was used before the water wax came into use but it seems today that the water float wax is becoming more popular. The spirit solvent wax needs to be polished and should not be used on surfaces that may be harmed by the spirit solvent. The janitor can make a wax of this type by the following formula which is given in the United States Department of Commerce, Bureau of Standards, Materials for the Household, Circular 70, pages 2, 3, and 4. The following ingredients are used:

Carnauba—two parts by weight, Ceresin—two parts by weight
Gasoline—high (.725) specific gravity—twelve parts

Melt the wax by setting in vessel of hot water and add turpentine and gasoline, cooling rapidly, stirring to a creamy mass. Always set can in hot water when heating and keep away from flames as gasoline and turpentine are inflammable.

Water Emulsion Wax

This wax is often called a self drying or non-buffing wax. It is used in many places and on many types of surfaces. It contains few or no chemicals harmful to asphalt tile, mastic, or cork. The water in the wax applied to the floor dries leaving a hard surface. If the floor is wet later, there may be a tendency for the water to reemulsify this wax. These waxes are usually made up of carnauba or some other suitable wax base in a water solvent with soap or certain other ingredients added.

The U. S. Bureau of Commerce, Bureau of Standards, Circular Letter, L. C. 275, outlines on page seven a plan for making cheap water emulsion wax. It is about as follows:

Dissolve one part (by weight) castile soap in sixteen parts of soft water. Heat to boiling. Add four parts (by weight) carnauba wax chips, stirring to a smooth emulsion. Cool by adding water to necessary thickness (usually fourteen to sixteen parts of water). Let mixture cool and filter through cheese cloth, stirring in a small amount of formaldehyde as a preservative.

The same Bureau of Standards outlines a process of making the brighter, water emulsion wax. The procedure is about as follows:

	Small Amount		Larger Quantity	
Carnauba—wax (No. 1)	72.	grams	6.6	lb.
Oleic acid	9.1	milliliters	.8	pt.
Triethanolamine	10.6	mil.	.95	pts.
Borax	5.4	grams	.5	lb.
Boiling water	500.	ml.	5.75	gal.
Shellac (dry polishing)	10.	grams	1.1	lb.
Ammonia (28 per cent)	1.75	ml.	.175	pt.
Water at room temperature	100.	ml.	1.	gal.

A milliliter, (ml.) is the same as a cubic centimeter.
(Increase in regular multiples for larger quantities.)

Melt wax and add oleic acid @ 194 F. in hot water bath. Add triethanolamine slowly—stirring. Dissolve borax in 5 ml. boiling water and add—stir five minutes. Add rest of boiling water slowly—stirring. Add the 100 ml. of water. Add shellac and stir.

These formulas are not given as an indication that the janitor should attempt to make his own wax preparations. He probably can purchase better ones. They are given to indicate to him the composition of some of the wax preparations and to indicate that there is no magic formula in their preparation.

Application of Wax

The method of applying wax will vary with the type of floor and the type of wax used. A homemade applicator may be made by cutting off a part of the strings of an old short string mop. These homemade applicators absorb much of the wax and are not as well liked as the lambs wool applicators. In most cases, the old wax has some dirt imbedded in it. Remove this old wax by buffing or by the use of some solvent before the new wax is applied. The new wax should be applied in thin layers. Heavy applications may pile up, causing slick places on the floor. One coat of wax is usually sufficient, but sometimes two coats of wax are applied. With some types of wax, the second coat may cause the first coat to soften and lose its bond with the floor. The janitor should remember that the wax is to serve as a protection for the seal, to hold dust, to provide a cushion, and to give a satisfactory appearance to the floor. Any wax in excess of the amount needed is wasted. It is not difficult or costly to apply another coat when needed.

There is some difference of opinion on whether buffing of wax finish is necessary. The spirit solvent waxes are usually buffed and polished. Some janitors regularly buff water emulsion waxes, contending that the buffing gives a sheen immediately, and that the buffing removes some of the lighter solvents that float to the top of the wax. Other janitors contend that the water waxes will be buffed by the shoes of the children in a satisfactory manner. Machine or hand buffing does seem to add to the wearing qualities of the wax.

The janitor should not use any spirit solvent wax on asphalt tile or linoleum where the solvent might injure the floor. He should not expect satisfactory results from wax on a rough floor. He should not use a dirty applicator. He should clean the applicator after each use. He should not wax stair treads. A floor that is properly waxed with a good wax will not be tacky. Tackiness can be determined by the way shoe heels seem to stick to the floor when walking slowly across it. The properly waxed floor will present a dry hard surface. It will not scratch easily and it will have a sheen or luster without a high light refraction. It will be slick and smooth but not too slippery. It will have good wearing qualities and will be easy to maintain. It will not streak or get dark and will be resistant to rubber burns.

Other sections have outlined types of floors and methods of sweeping, mopping, and scrubbing. Modern school floor maintenance involves more than cleaning. The janitor in charge of school buildings must know modern maintenance. It is desirable that he have an accurate knowledge of floors, of preservatives, and of surfacing compounds. He should also have a background of experience in the use, durability, and value of various surfacing agents. He must recognize the importance of floors and floor care to the building. He must become a floor specialist.

There are many theories, often conflicting, of the best methods to use in floor maintenance. Some practices recommended and satisfactory for one floor surface may not be at all desirable for the same type of floor in another location and used under different conditions. Few building planners give adequate attention to the floor maintenance problems that may arise after the building is put into use. The janitor will find it necessary to study his floors and to provide the treatment that secures the best service possible from the floors that are in the building.

In studying floor finish the janitor should realize that the type of finish may vary with the use of the room. For instance, gymnasium, library, and shop units may have the same type of floors but do not need the same maintenance treatments. Likewise, the age of the floor, the type of furniture used, and the condition of the playground may determine the types of floor finishes that may be applied. Certain floors may be treated with a wax finish while stair treads and gymnasium units should never be waxed. Maintenance methods must be adapted to the tools, materials, and man power available and the capable janitor will maintain his floors in the best possible manner with the facilities available.

Maintenance Practices and Standards

1. The janitor should know how to maintain an attractive floor with the proper sheen in an economical manner.
2. Proper floor maintenance includes those practices which provide durability and preservation. Good finish lasts longer.
3. The beauty of certain floors should not be marred by a paint that completely covers them, oils that soften them, or varnish that may chip and peel.
4. Good finish reduces the burden of daily care.
5. Bleaching agencies have no place on most floors.
6. Dust holding power is desirable but tackiness should be avoided.

In order to maintain floors in a desirable manner with a minimum cost and labor the janitor must know floors, cleaning methods and surfacing agents. He should be able to evaluate the claims of salesmen who may promote a material for a use for which it is not at all adapted. Since various floors require different treatment it seems desirable to outline some generally accepted maintenance practices and to list some cleaning and surfacing materials adapted for use on some of the more common floors.

Cleaning and Surfacing Preparations

The Procurement Division of the U. S. Treasury Department specifications gives detailed description of the standards set up for articles purchased by that division. They define one cleaner which is usable for certain composition floors as a preparation of linseed oil and potash with a coverage of 4000 square feet on linoleum or 2000 square feet on mastic. A crack filler of ground silica and a volatile liquid dryer should cover about 60 to 70 square feet of oak floor for each pound of filler. A water emulsion finish (wax) would have 17 per cent solids of gums and vegetable waxes, of which at least seven-tenths should be a vegetable wax. It will have a coverage of 1000 square feet per gallon on treated wood or composition floors. The same division lists several seals varying in content and composition, depending on the use for which they are intended. In general, they will have some penetrating qualities, will not be slippery, and shall have preservative qualities. They will have a coverage of from 300 to 400 square feet per gallon.

As stated previously, floor treatments and floor maintenance methods vary with the use of the room or unit. It also varies with the type of floor. Since much of the discussion under the headings of sealing, waxing, and oiling referred primarily to wood floors, that part of the wood floor maintenance procedure will not be repeated here. In general the treatment of classroom floors preferred by most janitors is *first* to produce a good surface. If the floor has been sanded, all loose dust should be wiped up with a burlap cloth or a Turkish towel before a finish is applied. Next, the janitor applies about all the penetrating seal that the floor will take. It is often desirable to buff off the loose wood nap before the second coat of seal is applied. The buffing may be started before the seal has completely dried. After the surface has dried the second coat of seal is applied. After the seal has dried the wax finish is applied.

If the floors need filling, and open grained floors like oak often do, a filler can be made by one of several processes.

1. A simple effective filler can be made by mixing the dust made by sanding with a good quick drying seal.
2. Another filler can be made by mixing one part flour, one part corn starch, one part Japan dryer, and one part linseed oil. Mix powders, add dryer, and then linseed oil.

3. Stick shellac or plastic wood make good fillers, particularly for cracks.
4. A satisfactory filler may be made of newspaper pulp and alum boiled and mixed.
5. Another filler may be made from powdered silex or silica and linseed oil or turpentine and Japan dryer.

Fillers should be made into a fairly stiff paste. Most janitors apply filler after the first coat of seal, others feel that less seal is required if the filler is applied first. The filler should be rubbed over the floor in a manner to fill pores and cracks. It should be buffed in and all surplus removed before applying other treatments.

In caring for wood floors the janitor should not apply too much wax, use only good seals and waxes, and use no oily sweeping compounds on wax or seal finishes. He should not attempt to paint or seal over old wax. Worn spots should be retouched as soon as they appear in the traffic lanes or the aisles.

Maintaining Masonry Floors

Marble

Marble floors where the floor slabs are of equal hardness wear well. However, many problems arise in the care of marble. The marble is sufficiently porous to absorb stains and one cleaning may injure the surface. Oils, tar, and soaps may stain the marble. Acids will react on the marble and cause the floor to disintegrate. Coarse abrasives are harmful to marble finish. Stains may be removed by a paste poultice but there is some danger that the poultice may pit the surface of the marble. Clean water without any cleaning compound is usually sufficient for marble. The janitor should avoid crystallization from the use of strong salts or alkalines. Damp mopping with water containing a mild abrasive or a small amount of T.S.P. will usually provide all of the treatment needed for cleaning. Sealing or waxing are not usually necessary.

Concrete Floors

There are many concrete floor surfaces in school buildings. Many of these have not been properly constructed, surfaced, or cured. Some of these dust and become pitted. The dust or sand that arises serves as an abrasive to cause further wear of the concrete and of the neighboring room floors to which it may be carried. Concrete floors are subject to deterioration from the effect of acids, from greases, or from strong alkalies. In cleaning concrete floors the janitor should be extremely careful in the use of gasoline or other inflammable liquids. A mild solution of T.S.P. in warm water will usually clean the floor.

In order to preserve concrete floors many treatments have been tried. Wax provides a slick surface but does not seem to stand up. Concrete paints or surface treatments containing rubber asphalt or other flexible materials have been tried. Several manufacturers have developed paint treatments that wear well and that give good service. However, not many janitors report complete satisfaction with any concrete paint preparation for floors. The impact of sharp heels on the unyielding concrete seems to cut through the finish. Painted concrete floors worn into visible traffic lanes are unattractive and are difficult to maintain.

Concrete Seals

Probably the most satisfactory treatment to prevent dusting and pitting is to seal the floors. Many floors are sealed and hardened with some metallic oxide seal when constructed. Some of these seals add color and seem quite effective. Many of the floors were not properly sealed and hardened when laid and the janitor must apply some treatment that will preserve the floors and prevent further dusting. Some of these pre-hardened floors need re-sealing in a year or two. There are a number of seals that may be purchased, most of which are quite effective. If the janitor does not have these he can prepare his own seal. He may use any of the following methods. (A part of these formulas are outlined in "Circular Letter No. 139," October 28, 1921 from the United States Bureau of Standards, and in "Circular Letter No. 42," issued in February 1923 by the same bureau.)

1. Aluminum Sulphate treatment
   Add 2½ pounds aluminum sulphate to one gallon water and 2 cc sulphuric acid. Mix in barrel or stone jar—stir well. Dilute mixture ½ for first coat and second one applied one day apart. After another day add last coat 2 parts solution and one part water. Apply with brush. This seal is durable and economical.
2. Magnesium fluosilicate applied in three coats. Mix first coat 1 to 2 with water, second coat 1 to 1, and third coat 2 to 1 with water. This seal is durable.
3. Sodium silicate is probably the most economical and the most easily applied of all the home made seals. The sodium silicate (sometimes called water glass) may be purchased at from fifty to ninety cents per gallon. It is an alkaline, syrupy, viscous liquid. For sealing concrete those varieties containing more silica and alkalies seem preferable. These are mixed about one gallon to four gallons of water. One gallon of the mixture should cover about 1000 square feet unless the concrete is in bad condition. A second coat will probably be needed. The first coat should dry twenty-four hours before the second coat is applied.

The seals listed here will give a sheen and will retard dusting. They will wear out but can be replaced in worn areas without showing the lap. Sealed concrete floors may be cleaned daily with the same type of tools used for other treated floors. Before applying the seal, all dirt should be removed. The floor should be swept to remove dust and sand. In applying the seal over worn spots, it is not necessary to apply near the walls where little wear has occurred.

Terrazzo Floor Care

Terrazzo floors are a combination of cement and marble or granite chips. These floors are hard and smooth. They may be mopped with the wet mop and scrubbed with the scrubbing machine. As a rule, these floors are easily maintained. However, many of these floors crack. Since they contain a cement binder they are subject to blooming and pitting.

Varnish is sometimes applied to prevent dusting, but it may crack and peel, and may discolor the terrazzo. Waxes make the floor too slick. Probably the best treatment is that of sealing. There are a number of good seals on the market. They are applied in the same manner and provide comparable results on terrazzo floors. Terrazzo can be made too slick for safety. One of the janitor's tasks is to provide the surface needed without making the floor slippery. Heavy soaps and strong alkalies should be avoided in cleaning.

Magnesite Floors

Since these floors have a cement base they should have about the same treatment as that provided for terrazzo and concrete. The magnesite floors are porous and need sealing.

Tile Floors

Tile floors are quite impervious and may be cleaned by mopping. Heavy soaps will pile up on the floor and make them slick. Acids or strong alkalies will attack the grouting or binder between the tile and may cause the tile to loosen. Their use should be avoided. Quarry tile may be inclined to bloom and should be sealed. Waxing is not necessary.

In the care of masonry floors the janitor should avoid using strong salts or alkalies that may lead to floor injury. He should also avoid the use of acids on masonry floors. When either acids or alkalies are used, the floor should be thoroughly rinsed.

Maintaining Composition Floors

The maintenance problems of the janitor increased with the introduction of composition floors. The various materials used made it necessary for him to study the materials used and to know how to maintain these floors. One problem that arises is the prevention of scuffing and denting of the floors. Sometimes these floors are laid on concrete that is damp or that has not had time to cure. This may lead to softening in linoleum floors. Dampness may also cause linoleum binding glue to give way thus permitting the floor to bulge or buckle.

Linoleum Floors

Linoleum floors are usually glazed with lacquer or some similar substance at the factory. The use of any abrasive cleaners may cut this finish and expose the linoleum to the effects of water and wear. The linoleum is made up of a combination of linseed oil and cork chips, so no cleaner containing a solvent for linseed oil should be permitted on it. Corn oil, mineral, or cotton seed oils and free alkalies are harmful to these floors. The surface must be protected. Frequent washing may destroy this surface. In fact, it is often stated that linoleum floors may be washed out before being worn out. They may be mopped occasionally with water and a neutral soap, linseed oil soap preferred. If properly cared for no new seal need be applied. Spirit solvent waxes are harmful and should not be applied. Water emulsion waxes with a low bakelite content may be applied in thin coats. Wax treatments of this type bring out the color and are essential for linoleum preservation. Waxes loaded with heavy gums make the surface too slick. The floor should be kept dry. Oil stains may be removed with a cloth dampened with hydrogen peroxide.

Cork Floors

These floors often need to be buffed with steel wool before waxing. The cork chips are bound together with a glue binder and no cleaner that will dissolve the binder should be used. It should be kept dry and surfaced with a thin coat of water emulsion wax.

Rubber Floors

Rubber floor tile are usually made with a hard plate-like surface by a process called calendering. In caring for rubber floors the janitor should try to preserve this finish. Abrasives, oils, and alkaline soaps are particularly harmful to this finish. Naphtha and other mineral oil products are destructive to rubber. For this reason, spirit solvent waxes should never be used. Oils make the rubber spongy. The rubber is not particularly susceptible to the effects of water but it may deteriorate with age and check or crack on the surface from the effects of air and sunlight. The light colored rubber tile seems to check worse than does the dark colored floor. The hard tile does not seem to deteriorate as rapidly as does that with a soft cushion back.

The rubber does not soil readily and can be cleaned easily. The surface should be protected from air and sunlight. A light application of water emulsion wax may be applied. The floor may be cleaned with the dust mop and occasionally by mopping. Soaps are not needed. However, the water may be softened with T.S.P. If the floor checks or becomes soft it may be resurfaced with steel wool. Damaged tile may be replaced.

Mastic and Asphalt Tile

Asphalt tile is particularly adapted for ground floor or basement surfaces. If it gets too dry it may crack. Many janitors find it advisable to mop these floors occasionally to keep them moist. This often creates a problem since the water emulsion wax may be removed by the process. The asphalt tile are particularly susceptible to damage from oils or any petroleum products. Oils cause them to disintegrate and become gummy. Spirit solvent waxes should never be used. It may be washed and should be surfaced with a water emulsion wax. The wax used should not contain an excessive amount of gums or the surface may become slippery. With the proper wax treatment the tile will remain pliable but not too soft. The footing will be safe and sure. Sand should be kept off the floor since it will mar the finish. Steel wool may be used to remove soft spots. Damaged tile may be taken up and replaced.

Care of Gymnasium Floors

In many schools it is necessary to use a gynasium floor for dancing or auditorium activities. For dancing a slick floor is needed. Corn meal may be used but it cuts the finish. Shoes with leather soles are hard on the gynasium finish. Borax flakes or crystals sprinkled on the floor provide the slipperiness needed for dancing and will to some extent protect the floor. A damp mop may be used to remove the borax crystals. If the floor remains slick it may be mopped with a mop dipped in warm water.

Miscellaneous

One of the first principles of floor maintenance is to provide a suitable surface. A second principle is protection. A third is care and upkeep. The development of a suitable surface has been outlined. One of the first steps in protection is to keep dirt out of the building. Rubber, steel, or cocoa mats, scrapers, brushes, and brooms should be provided as an aid to shoe cleaning before pupils enter the building. These are vital to floor protection. In the care and upkeep of a building all dirt, sand, and grit should be kept off the floor. Bleached spots and marring stains should be removed as soon as possible. The school floor can provide a beautiful base or background for an attractive school room if properly maintained. On the other hand, the lack of an attractive floor may mar the appearance of any otherwise attractive room.

Chapter 12

Heating and Ventilating Systems

THE EFFICIENT SCHOOL janitor should be familiar with the importance of and the principles involved in a modern system of heating and ventilating school buildings. He should know the various methods of generating heat, the types of generating units used, and the methods of distributing this heat. It is essential that he understand the principles of combustion and the value of the fuels used. He should know how to care for his fires to obtain the greatest heat value with a minimum of effort and of fuel. He should know how to care for the pumps, fans, and other devices used in a modern heating and ventilating system.

The discussion in this and the following sections is not intended as a scientific exposition of heating and ventilation. It is developed for the purpose of aiding the janitor or school official in a study of his system, the principles involved, and operating practices that may lead to economical, efficient operation. Principles and practices that do not apply directly to school buildings are omitted. Figures denoting measurements and quantities have of necessity been given as approximate estimates. These principles and practices are outlined in descriptive form rather than as definite rules and regulations. This is done on the theory that the modern school janitor-engineer is an intelligent man. He will have a wider and deeper knowledge of his job than can be obtained in a list of rules and regulations on a "do" and "don't" basis. In a few cases definite suggested regulations are listed.

In school buildings where a number of pupils are brought together in one room or group and heat and ventilation are closely related, it is almost impossible to discuss them separately. The heating system is supposed to provide the temperature needed. The ventilating system aids in diffusing the heat to the various parts of the building and in removing excess heat. In some types of heating systems, a part of the ventilation is provided by the warm air brought in. The exhaust ventilation is aided by the air pressure built up. Either a lack or an excess of heat or of air movement may make less efficient the other system.

There was a time when school buildings were heated by open fires in huge fireplaces or by crude box stoves. Some of these stoves are still in use. The stoves provided a direct heat that often did not extend very far from the heating unit. Many of us can remember the old open, stove heated rooms where the pupils roasted on one side and froze on the other side. The stoves were difficult to service and gave rise to much dirt in the room. The room stoves were finally replaced by one large (stove) heating unit located in the basement and the heat was piped to the rooms, or perhaps even to several buildings. The development of the central heating system has created a number of problems in heat distribution and in heat regulation. The modern heating and ventilating plants can provide controlled heat of the temperature desired, with positive air changes, and the occupants of the room will not realize that any change is taking place.

Importance of Adequate Heating

Experience and tests indicate that children do more and better work when they are comfortable. If a room is too cold pupils cannot work in comfort. If it is too warm they become sluggish. Physicians tell us that controlled temperature within a desirable range, for pupils seated in a school room, is essential to promote healthful conditions.

Principles of Heating

An efficient heating plant should maintain the desired room temperature regardless of outside temperature. In order to overcome variations in outside temperature, it is necessary that the heating plant be flexible in operation. It must be able to overcome the lowest possible temperature yet be able to operate efficiently when the outside temperature is only a little below that desired in the room. The pupils in laboratory and gymnasium units are more active than are the pupils in other classrooms and do not need the same amount of heat. The heating system should be flexible enough and should be adjusted to provide the temperature needed in each of these rooms. The effective temperature in the classroom may be affected by the moisture in the air and the air motion. In general, classrooms should have a temperature range of from 67 to 71° F. with no rapid change of more than two degrees.

Heat Transfer

In practice the heat is generated in a central furnace located either in or out of the building. The initial heat is obtained by the rapid oxidation or burning of fuel. However, this heat source is usually too far from the classrooms for the direct heat of the fire to have any effect on room temperature. To obtain heat for the classrooms the heat from the furnace fire is brought into contact with a conducting surface, usually some form of iron. The heat conducted through this metal is transferred to some flexible medium such as water or air that may be sent to the classroom. In some heating plants the heated water rises or is forced to the classrooms. In other cases the water is converted into steam which is sent to the rooms. In hot air systems the heated air rises or is forced to the classrooms. In all cases the room units are designed to retain the heated medium until it has given up a considerable part of its heat to the room air.

With hot air systems the warm air enters and is mixed with the room air, thus tempering both the room air and the incoming air. The heat from classroom steam or hot water units is delivered in one of three methods. These are conduction, convection, and radiation. Not much room heat is provided through conduction, which means the transfer of heat along and through a substance such as a metal rod. Convective heat is that which is carried by an air current. Radiated heat is that which is thrown out or off as an excess from a unit like a stove or a radiator. The latter two methods of heat transfer are used extensively in school room heating and are outlined in more detail.

Heat Diffusion

A convective heater located in or out of the room with a forced air circulation around it provides the most rapid method of heating a school room. In some cases this circulation is induced by shields or ducts which direct moving air around the unit. In other cases the air movement is accelerated by the use of fans. Some method of air circulation is the only practical one for heating large areas with high ceilings.

Radiating heat units are used in many classrooms. These radiators are located in the room and give up their heat to the air surrounding them. Radiant heat travels in straight lines and like the sun's rays gives up little heat to the air, but does warm objects in its path. Unless there is some air movement this heat does not reach all parts of the room. In the installation of direct radiation an attempt is made to overcome this difficulty by locating the radiators under the windows so that the warm air rising from them will mix with the air coming through the windows and thus be carried over the room. This makes use of both radiant and convective heat.

This spreading or diffusion of heat is important. If the heat is not properly diffused it rises to the ceiling. Some parts of the room in the corners and near the floor may be cold when the temperature near the ceiling is much too high for comfort. This condition is particularly noticeable in some of the older basement rooms heated by ceiling radiators. Methods of distributing and diffusing room heat will be discussed more fully under the heading of ventilation (Chapter 12).

Methods of Delivery

For many years it has been customary to designate or name the heating system from the type or method of delivery. There are many different types of heating plants that deliver their heat in the same manner. For this reason, it seems better to discuss methods of delivery separate from the types of heat generating units. Heat is delivered to the classrooms from or through one or two types of units (not systems). All units that are located in the room and deliver their heat to the room are *direct heating* units, regardless of the method of diffusing heat through the room. These include stoves, gas-steam radiators, steam or hot water radiators, unit heaters or ventilators, and electric heaters if located in the room to be heated. Some of these are convectors and some are radiating heaters.

The *indirect heat* dispensing units are located outside the room and the air heated by these units is sent to the room.

In some cases the heat dispensing units are radiators located in ducts or tunnels below the rooms. Air passing over these coils is tempered before delivery to the room. In other cases the air is heated by being passed over a furnace. The latter is called a hot air furnace. The third method of heat delivery is known as a *split method*. This method is a combination of the direct and the indirect method. One or more direct dispensing units are located in the room. In addition, tempered air is brought into the room after having been passed over some indirect units located elsewhere in the building.

The direct method and the indirect methods may supply heat generated by either steam or non-steam (hot air) systems. The split method is supplied by a steam heating system. It should be noted that all methods depend on the classroom air for their efficiency. The heat may be carried from the furnace to the room by steam, hot water, or air. When it reaches the room it must be transferred to the room air in order to become effective in controlling room temperatures.

Types of Heating Systems

As stated previously, some heat generating units are located in the room to be heated. These include stoves, room gas burners, and electric stoves. These are all isolated or segregated units and are not used extensively except in rural schools. During recent years a newer type of room gas heater has been installed in a number of school rooms. One of these units is known as a gas-steam radiator. The radiator has a gas burner in its base and generates room heat from the water or steam in the radiator. The other unit is sometimes called a gas unit heater. It has a fan which creates air movement around the heating unit. This unit is best adapted for use in shops or in large areas that are to be heated for only short periods of time. Each of these units need exhaust ventilation for the gas fumes. They should also be equipped with both safety valves or controls and hand valves for manual operation. These units present some hazards and are not often recommended by school heating engineers.

Steam Heating Systems

In general, all steam heating systems generate their heat in boilers attached to or connected with a fuel consuming furnace. While there are several types of steam generating units (boilers) the differences in steam heating systems are primarily in the method of distribution. The distributing methods are usually classified as one pipe, two pipe, and vapor vacuum systems. There is some overlapping and much similarity between these systems.

One Pipe Steam

There is only one line connecting the radiators to the boiler in the one pipe system. The steam line usually makes a complete circuit leaving the boiler through a header located at the top of the boiler and returning at a point near the bottom of the boiler. In this system the steam line must carry both steam and the condensed water returning to the boiler. The steam line must be located under the rooms. The steam enters the radiator at one end near the bottom and the condensed water leaves by the same route. This makes it necessary for the radiator to slant upward from this port. In a few of the older installations, the steam main sloped upward from the boiler and returning water flowed backward against the flow of the steam. In later and better installations the steam line is highest just over the boiler and slopes downward from this point. All condensation returning to the line flows along with the steam.

The one pipe distributing system is installed only in small buildings now. With this system it is desirable to have air valves on the radiators, otherwise the air in the radiators would block the inflow of steam. Some of the newer air vents are adjusted to permit air to escape but to prevent any air from entering the radiators through these vents. It is contended that such vents help create a partial vacuum in the radiators thus speeding up the heating process. While this system can be made fairly effective, the water in the steam lines cools the steam and makes it more difficult to supply dry steam to each radiator. Partially closed radiator valves and water pockets may cause gurgling and hammering, while air blocks may prevent a free flow of steam.

Two-Pipe System

The two-pipe system is so arranged that steam travels from the boiler to the radiator and the condensation travels back to the boiler in another set of pipes. This avoids having the condensed water and the steam in contact in the steam main, and thus avoids reducing the efficiency of the steam. In this system it is often necessary to bleed the steam main into the return line at various points to prevent the accumulation of water from condensed steam in the main. Two-pipe jobs are generally trapped at the radiator with traps that permit the passage of water and cold air from the radiator but which close at the temperature required for steam. This means that steam is not supposed to pass through a trap, but that the trap will open to permit all water and air to pass. This system is more effective with the installation of a pump or vacuum return traps which pull water and air out of the return mains thus making the system react more quickly. With this type of system sufficient heat is usually provided with a steam pressure of from zero to two and one-half or three pounds. In poorly installed systems where pockets have been allowed to develop in the steam mains it may be necessary to maintain a steam pressure of ten or twelve pounds to force the steam through these water pockets. This condition can usually be corrected by eliminating the low spots in the lines. In this system the radiator is tilted so that the low end is near the water outlet. The steam may enter either near the top or bottom of the radiator. The live steam mains should slope with the flow but may extend around the building either under the rooms or in the attic. The return lines are located below the radiators.

Vapor Vacuum Systems

The vapor vacuum system is really an improved type of a two pipe system. It has a vacuum pump connected with the return lines. This pump creates a partial vacuum in the return lines thus aiding the flow of the heating medium. This vacuum is gauged (measured) in equivalent inches of mercury. The pump is adjusted to start and stop automatically and to return water from the condensed steam to the boiler. Because of the lesser boiler pressure with this system, water is supposed to steam at a slightly lower temperature.

Steam Hot Blast

In some school buildings the steam is piped to radiators located in a tunnel under the classrooms. There may be one set of radiators supplying the tunnel but usually one radiator is located in the opening or duct leading from the tunnel up to each room. A central fan builds up an air pressure in the tunnel forcing air over the radiators and up to the rooms. In some cases room heat control is obtained by thermostatic regulation of steam flow to the radiator or by controlling the wing or fin that directs a part of the tunnel air flow into the duct leading to each room. This system is sometimes called a hot blast steam system.

Split System

A combination of direct radiation and a hot blast system is called a split system. The tunnel and fan set up are similar to that of the hot blast system. Some radiators are located in the room as in any direct radiation job. In this case, the air is generally delivered to a room at a lower temperature than when the hot blast system is used. Automatic controls on the steam flow to the room radiators are used to regulate room temperature in each room.

Unit Heaters

In order to provide individual control and to overcome some of the objections to the open room radiators some schools have installed a system of unit heaters (sometimes called unit ventilators). These units make use of the direct room radiator (usually of copper or other good conducting metal) and add a fan or set of fans to create a convective heater. Some of these units have automatically adjusted mixing dampers that regulate the mixing of recirculated room air and of the fresh air brought in through a port at the rear of the unit. Another and larger type of unit heater is used to heat large areas like gymnasium units. These units do provide air movement and heat diffusion in the room. Some of the newer units equipped with silent fans create little noise, but some of the older units equipped with poorly insulated propeller type fans are quite noisy. In installing these units it is necessary to wire for and to provide a separate motor for each fan. The fact that the current for the unit heater fans is usually taken from and metered with the lighting current makes it difficult to estimate this cost.

Steam Generating Boilers

Steam generating boilers for school buildings may be of cast iron or steel construction. The cast iron units are usually made up of "U" shaped sections set on end (inverted) on top of a cast iron base. The base serves as a part of the ash pit. The "U" shaped sections are hollow and are fitted together with grooves and interlocking nipples to permit a flow of water and steam between sections. Special flat sections form the front and rear ends. The sections are held together by long bolts extending from front to rear. (Since there is some expansion when the boiler is heated these bolts should not bind tightly.) Open ports are so arranged in the sections that the hot gases from the fire may flow at least twice through the sections in order to use most of their heat in heating the water. The heating bed or furnace usually extends the full length of the boiler and the length of the boiler is usually limited in the number of sections that may be used. Such boilers are classed as low pressure boilers, according to engineers.

Steel Boilers

Steel boilers may be classified under several different headings. One classification may be made on the basis of the steam pressure carried. Heating boilers carrying a steam pressure of over 15 lbs. are classed as high pressure (heating, not power) boilers, and ones carrying less pressure are classed as low pressure boilers. Another classification may be made on the basis of the setting. Those boilers set on a brick foundation and partially or wholly encased in a brick wall with the furnace outside or below the boiler are classed as brick set boilers. Those having the furnace encased in a part of the boiler with a water leg extending down on each side of the furnace or fire box, are usually called fire box or water leg boilers. They are sometimes called portables.

Boilers are also classified according to the direction the flues run and the method of circulating the smoke and hot gases. Those boilers having vertical flues are called upright or vertical boilers. They are not used extensively in school heating. Those boilers having the flues running from front to back are called horizontal boilers. If the boiler passes the gases from the furnace to a smoke box at the other end of the boiler and then returns it to a smoke box or exhaust chamber over the furnace, from where it enters the smoke stack, it is known as a horizontal return tube (H.R.T.) boiler. One type of return tube (H.R.T.) boiler is sometimes called a three pass boiler, since the hot gases pass back under the boiler, then through tubes to a front smoke box, then up and back through another set of tubes to the rear end exhaust smoke box. If the flues extend only from the front to the back of the boiler so that the smoke and gases pass only once through the boiler it may be known by one of several names such as straight fired or straight tube or even as a one pass boiler in contrast with the return tube (R.T.) or double pass boiler.

Boilers may also be classed according to the manner of firing. Those with a double set of grates which are fired on the upper grates are known as down draft boilers. They are also called smokeless boilers. While they probably do consume more of the gases, the name is to some extent a misnomer. Those boilers having only one set of grates with the draft coming from the ash pit up through the grates are known as updraft boilers. There are several other names or descriptive titles indicating some particular characteristic of the boiler. Some of these are marine, locomotive, electric welded, or seamless, etc. However, the types discussed here cover most of the steel school heating boilers. It should be understood that there is much overlapping of types.

Boiler Rating

There are several methods of rating the capacity or possible output of school heating boilers. High pressure boilers may be rated in horse power (H.P.) generated. This rating is usually of little value to school janitors. However, 1 H.P. is often referred to as sufficient energy to heat 135 to 140 square feet of equivalent direct radiation (E.D.R.). The E.D.R. is the amount of heat service that will give off 240 B.t.u.'s per hour when filled with steam at a temperature of about 215° (under pressure) and surrounded with 70° air. One square foot of steam radiation thus becomes 1 E.D.R. under these conditions. Steam heating boilers are usually rated on the square feet of radiation they will serve. Boilers are also rated on the furnace grate area, but variations in the type of fuel used probably make this measure less valuable than one based on the boiler area exposed to the furnace heat.

Hot Water Heating Systems

A few schools are heated by hot water systems. The water is heated in a hot water heater or boiler. This system may operate on a gravity basis or may have a circulating pump. In the gravity system the water is heated and rises through the lines to the radiators. The cold water returns through the return lines to be heated and rise again. An expansion tank is located somewhere above the top radiator to care for the expansion of the water when heated. This type of system does maintain regular heat. It warms up slowly after it has cooled off during the night. This system requires more radiation than does the steam system.

Since the radiators and lines are constantly filled with water this system must be protected against freezing.

Hot Air Heating Systems

During recent years a number of schools have installed hot or warm air heating plants. These are of two types. One is known as a gravity plant and the other as a fan or forced air type. In each type the air is brought into direct contact with the metal housing of the furnace after which it rises or is forced into the classrooms. The gravity system is limited to small buildings where the air will not have to travel any considerable distance before entering the classroom. It is generally installed in small buildings where no electricity is available for fan motors.

The fan forced or fan furnace system is more flexible. In operation, it is quite similar to the steam hot-blast system except that the air obtains its heat directly from the furnace rather than through tempering steam radiators. The tempered air may rise to the rooms in one trunk line or by individual ducts. In either case definite controls are needed. With this system it is possible for the air to be dried out (scorched) when it comes into contact with the hot metal around the furnace. Manufacturers or hot air systems now claim to have overcome this difficulty by a humidifier that throws moisture into the air stream. Since the air from around the furnace goes directly to the classrooms it is essential that it be free from any furnace gases that might seep through furnace cracks. All furnaces should be absolutely leak proof.

Hot air systems are rated on the basis of the B.t.u. output rather than on the radiation needed. Air ducts are based on the air speed at the smallest diameter of the duct. Room registers are computed on the square inches of clear air passage area.

Air Circulation and Controls

Fan driven air circulating systems are usually pressure systems and there may be more exfiltration (leakage) than with a non-pressure system. Circulating air systems are also subject to the effect of open windows and wind currents. For these and other reasons automatic control of dampers regulating the flow to each room is desirable. Air circulation systems will not be effective unless some method is provided for exhausting used air from the rooms. In practice a part of the air is exhausted by the ventilating system and a part of it is returned to be recirculated. If this air is returned through clean ducts there will probably be little dust picked up by the air stream. If the air is returned over dirty corridor floors as is sometimes done, the air may become polluted with dust. One criticism that has been made of any warm air distributing system is that of noise. This noise comes from two sources, small ducts through which the air must pass at rapid speed, and the noise made by the fans. The first can be corrected by installing larger ducts. The fan noise can be overcome by installing multiblade fans (the squirrel cage type) and by connecting the fan housing to the air ducts with a heavy canvas connection.

Factors in Heating Efficiency

There are a number of factors that must be considered when attempting to secure efficient economical results from the heating system. Fuel, method of firing, and plant operation will be discussed in some detail in Chapter 14. Other factors such as installation, building exposure, draft, humidity in the air, and temperature control will be outlined briefly in the following paragraphs.

Installation

In many cases the janitor will have no part in planning the heating plant. In other cases he may find it necessary to make some changes in the plant. Heating plant efficiency depends to a great extent on clean flues and a clean furnace. If the boiler room is small and if there is not sufficient room to permit the flues to be cleaned easily the whole system may suffer from a lack of care. The furnace (fire box) should be high enough to permit combustible gases to be burned before coming into contact with cooling surfaces. In some cases conditions may be improved by raising the boiler. Another installation factor is that of pipe insulation. Exposed pipes or ducts make possible a heat loss, usually in a place where no heat is needed. Exposed pipes may lower the temperature of air or steam which is being sent to distant rooms. Other factors such as the length of the fire box and smoke flow are also important. Radiator installation may become a factor in heating efficiency. Tempering radiators in corridors often prevent a flow of cold air into classrooms. In direct radiation the location of radiators under windows permits mixing the warm air from the radiator with cool air from the window and aids in preventing cold drafts. Radiators painted in gray, black, or some other suitable color will be more efficient than those with either a bronze or aluminum finish. Radiator shields help create air circulation in the room.

Building Exposure

The exposure of the building may play an important part in heating efficiency. The janitor cannot control exposure but he can have some control over heat loss through infiltration of cold air and exfiltration of warm air. Window caulking and weather stripping of openings may check a large part of this loss.

Furnace Draft

Furnace draft plays an important part in fuel combustion. The chimney is erected to help produce the desired draft. Since smoke travels upward in a sort of spiral motion, a square or round flue will be more efficient than a flat or oblong one of equal area. A lack of chimney height may be corrected by extending the flue. Chimney leaks should be detected and closed.

Relative Humidity

The amount of moisture in the schoolroom air is important to the comfort of the occupants. The heat required in the room depends on the amount of moisture, too. The term relative humidity refers to the present air moisture in terms of a percentage of the total that the same air could carry (without dropping) at the same temperature. For instance, if the air in a room at a given temperature could carry six quarts of water and actually has in it three quarts, the relative humidity is fifty per cent. Warm air will carry more water, hence, when air is warmed it may contain the same moisture but the relative humidity will be lower unless more water is added. A relative humidity of from 30 to 60 or 65% is desirable for schoolrooms. Experience shows that less heat is required to maintain comfortable conditions if the relative humidity is high. A temperature of 68° with a relative humidity of 62% gives about the same comfort in feeling as does a 70° temperature with a relative humidity of 47%; or 72° with 32%; or 75° with 15%; or 77° with 2%. We also know that if we raise the room temperature from 70° to 75° we use about fifteen per cent more fuel, and if we raise it to 77° it is necessary to use about twenty-two per cent more fuel than is used at 70°. Thus relative humidity may become an important factor in heating costs. Many modern heating plants are equipped with an atomizing spray or an evaporating humidifier to provide air moisture. Some of these plants are also equipped with humidistats to control the amount of moisture to be added. These regulators may control the actual moisture provided but since relative humidity evaluation requires a double measure involving both moisture and temperature these regulators are not usually exact in operation.

Pupil Heat

In order to understand room heating and its control it is necessary to know how this heat is developed. When the janitor comes to the building in the morning he sees that the temperature in each room is raised. When the pupils arrive, often chilled, they admit a quantity of cold air as they enter the building. For a while after they enter the room it may seem comfortable. However, these pupils may each give off from 200 to 240 B.t.u. of heat per hour. This heat, added to that provided by the heating plant, may make the room too warm and make some control necessary.

Radiator and Latent Heat

The radiator heating system uses what is known as Latent Heat. This heat is best described in the following manner. It is the heat required to change the physical condition without changing the temperature. Its use in this case is as follows. It requires about 970 B.t.u.'s to change one pound of water from a temperature of 212° F. (still water) over into steam which will still have a temperature of 212° unless compressed. This is the latent heat or the heat of evaporation. This steam is sent to the radiators where it is held in check by the traps on the radiators. While held in the radiator the steam condenses and in so doing gives up its latent heat which is used to temper the air in the room.

Temperature Control

Temperature control may be an important factor in heating costs and in heating efficiency. We have previously mentioned the added cost and waste of fuel with high temperature in the classrooms. Temperature control also aids in maintaining comfortable working conditions for the pupils and in protecting their health. A constant classroom temperature of from 68° to 71 or 72° F. is desirable. If a teacher does not neglect this duty, she may still find it difficult to overcome great excesses or deficiencies in the heat provided by the heating system.

There are several types of temperature controls. The reducing valve on high pressure steam systems is designed primarily to reduce steam pressure. However, since steam under pressure has a higher temperature, this valve has some effect in controlling temperature.

Perhaps the most common type of temperature control is the pneumatic system. This system is operated by air pressure generated by a pump in the control room. A pipe from a central storage tank is run to each controlled radiator. A room thermostat is regulated to provide the impulse that closes or opens the valve in the steam main serving that room. In a few buildings one thermostat located in a corridor or elsewhere in the building is used as the only control. These have some value but cannot give complete control for each room. Other systems modeled somewhat after the pneumatic systems have been developed. These operate wholly within the room. Their use has not become general. Unit heaters may be controlled by the pneumatic controls which shut off or turn on the steam supply, or by an electric system that regulates the dampers controlling the amount of fresh air brought in. The hot air systems are sometimes controlled by a pneumatic system and sometimes by an electric system. Under either plan the dampers are regulated to control the amount of heated air delivered to the room. In some instances controls have been placed on the trunk air lines and on the damper controlling the inflow of fresh air to the whole system. Neither these central controls nor the hand dampers set in the trunk line give adequate control of the air flow to and the temperature in each room.

The general controls listed here are only a few of those that have been developed. They represent the general types. Others have been developed to control various units, combustion rate, or the heat output. One general regulator has been devised to regulate fuel combustion on the basis of outside air temperatures. It is actuated by an outside regulating device. Another device has a thermostatic unit in the smoke chimney. This device is supposed to close certain dampers when the temperature of flue gases reaches a certain point. It is thought that these units prevent excessive fuel waste through the control of smoke stack loss. One control device cuts off the automatic stoker when steam pressure reaches a designated point. Another controls an intake water valve operated by an internal float. It is designed to admit makeup water to the boiler when the water level gets low. The steam radiator traps also serve as regulators.

Radiating Units

In steam and hot water heating systems heat is transferred to the room through some type of radiator. In some of the earlier systems this radiator was a series of steam pipes through which steam flowed unchecked. The pressure in the return lines was little less than that in the supply lines. The boiler was required to work against the pressure in the return line. Modern systems use a heat dispensing unit or radiator. Some of these radiators are of cast iron and some are of copper or aluminum. The radiator should have a large heating surface to transfer heat readily to the surrounding air. The modern radiator has slender tubes that expose a large area to the air. Some radiators are equipped with shields or fans that direct currents of air around the radiator to hasten the heat absorbing process. In order to obtain full value from the latent heat in steam it should be retained in the radiator until it condenses. For this purpose traps are installed at the outlet end of the radiator. They contain a thermostatic element which operates a valve that opens or closes the line. The thermostatic element is often made up of a bellows-like device that expands at steam temperature thus forcing a plunger valve down to close the opening. It opens at water or air temperature to permit water or air passage. There are several types of traps, but all are designed to serve the same purpose.

Ventilating Systems

Many theories and principles have been developed on school room ventilation. At one time it was stated that the carbon dioxide given off by pupils in the room was poisonous when rebreathed by others. Another theory was that the air breathed out by one pupil was toxic in its effect on other pupils. Other theories cover such features as bodily temperature and air stratification. Based on the ideas developed, some states passed laws requiring that schools supply to each room a total of thirty cubic feet of fresh air per pupil per minute.

In practice these older standards seem to be excessive. They are impossible to attain without a forced ventilation system.

Using the 30 cubic foot standard it would be necessary to supply 1050 cubic feet per minute (C.F.M.) of fresh air for a room housing thirty-five pupils. This would require about eight and one-half air changes per hour in a classroom 31 × 21 feet with a 12 foot ceiling. If this air is brought in through a duct having an opening size of 6 square feet the speed of air flow would be 175 feet per minute. (F.P.M.) This speed would create a draft.

Present Standards

While most authorities on ventilation now agree that 30 C.F.M. standard was too high, there is no general agreement on the amount of fresh air that should be provided. Some heating companies now contend that no fresh air need be brought into the room. They feel that recirculation of room air will satisfy all needs. Contentions of this type must be carefully evaluated in the light of the commercial interests involved. There is a general feeling that some fresh air should be supplied at all times when pupils are in the room. Many engineers now recommend four to five air changes per hour in full classrooms. In rooms containing 630 square feet of floor area or 7560 cubic feet of air space housing 35 pupils this would supply 15 to 20 C.F.M. per child. It should be understood that standards must vary for different rooms. Auditorium and shop units present special problems in ventilation.

Importance

Ventilation in school rooms is of vital importance for several reasons.

1. It removes body odors which may become obnoxious.
2. It creates room circulation to aid in diffusing room heat to all parts of the room. It aids in preventing air and heat stratification with the hot air at the top of the room. It thus aids in temperature control.

3. It aids in regulating the relative humidity.
4. It provides the fresh air needed in the room.
5. It provides a more comfortable room.

Tests indicate that there are fewer pupil absences because of illness in well ventilated rooms. There are two major types of ventilating systems. These are known as the gravity and mechanical systems.

Gravity Ventilation

When using gravity ventilation the fresh air is brought into the room through the window or some other port provided for this purpose. The air coming in at the bottom of the windows is often deflected upward by deflectors placed in the bottom of the window. If the room is heated by direct radiation the fresh air is mixed with the warm air coming from the radiator. This air is spread over the room and extracted from the room through an *opening near the floor line* on the corridor side of the room. (A part of the foul air may be exhausted through the cloakroom.) The air may be taken from the room by individual ducts extending from the opening, near the floor in the corridor wall, out through the roof. Ducts emptying into the attic do not seem to give as satisfactory results as do those extending through the roof. In some cases the air is exhausted by what is known as corridor ventilation. The air is taken from the room through openings in the lower part of the corridor wall or through an opening in the bottom of the corridor door. It is then exhausted from the building through ventilating ducts extending from the corridor out through the roof. All gravity vents should be ample size to provide the air changes needed. Air movement is accelerated if the ducts are capped with approved ventilating heads. Ducts should be equipped with dampers that may be closed at night to prevent an inflow of cold air. These dampers should be open when pupils are in the rooms.

Mechanical Ventilation

Any air movement system that forces air through the rooms and exhausts a part of it out through ducts in the roof may be termed mechanical ventilation. A system that circulates room air without making any provision for taking in fresh air or of exhausting air through ventilating ducts is called recirculation and is not considered here as a ventilating system. One of the most common mechanical ventilating systems is arranged to take in fresh air from the windows as with gravity ventilation. Air is exhausted from the room through ducts just as in the gravity systems. In the attic these ducts empty into a plenum chamber where a suction fan aids in pulling air from the room and exhausting it from the building.

Another type of mechanical ventilation is developed by unit heater (ventilator) systems and by a system of forced hot air heating. These systems, if properly operated, take in some fresh air at all times and force it into the room. The air pressure developed in the room aids in exhausting the air out through the roof if suitable ventilating ducts are provided. This system is really a combination of the gravity and the mechanical methods.

Toilet rooms, cooking rooms, laboratories, and dressing rooms create special ventilating problems. Regardless of the system used these rooms should not be vented with other rooms but should be vented separately, directly out through the roof. The janitor should remember that no ventilating system is efficient unless it is in operation. Ventilating ducts closed with card board or dampers, do not remove foul air or permit the free introduction of fresh air. Mechanical ventilating systems with the fans idle may even prevent use of the ducts as gravity vents.

One measure of the efficiency of the ventilation is the air circulation in the room. This is important in securing a good diffusion of heat in the room. Room air circulation may be measured by what is known as a smoke test. A smoke bomb or pot, made up (or purchased) of tar, asphalt, or other substance having a smoke that is visible for some time, is lighted and placed in the air stream near its entrance. By watching the motion and spread of the smoke it is possible to determine the rate and direction of the air flow in the room. Dead spots and stratification can also be detected.

Chapter 13

Fuels and Combustion

ENERGY HAS FOR many years been stored up in various materials found in nature. Man has found that when these materials oxidize they give up this energy in the form of heat. Some of these materials are called fuels. The principal fuels used to obtain heat for use in school buildings are coal, oil, gas, and wood. These fuels vary in quality, cost, and in abundance in various localities.

Coals

Coal is probably used more than any other fuel for heating school buildings. It has been found in many parts of the United States. It is easily transported and can be stored for a considerable period of time before being used. It is a product of ancient vegetation which decomposed and under great pressure formed the various grades of coal. After being mined coal may be treated (heated) to provide a derivative called coke. However, most coal is burned in its natural or raw state. There are several methods of classifying or rating coal. One classification is based on the ratio of carbon to volatile matter, another on the method or rate of burning, and another on the size of the pieces sold for use. The United States Geological survey separates native coal into several classes based on the type or nature of the coal.

Peat

Peat is an organic matter partially converted into coal. When first taken from the bog it contains much water. Sometimes this fuel is moulded into bricks before being marketed. Peat has not had a wide use for school building heating. It is comparatively cheap but school heating plants are not generally adapted to its use.

Lignite

Lignite is a type of coal having a brown appearance and woody texture. It is a grade somewhere between peat and subbituminous. It is clean to handle, ignites readily, burns rapidly, and gives off little smoke. It is ranked low in heating value and because it dries out rapidly, it slacks worse than does a high grade coal. It has a tendency to spontaneous combustion. Lignite is found in Arkansas, Colorado, Kansas, New Mexico, North Dakota, and Texas.

Sub-bituminous

This is sometimes called "black lignite." It does not have the woody appearance of lignite and has more of the heating qualities of the bituminous coal. It slacks rapidly and may be subject to spontaneous combustion. It is clean to handle and burns freely with little or no smoke. It is found in Colorado, Montana, New Mexico, Texas, Utah, Washington, Wyoming, and Alaska. This coal is usually ranked next to bituminous in heating qualities.

Cannel

This coal burns with great heat and a long flame. It is rich in volatile matter having more volatile matter than fixed carbon. It shatters, like glass. It occurs in limited quantities. Some has been found in most of the coal producing states.

Bituminous

Bituminous coal is widely used as a fuel in school heating plants. It is little affected by weather, but when it is, particles will break off that are prismatic in form. Bituminous coal is commonly called soft coal, but all soft coal is not bituminous. Bituminous coal in the eastern part of the United States is usually of higher heating value than that found in other parts. It is high in volatile matter and burns rapidly. Unless fired carefully it may give off quantities of smoke. It is mined in Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa, Georgia, Kansas, Kentucky, Maryland, Michigan, Missouri, Montana, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Utah, Virginia, Washington, West Virginia, and Wyoming.

Semi-bituminous

This is a super type of bituminous coal. It has more fixed carbon and less volatile matter than the bituminous coals. It burns freely with a long flame and is generally known as a smokeless coal. It has excellent heating qualities. Clinkers are not common. The principal sources are West Virginia, Virginia, and Pennsylvania, with some found in Maryland, Arkansas, and Oklahoma.

Semi-Anthracite

This is a low grade of anthracite. It is less dense and has less of the metallic luster. It ignites easily and burns freely. Since it has a high fusing temperature there is little clinkering. The principal sources are Pennsylvania, Arkansas, and Virginia.

Anthracite

This is a hard dense coal with much carbon and a low volatile ratio. It ignites and burns slowly with a short flame and little smoke. It has a high ash fusion temperature and it is not much inclined to cake, coke, or clinker. With this coal rate of burning and heat controls are comparatively easy. Most of the anthracite coal is produced in Pennsylvania, but some of it comes from Colorado.

Classification on Size

The size of the lumps of coal delivered are an important factor in the work of the fireman in the regulation of his drafts and in the passage of air through the fire bed. The anthracite coal lump sizes are pretty well standardized. They are based on the size of lump or piece that will pass through the holes of a round mesh screen of a certain size but will be rejected or passed over by a smaller size. The sizes are about as follows:

Trade Name	Size of Screen Mesh[1]
Broken	3 7/16 to 4 7/16″
Egg	2 1/2 to 3 7/16″
Stove	1 9/16 to 2 1/2″
Nut	3/4 to 1 9/16″
Pea	1/2 to 3/4″
Buckwheat	5/16 to 1/2″
Rice	3/16 to 5/16″
Barley	3/32 to 3/16″

The softer coal sizes are not so definitely standardized. In the bituminous coals the term mine-run is used to designate coal as it comes from the mine with no screening. Large and small lumps and dust are intermingled, the quantity of each depending on the nature of the coal and the methods of handling.

[1] Committee of Ten—Coal and Heating Industries. "Mimeographed Reports."

Other names used to designate sizes are lump, egg, stove, nut, pea, and slack.

Other Classifications

One classification that is often used rates all coals having more than 69 per cent of fixed carbon according to the fixed carbon content, and those coals having less than 69 per cent of fixed carbon according to the B.t.u. heating value. On this basis, coals are often rated about as follows:[2]

	Fixed Carbon About	Volatile Matter About	B.t.u. Heating Units
Anthracite and Semi-anthracite	97	3	
Semi-bituminous	90 to 85	10–15	14,800–15,600
Bituminous—Eastern	85–70	15–30	12,500–14,800
Lignite	Up to 50	Over 49	11,000–13,500

The ratings are approximate and may vary for any one type of coal and even for coals from different levels in the same mine.

Coals are also classified according to their tendencies to react to heat, and their tendencies to disintegrate or decompose. The so-called caking coals show a tendency to melt and run together when heated. These coals swell when heated and may give rise to either soft or hard clinkers. Coking coal swells when heated but does not cake as freely as the caking coal. Free burning coal swells little when heated. It does not cake or coke. It burns freely and at times even flashily. The so-called smokeless coal usually has a low volatile and a high fixed carbon content. As a rule it ignites and burns slowly with a short flame. Coke is a fuel prepared from coal by having many of the volatile gases extracted by heat. It burns slowly with little smoke. Block coal

[2] Bartrim, W., "Information on Boilers and Coal."

is a local term applied to a coal that breaks down into even faced blocks or lumps. Splint coal is also a local term that is used to designate coal that breaks into oblong blocks. These lumps are often hard, sometimes metallic in appearance, and have a tendency to splinter when heated.

Coal Preparation

As stated previously, some coal is delivered to the bin just as it comes from the mine. Experience indicates that better results are obtained when using a treated or prepared coal. One of the earliest forms of treatment was to separate the coal according to size. This earlier separation was performed by passing the coal over bar grates (called grizzlies) where the fine coal and thin slabs passed through the grates and the large pieces passed over the grates. Later methods made use of shaking and rotating screens to separate the various sizes. Each of these methods creates some coal dust through breakage. During recent years newer methods of preparation include washing and the addition of dust allaying or anti-freeze solutions. With these processes the coal is first passed over a conveyor where pieces of slate and stone are picked out. The coal is then sent to jigs or washers that grade and clean the coal. This grading is important for all school coal users and particularly to those schools using stokers. The washing also aids in reducing the sulphur content of the coal. Some companies add an oil film to the coal. Others provide a film of some substance like sodium silicate, while some add a calcium chloride (salt) treatment. The salt may have a corrosive effect on the furnace.

Other Fuels

While coal continues to be the fuel used in a majority of the school buildings many schools can purchase wood cheaply enough to make it attractive as fuel. Other schools find that when gas or oil can be purchased cheaply, their use offers advantages in added cleanliness and in the constant flow that requires little attention from the janitor.

Gas

Schools located near some of the large gas fields or lines have used gas successfully for fuel. Gas has the advantage of being clean and easy to handle. By watching the furnace and the type of flame produced, the janitor soon can learn the most economical mixture of air and gas to use in a furnace. If too much air is used, the gas will spit and may blow out. If too little air is permitted to enter the burner, the flame is red and will cause some smoke. The janitor should know that when gas burners are installed in brick set furnaces, it is desirable to raise the fire wall to throw the heat up against the boiler and to prevent waste by excessive draft. Gas used in school buildings should contain a malodorant which will give off an easily detected odor as a protection against leak and explosion hazards.

Oil

Oil is fed to the furnace through a specially prepared burner. The proper mixture of oil and air is essential to secure the best results from an oil burner. It is essential to have a siphon in the feed line to the burner to prevent any possible kick-back which might cause an explosion of the oil in the feed line. If the janitor does not secure proper combustion, he will have an accumulation of carbon in the flues. An examination of several oil burning boilers demonstrates the fact that the smoke from the oil burner may deposit soot and carbon on the flue sufficient to prevent full use of the heat provided by the oil. Oils vary in heat values and in their effect on the boiler.

Wood

Dry woods available in this country possess no wide variations in heating value. The water content, however, is an important factor, as it reduces the net amount of heat available. In green wood the moisture ranges from thirty to fifty per cent or more, but after eight or ten months of air drying the moisture is reduced to about twenty to twenty-five per cent. Wood is bulky and a large fire box is needed.

HEATING VALUES OF WOODS AIR DRIED[3]

Kind	B.T.U. per Lb.	Lbs. per Cord	Lbs. of 13,500 B.T.U. Coal Equivalent to a Cord of Wood
Ash	5450	3520	1420
Beech	5400	3250	1300
Birch	5580	2880	1190
Cherry	5420	3140	1260
Chestnut	5400	2350	940
Elm	5400	2350	940
Hemlock	6410	1220	580
Hickory	5400	4500	1800
Maple, hard	5460	3310	1340
Oak, live	5460	3850	1560
Oak, red	5460	3810	1340
Oak, white	5400	3850	1540
Pine, white	6830	1920	970
Pine, yellow	6660	2130	1050
Poplar	6660	2130	1050
Spruce	6830	1920	970
Walnut	5460	3310	1340
Willow	6830	1920	970

Combustion

The process of releasing energy in the form of heat for use in school buildings is called combustion. The school janitor-engineer should know the principles and processes of combustion. He should also know how the resulting heat from combustion is transferred through the walls of the heating

[3] Committee of Ten—Coal and Heating Industries, "Solid Fuels and Their Use in Hand Fired Plants." P. 29.

chamber to a fluid (water or air) medium that will carry this heat to the desired location where it is released.

Nature and Principles of Combustion

A combustible is a substance that burns and develops heat, or a material which when heated to the ignition point unites with oxygen and is partly or wholly consumed. Combustion is in effect a rapid oxidation or decomposition of a combustible material. This decomposition or oxidation takes place in nature when conditions are right. The rotting of a log in the woods and the development of bodily heat in animals by the burning up of body cells are examples. In these cases the oxidation is comparatively slow and the resulting heat is absorbed by the surrounding air. A limited quantity of air aids in the retention of the heat in spontaneous combustion. In the school furnace oxidation is speeded up by the effect of heat which hastens the chemical action.

Rapid oxidation or combustion requires at least three things or conditions for completion. It is necessary to have a combustible material or fuel. Heat is essential to speed up the process and enough oxygen must be supplied to combine with the elements released. During the oxidizing process the oxygen of the air combines with the carbon of the coal, wood, oil, or gas and passes off as carbon dioxide (CO_2) or carbon monoxide (CO). The rapid release of the energy of the fuel produces heat. Man has learned how to exert some control over the rate of combustion by regulating the flow of air (containing oxygen) through the fire. He has also learned how to conserve and use a considerable part of the heat developing by confining the fire in stoves and furnaces of conductive material (metal) which permits transfer of the heat to the heating medium previously mentioned.

Nature of Fuel

If he is to obtain the best results from the fuel consumed the janitor must know something of the nature of the fuels used. The composition of fuels varies some with the type used, but since the basic elements are similar, the description given here will refer primarily to coal. Coal contains various natural elements such as carbon, hydrogen, and sulphur. The air with which it is combined in combustion contains principally nitrogen, hydrogen, and oxygen.

Carbons

The carbon in the coal possesses a high heat value. Some of the carbon is termed non-fixed carbon and may combine with oxygen and be released as carbon monoxide. The so-called fixed carbon is not so easily released and provides much of the heat value. As stated previously, the fixed carbon content of some of the better coals may be as much as 90 to 98 per cent of the total.

Volatile Matter

In coal combustion many elements may pass off as volatile gases when the coal is heated. Some of these elements such as hydrogen, methane, and carbon monoxide are capable of producing much heat if subjected to the proper conditions. If they are permitted to pass out of the furnace before being consumed much of the heat value of the coal is lost. One of the chief losses of a volatile gas is in the form known as carbon monoxide. If sufficient oxygen and heat are supplied the combustion of this gas may be completed and the residue having no heating value passes off as carbon dioxide. The amount of draft and the shape of the furnace or combustion chamber are important factors in the combustion of volatile gases.

Ignition Temperature and Flame

The ignition temperature is that at which a fuel may begin to burn or to combine with oxygen and generate heat. This temperature is higher for the anthracite coals than for some that contain more volatile matter. This explains why it is harder to start fires with some coals. Some of the heat released by the fire is used to raise the temperature of other coal to be burned. If sufficient temperature is not maintained the fire dies. The gas, carbon monoxide, requires a temperature of about 1100 to about 1200° F. before it ignites. It is released at a lower temperature. This explains the possible loss of this gas if the heat from the fire bed is not sufficient to ignite it. The ignition temperature of sulphur and fixed carbon is much less than that required for the carbon monoxide. This is fortunate since it permits these elements to burn and create the heat necessary for the consumption of the gas.

The janitor who knows his fuel can learn to regulate his fire by the appearance and nature of the flame. The carbon monoxide burns with a blue like flame. Solids glow when heated in red, yellow, and a brilliant white color. Solids like carbon in the gases may cause the gas flame to glow. Visible smoke over the flame may consist of unburned carbon and other solids. Visible flame may be an indication of poor combustion. In order to obtain complete combustion of the gases it is essential that the temperature of the flame be not reduced below their ignition point. For this reason the flames should not be permitted to come into contact with the crown sheet, the flues or other cooling surfaces. This necessitates a high combustion chamber for fuels that burn with a long flame. However, the greatest heat value may be obtained if the flames end just short of these surfaces since the point of greatest heat is just above the flame. It is estimated that a dark red flame from coal has a temperature of about 950 to 1000° F., a dull cherry red flame of about 1450 to 1500° F., a clear cherry red of about 1800° F., a white of about 2370° F., and a bright or dazzling white flame of about 2500 to 2700° F. By studying the flame, the janitor can judge their value in heating and in the combustion of the gases.[4]

The amount of air and space available may play an important part in the process and rate of combustion. It is impossible to state the exact amount of air needed for complete combustion. Even though we know the quantity of oxygen in the air and the amount of oxygen needed for each part of carbon we do not always know the amount of available carbon. It has been estimated that about 11 to 15 pounds of air or about 175 to 200 cubic feet are necessary for complete combustion of one pound of good coal. This indicates the need for ample draft to insure good combustion. In a plant burning one-half ton during a ten hour day or 1⅔ lbs. per minute a total of 300 to 350 cubic feet of air per minute may be needed. If the ash pit doors have an opening of 16″ x 40″ the air inflow speed necessary to supply this air will be about 75 feet per minute. The height of the combustion chamber is also an important factor in the rate of combustion. If the chamber roof is high enough to permit complete combustion before the gases are cooled by contact with these surfaces, more heat is generated by the furnace and less fuel is needed to produce the heat units desired.

If we were to secure perfect combustion all elements and temperatures would be brought together in exact ratios. Hence, there probably is little perfect combustion in the average school furnace. It is possible to secure what is termed complete combustion where all fuel is consumed. It is often stated that the presence of much black smoke indicates poor combustion.

[4] Bartrim, W., "Information on Boilers and Coal." P. 7.

While this is true, the absence of black smoke is not always an indication of perfect combustion. An excess of air may reduce the smoke but may also reduce the efficiency of combustion by cooling the flues and by heating excess air which is of no value.

Products of Combustion

Combustion releases the minerals in the coal and the gases in the coal and air used. Some of these different elements combine in various forms. Some of the carbon and the oxygen combine to form carbon dioxide or carbon monoxide. The water and the sulphur gas may combine to form a mild sulphurous acid to pass off in the smoke. The unconsumed minerals such as silica, aluminum oxides, iron oxide, calcium oxides, etc., are left on the grates or drop into the ash pit as ashes. As stated elsewhere, some of these ashes may fuse and be deposited as clinkers.

The reason for controlled combustion in school buildings is to provide heat. The value of the fuel is determined primarily by its heat value. This heat value is rated or measured in several ways. The heat produced is measured in degrees on a thermometer. The heat producing power is measured in terms such as B.t.u., the therm, calorific value, and sensible value. The B.t.u. (British thermal unit) is the amount of heat required to raise the temperature of one pound of water 1° F. when water is at its greatest density of about 39° F. It will raise the temperature of 55 cubic feet of air 1° F. The therm as a measure of heat, usually applied to gas heating, represents 100,000 B.t.u. (or 100 cu. ft. of 1000 B.t.u. gas). The calorific heat value is the amount of heat (in B.t.u.'s) which is generated by the complete combustion of 1 lb. of solid or liquid fuel, or one cubic foot of gas at standard pressure and temperature. Sensible heat is that required to raise 1 lb. of water from 32° F. to the boiling point at about 212° F.

Combustion Controls

The janitor should understand that the rate of combustion and the completeness of the process of combustion is closely connected with the rate of air passage through the furnace. The impetus for his draft is supplied by the chimney. Too much draft may pull the hot gases into the flues or throw them against cooling surfaces where they are cooled before being consumed. On the other hand too little air makes the fire sluggish. The wise janitor soon learns to regulate the drafts from the appearance of the flame. After the heat is generated it must be extracted from the gases before they pass up the chimney, if it is to be of the greatest value in heating the building. Long winding tortuous passages in the heater or boiler aid in this absorption of heat from the gases. A high flue temperature usually indicates a waste of heat. Smoke stack temperatures of 400 to 600° F. for heating furnaces seems to indicate much less waste than do temperatures of 1000° F. With slow or banked fires, stack temperatures may drop to about 200 to 250° F.

Some Heating and Ventilating Terms Defined

The janitor-engineer should be familiar with the more common terms used in heating and ventilating literature, so that he may be the better enabled to understand directions given in instruction sheets, read descriptions in catalogues, etc. Brief definitions of some of these terms are given here.

Automatic Steam Regulator—A device operated by steam, that limits the pressure in the boiler by closing drafts, or by retarding the fuel feed.

Arch Plate—The cast iron plate forming an arch over the fire door.

Aspirating Coil—Heating coil placed in vent stack to accelerate air flow by convection.

Air Washer—A device using water to clean the air circulating in a building.

Ash—Non combustible matter left after solid fuel is burned.

Ash Fusion Temperature—Temperature at which ash will melt or fuse together and form a plastic mass or clinker.

Blow Off Valve—Valve on pipe fitted to lowest point of water space in a boiler through which sludge may be blown out or the water drained.

Bleeder—A small pipe fitted with a steam trap, through which condensed water may pass from the steam main to the return line.

Brick Set Boiler—A boiler whose furnace and combustion chamber is made of brick; or a boiler so surrounded by brick that much of the shell is exposed to the heat.

Breeching—The smoke pipe between the outlet from smoke box and the chimney.

B.t.u.—Abbreviation of British thermal unit. A standard of heat measurement generally used by engineers to express quantity of heat. One B.t.u. is the amount of heat that will raise the temperature of one pound of water one degree Fahrenheit, when the water is at a maximum density, or from 39° F. to 40°F. It will raise the temperature of 55 cu. ft. of air 1° F.

Bottled Heat—Heat that has accumulated in the furnace faster than it can be absorbed or carried off.

Check Valve—A valve that allows fluids or gases to flow through a pipe in one direction only. Often used in return lines to prevent water from flowing back out of boiler.

Combustion—Rapid oxidation.

Combustible—Something that will burn rapidly and release heat.

CO_2—Chemical symbol for carbon dioxide. A gas that is formed when carbon is burned.

CO—Chemical symbol for carbon monoxide. A gas that is formed when combustion is not complete.

C.F.M.—Abbreviation for cubic feet per minute.

Calorific Value—Amount of heat in B.t.u. released by complete combustion of one pound of solid or liquid fuel, or 1 cubic foot of gas at standard pressure and temperature.

Condensation—When a gas changes to a liquid, or a liquid to a solid, the process is called condensation.

Down Draft Boiler—A boiler whose furnace has two sets of grates; the upper grates consisting of a row of water tubes and the lower of ordinary rocker or stationary grates. The fuel is placed on the upper grates and the draft comes in above it, striking a baffle at the back which forces the volatile part of the fuel down through the hottest part of the fire bed, where it ignites, and then passing over the hot coke fire on the lower grates, is completely burned. The heat then passes into fire tubes.

Damper—A device used to control the flow of air through the furnace, or through ducts in the ventilating system.

Dumping Grates—Grates that can be turned sufficiently to dump the ashes into the ash pit.

Direct System—A system where all the radiators or heating units are in the room to be heated.

Deflector—A shield that diverts the air stream coming into the room from windows or other openings; usually throwing it upward, and thus preventing it from striking persons in the room.

Degree Day—One twenty-four hour period of the heating season with a temperature 1° F. below an arbitrarily set average of 65° F. One day with average of 60° F. equals five degree days.

Exfiltration—Air leaving a building through pores, cracks in the walls, leaky windows, etc.

E.D.R.—Abbreviation for equivalent direct radiation. A square foot of direct radiation is standard when it will emit 240 B.t.u. with steam at 215° F. in an environment or a surrounding air with a temperature of 70° F. A modern heating unit that will give off the same quantity of heat, under the same conditions, is said to be equivalent to one square foot of direct radiation, or one square foot E.D.R., regardless of its area.

Effective Temperature—An index of the degree of warmth felt by the human body under the influence of a composite of ambient temperature, humidity, and air movement.

Embrittlement—Breaking down of metal of boiler, usually caused by caustic water.

Fire Box Boiler—A boiler with the fire box inside. The fire box is surrounded by water except at the bottom, and in some cases even the bottom including the ash pit is surrounded by water.

Furnace—The fire box.

Furnace Baffle—A deflector made of fire brick or refractory tile placed in the heat stream to direct it against the heating surface of the boiler.

Fuse Plug—A plug made of some metal that will melt at a low temperature. It is usually placed in the crown sheet or just above the top row of fire tubes in the flue sheet. If water gets dangerously low the plug should melt so that escaping steam may extinguish the fire.

F.R.T.—Abbreviation for fire return tube.

F.P.M.—Abbreviation for feet per minute.

Gusset Stay—A flat bar riveted to angle irons on boiler head and girth plate to support boiler head.

Gas Steam Radiator—A self contained heating unit. It has a small boiler cast in the base of the radiator and a gas burner under it. Steam generated in the base heats the radiator.

Header Drip—A pipe leading down from steam header to return line to drain water from header. This pipe is sometimes called an equalizer.

High Pressure Boiler—A boiler built to carry over 15 lbs. pressure per square inch.

Head Room—Height above grates to crown sheet or cooling surface.

Heating Surface—Surface of boiler or furnace exposed to heat from furnace on one side and in contact with heating medium (air or water) on other side.

Hand Holes—Holes fitted with plugs in outside boiler shell, usually at bottom of mud leg, to facilitate cleaning and inspection.

Humidity—Moisture in the air.

Hygrometer—An instrument used to measure relative humidity.

H.R.T.—Abbreviation for horizontal return tube.

Indirect System—A system where the heating units are outside the rooms to be heated and the heat is carried through ducts by an air stream to the rooms.

Insulation—Covering made of low conducting material to prevent heat loss by radiation from pipes, boilers, etc.

Latent Heat—The quantity of heat required to change the form of a substance without raising its temperature, i.e. ice to water or water at 212° to steam at 212° F.

Low Pressure Boiler—One having a pressure up to 15 lbs.

Man Hole—A hole in the boiler shell large enough for a man to enter for inspection, cleaning, or repairs.

Mixing Dampers—Dampers in air ducts, arranged to regulate the mixture of cool and warm air.

Mb—Symbol meaning 1000 B.t.u.

Mbh—Symbol meaning 1000 B.t.u. per hour.

Peripheral Speed—Speed in F. P. M. of extreme outer edge of fan blades.

Recirculation—Using same air over and over again. Little or no fresh air added.

R.P.M.—Abbreviation for revolutions per minute.

Reducing Valve—A valve operated either by a diaphragm or a piston that will reduce the pressure of steam water or air in a pipe. It is often used where a group of buildings are heated from a central plant, to reduce the pressure where the branch main enters each building.

Retort—The box in the furnace at the end of the delivery tube of underfeed stokers. It receives the green coal and passes it up to the fire bed.

Relative Humidity—The amount of moisture in a given volume of air at a given temperature compared to the amount it will hold. It is usually expressed as a percentage of the maximum.

Steam Gauge—An instrument to indicate the pressure per square inch in the boiler.

Safety Valve—A valve on a short pipe connected directly to the top of the boiler to relieve all above the safe working pressure. It is sometimes called a pop off valve.

Steam Header—The large horizontal pipe above one or more boilers, to which all of them are connected, and from which the steam mains lead off.

Steam Trap—A device used to drain condensation from radiators, mains, risers, etc., without allowing steam to pass. The valve is operated by either a float or an expanding unit. The latter is called a thermostatic trap.

Stay Bolt—A long bolt that ties the shell and furnace plates of a boiler together. They hold the furnace in place and prevent flat surfaces from bulging.

Stoker—A mechanical fireman.

Safety Clutch—A device to release the motor on a stoker, when the fuel tube gets choked or clogged up.

Shearing Pin—A device used for the same purpose as safety clutch.

Split System—A system using both direct and indirect heating units for heating the same room.

Stationary Grates—Ordinary bar grates that are immovable.

Shaking Grates—Grates that can be shaken by a bar outside the furnace.

Scale—Mineral salts that have been precipitated on the tubes and furnace plates of a boiler, hindering the heating of the water.

Sensible Heat—Heat imparted to a body that will cause the temperature of the body to rise.

Tuyere Block—A casting set around the top of a retort. The forced draft supplying the fire comes through its ports.

Tempering Coils—Large heating coils placed in the entrance of the fresh air stream where it enters the building, to raise the temperature of the fresh air. They are sometimes called blast coils.

Thermostat—Thermometer or heat register designed as a regulator for steam, air or water flow.

Try Cocks—Pet cocks on water column to check level of water in boiler.

Up Draft Boiler—A boiler where the draft travels upward through the grates and fire bed.

Volatile Matter—Combustible oils and gases that distill out of wood or coal when heated. Unless they are burned, a considerable portion of the heat value of the fuel is lost.

Chapter 14

Firing the Furnace

In large school buildings a trained engineer-fireman may be employed to care for the heating plant. In some cities all janitor-engineers in buildings of a certain size must be certified engineers or firemen. However, in a majority of the school buildings the custodian or janitor must care for the heating plant. In many cases these men have had little or no preparatory training for this duty. Some have had brief experience in firing a boiler for a sawmill or a threshing machine. Firing a school heating furnace is a type of task requiring specific training in that field. Previous experience in other lines may be of some value but does not guarantee success in firing a school furnace.

School heating presents a very different problem than does the heating of other buildings. The school building houses children who do not know how to protect themselves against the ailments that may follow extreme heat or cold or rapid temperature fluctuations. For a considerable part of the day, the building is not occupied. The pupils enter the building at various times during the day and bring cold air with them. After entering the building they are grouped together where body temperature added to furnace heat may make the rooms too hot. These conditions, together with the fact that most buildings are permitted to cool down at night and must be heated quickly in the morning, make regularity in firing almost impossible.

In spite of the difficulties involved, the janitor is expected to get results from his heating plant. Children are required to attend school and comfortable conditions should be provided for them. The janitor may have to use a poor grade of coal. His heat generator may be too small. On windy days he may have to heat the inside of the building and a considerable part of the outside. He may have to arrive at the building at four o'clock in the morning, but he is expected to keep it warm.

The necessity for heating service under all types of conditions makes it necessary that the janitor make a study of heating principles, of fuels, and their reaction on the fire bed. He must study his building and his heating system. He must know the cold spots in his building. He should know how to fire the furnace with the fuel available to secure the desired results without wasting fuel and without using time that should be devoted to other duties. Not all janitors are engineers (although the day may come when all of them must pass certain tests), but most of them can with some study become efficient firemen. The following discussion has been prepared as an aid to the janitor in the task of generating heat for use in the school building.

The Degree Day

Heating engineers often determine the need for heat and the amount of fuel needed on the basis of a "Degree Day." This degree day is thought of as a variation in the average 24-hour temperature from a fixed point. Ordinarily, no room heating is required when the outside temperature (average for the 24-hour day) is equal to or above 65° F., then a *one degree* day is a day with an average temperature of 64° F. or 1° below the 65° average. If the average temperature for the day were 55° F. or 10° below the base, that 24-hour period would be a *10 degree* day. The sum total of degree days during the heating season represents the heating load. Engineers know the number of B.t.u.'s required to supply the heat needed to counteract each degree day unit per 100 cu. ft. of air. Knowing the degree day load in a given locality, they can then compute the fuel needed with efficient firing methods for each building. As a basis for general information a list of the approximate degree day loads in various locations is given. Minneapolis, Minnesota, 7953; Milwaukee, Wisconsin, 7366; Des Moines, Iowa, 6744; Chicago, Illinois, 6300; Lincoln, Nebraska, 6231; Cleveland, Ohio, 6096; Washington, D. C., 6039; New York City, New York, 5348; Indianapolis, Indiana, 5331; Topeka, Kansas, 5282; Baltimore, Maryland, 4591; St. Louis, Missouri, 4583; Richmond, Virginia, 3789; Raleigh, North Carolina, 3267; Nashville, Tennessee, 3550; Little Rock, Arkansas, 2861; Birmingham, Alabama, 2527; Jacksonville, Florida, 1080.[1]

In addition to the degree day load many variables such as wind velocity, size of the building, heat loss through cracks, and the type of fuel available must be considered. In planning the school heating plant engineers usually design it to supply an inside temperature of 70° F. when the outside temperature is 15° F. below the average low marks for a ten year period. (This is sometimes termed a "Design Day.") Most school heating plants are designed to stand an overload of about twenty per cent for short periods of time. However, the janitor should know that overloading or crowding with forced fires may injure his heating plant and will in all probability result in a waste of fuel.

Firing with Coal

Since coal is used as a fuel in most school buildings the discussion in this section will stress the frequency of firing, firing

[1] Committee of Ten—Coal and Heating Industries, "Automatic Coal Heat With Mechanical Stokers," pp. 27, 33–34.

methods, grate care, clinkers, and smoke problems that may arise when using coal as a fuel. Other discussions define the types of coal and the principles of combustion. The competent fireman will know not only his coal and his furnace, but he will also know his fires. He will learn to judge the efficiency of his fire by the appearance of the fire bed, the color and length of flame, and the smoke entering the flues. These conditions will vary with the type of fuel and furnace used.

Hand Firing Methods

There seems to be no one best method of firing for all coals in all furnaces. Good firing should produce the heat desired with an economy of fuel and effort. It should produce a fire bed without holes, little smoke, and few if any clinkers. Some of the methods used in applying fresh coal are listed in the following paragraphs.

Ribbon Method

Many authorities consider this one of the most efficient methods of applying fresh fuel to the fire bed. In using this method fresh coal is added in strips of about 12 to 14″ wide (shovel width) from the front to the rear of the fire box. This leaves a strip of fresh coal and a strip of live or hot coals. As the fresh coal gets hot the volatile gases are distilled. As they pass over the hot coals the heat should raise the temperature to their ignition point and thus aid in securing a more complete combustion. At the next firing, coal is placed on the alternate strips left bare at the last firing. It is not possible to set up fixed recommendations on frequency of firing and the amount of coal to be added. Since large quantities of coal cannot be added at a time in the narrow strips this method calls for more frequent firing than do some other methods. This method is best adapted to a rectangular fire box of some size. The janitor may determine by trial the amount of coal to add and the frequency of firing. The fact that this method requires frequent attention and that the janitor has other duties that may call him away makes this method less attractive than some others for school firemen.

Coking Method

This method is considered the most practical and the most economical for use in the average school furnace by many janitors. It permits adding fuel at less frequent intervals but does require a little more labor at each firing since a part of the coals in the fire box are moved before fresh coal is added. Before adding fresh coal the hot coke and coals are shoved from the front to the rear of the fire box. They should be shoved back with the hoe and disturbed as little as possible. Under no conditions should the hoe be permitted to dip deeply enough to mix the ashes from the grates with the live coals. This moving should leave from one-half to two-thirds of the front of the grates with only a thin bed of live coals. The fresh coal is laid over this thin bed at the front. The whole fire bed should not be covered. Here again, the janitor must determine by experience the frequency of firing and the amount of coal to be added. Many janitors report best results if the coal (egg size) is applied in a layer of about eight or nine inches. They usually add the fresh coal when the last charge has become a red mass.

Most furnaces exhaust the smoke at the rear end of the fire box. In using the coking method the gases distilled from the fresh coal at the front as it is heated pass over the live coals at the rear. The heat from these coals aids in completing the combustion of these gases. This method is adapted for use in any type of fire box. It is particularly well adapted for furnaces that have their grates so connected that the front and rear sections can be shaken separately. When this method is properly used there should be little volatile gas escaping in the smoke.

Alternate Method

This method is somewhat similar to the ribbon method. It differs from the ribbon method in that one-half (one side) of the fire bed is covered with fresh fuel at each firing period. It is particularly well adapted for use in wider furnaces having two firing doors. This method requires less frequent firing than does the ribbon method since larger charges may be added. It may produce more smoke as the gases from a part of the side having a fresh charge of fuel may reach the flues without having to pass over a bed of hot coals. This method is well adapted for use in furnaces where the grates on one side may be shaken without disturbing those on the other side. A fire maintained with this method may not be quite as efficient as with the coking method when properly done, but it does require less labor.

Conical Method

In using this method fresh fuel is laid (not thrown) in a cone shaped heap near the center of the fire box. The purpose is to encourage the fire to burn at the edges. When a new charge of fuel is added the live coals at the center can be pushed to the edges of the fire box with the hoe. The same precautions mentioned in the coking method concerning ashes should be observed here. This method is not so well adapted for use when a very active fire must be maintained. It is quite well adapted for use on mild days when little heat is needed. In using this method the janitor should watch to prevent the development of holes around the edges of the fire bed. Frequent applications of fresh fuel are not necessary when only a light fire is needed.

Layer Method

This method is not often used in school buildings unless the draft is weak. In using this method a thin layer of coarse coal is spread evenly over the live fire bed and a thin layer of finer coal is spread over the top of the coarse coal. It is desirable to leave some live coals exposed or the fire may be smothered. This method seems to work better with the anthracite coals than with the more volatile bituminous coals. There is a slight tendency for air holes to develop in the fire bed.

Heaping Method

In using this method the hot coals are pulled to the front of the fire box with the hoe and fresh coal added at the rear. It is not well adapted for use with high volatile bituminous coals but is sometimes used with anthracite coals. Ashes should not be mixed with the live coals when pulling these coals to the front of the fire box.

Ordinary Method

This method is what the name implies both in practice and in results. It might well be called the piling method. The janitor gets a shovel full of coal, takes an aim at the fire door, and swings his shovel. He knows that he is getting results by the black smoke that boils up after the coal hits the fire bed. Sometimes the fire bed seems to settle down where the fuel hits it and at times the whole fire bed seems dead. The inexperienced fireman then may take a slice bar and thrust it under the whole mass giving a heave to bring some of the red coals to the top. He also probably brings some ashes into the heat zone where they are fused into clinkers to cause later trouble both in firing and in their removal.

Frequency

The method used must vary with conditions. Since the janitor in small buildings will have duties in other parts of the building, he may be absent from the furnace room a considerable part of the time. He must adapt his firing methods to the time available. Theoretically, firing should be done at a constant or uniform rate. Then too, it is often desirable to leave the fire door slightly ajar after adding a heavy charge of fuel. If the janitor takes time for this he may neglect some other duty. He must select the method that best fits his time, the weather, the furnace to be fired, and the fuel available. During the early fall months when little heat is required he may use the conical or coking methods. If these do not supply the heat needed for cold weather he may then change to another method.

Methods Adapted to Fuel

Under the section on fuels and combustion some coals are described as free burning, some are described as having caking tendencies, and others are listed as coking coals. Some are shown to be rich in volatile gases, while some have a low percentage of volatile gases but have much fixed carbon. Not only must the janitor adapt his methods to the type of coal but he must also make allowance for the size of the coal. It is quite obvious that the methods that are adapted for use with lump or nut coal may be not at all adapted for use with pea or slack coals. In using the low volatile anthracite coals almost any method may be used with the larger sizes. With the smaller or finer sizes of semi-anthracite the coking or conical methods seem satisfactory. With this coal the grates should be shaken down but the fire should not be poked too often with the slice bar.

The high volatile caking coals can usually be fired successfully with the alternate method. This method disturbs the top of the fire bed very little and with this method there seems to be little tendency to clinker. They may be fired by the coking method if the janitor is careful in using his hoe to push the live coals to the rear of the fire box. With the high volatile coking coals (some are both caking and coking) the janitor may use a modified conical, a coking, or the alternate method. With either of these coals in fine particles, such as pea or slack coal, the ribbon or alternate methods may be used successfully.

The high volatile free burning coals are usually fired with a light charge by either the coking, conical, or alternate method. These coals are not inclined to cake but holes may develop in the fire bed. Frequent attention to the fire is necessary. Much air must be admitted over the fire bed to aid in the combustion of the gases. Some janitors try to carry a heavy bed, when firing with these coals, and to control the fire with the dampers.

Down Draft Furnaces

The methods listed have referred primarily to up-draft furnaces. However, a large number of school buildings are heated by down draft furnaces. These furnaces have both an upper and a lower grate. The firing is done on the upper grate. The hoe may be used to keep the fire bed even over this grate. No bare spots or holes should be permitted to develop. A heavy fire bed is preferred by most janitors. Air for the fire bed is admitted through the fire door. Live coals and ashes drop to the lower grates where the live coals help complete the combustion of the gases. However, no firing is done on these lower grates. Some ashes may collect on the upper grates. These may be removed by using a small "T" bar run under the fire over the grates. Coal should not be piled up at the front end of the grates. The ashes should be spread out in a bed over the lower grates.

Hand Firing Tools

The most used tool in hand firing is the firing shovel. Most janitors prefer a shovel about 12 inches wide for small furnaces and 12 to 14 inches for large installations. This shovel should be a regular coal scoop with shallow side walls. The rake is used to loosen and remove clinkers from straight grate furnaces. Some janitors use a set of clinker tongs for the same purpose. The "T" bar is used to run under the fire on down draft furnaces and at times in updraft furnaces to loosen the fire or to reduce the ash bed under the fire. The slice bar is used to crack the crust of coking coal. It it probably the one tool too much used by the average janitor-fireman. Its use to pry up through the fire may lead to clinkering. The janitor also needs a hose to wet down the ashes in the ash pit, (put water in first if pit is depressed below surface) and a long handled shovel for removing ashes from the ash pit. A hoe is essential for shoving live coals to the rear of the furnace in the coking method of firing. A wheel barrow or truck is usually needed to bring coal from the bin to the furnace and to transfer ashes from the furnace to the ash storage bin.

Fuel Bed and Rate of Firing

In theory the janitor should add fuel at a constant rate. In practice where he has many other duties this is not possible. One result is that he must carry a deeper fire bed than would otherwise be necessary. The thickness of the fuel bed will depend on the draft and the type of coal used. It is possible to carry a higher boiler load with a thin fire bed and there is probably less clinkering. In using bituminous coals many janitors carry a fuel bed of from four to ten inches thick. These men feel that a bed of seven or eight inches is most economical. Regardless of the thickness of the bed the janitor should watch for fire bed holes that may permit cold air to pass through the furnace to cool the flues.

Never build up large fires and leave them until they burn down. Unless automatic room heat controls are provided this practice makes a fluctuating room temperature that may be harmful to the pupils. Regularity in firing usually proves economical. A steam heating plant should be run on the lowest possible steam pressure. It requires more fuel to fire against high steam pressure. Lower temperature with adequate air moisture produces the same feeling of comfort as does a higher temperature with less humidity. It takes over twenty per cent more fuel to maintain a room temperature of 77° F. than it does for a temperature of only 70° F.

Bringing Coal to Furnace

The practice of carrying coal some distance from the coal bin in shovels is usually a dirt making process and wasteful of time. A wheelbarrow or truck may often be used with much better success. The coal should be left in the conveyor until used. Coal scattered or dumped on the furnace room floor is unsightly and a mark of poor housekeeping practices. Janitors do not agree on whether the coal should be wet down before being placed in the furnace. The water does delay ignition of rapid burning coal, but generally water in coal is excess baggage that must be evaporated before the coal is ready to burn.

Stoker Firing

Many school furnaces are fired with stokers which are automatic devices to add coal to the furnace as needed. There are several types of stokers for use in schools. One type is known as a chain grate or a traveling grate. This grate provides a fuel bed the width of the furnace. The coal is fed to the grate by gravity from a hopper. Since the fire bed travels toward the rear of the furnace it is desirable to have a combustion arch at the front of the furnace to start distillation of the coal gases. The coal should enter the furnace at an even rate with no break. The grate travel speed and the thickness of the fuel bed are controlled by a thermostat. This type of stoker is more easily installed if the boiler mounting is higher than in ordinary installations.

There is also an overfeed type of stoker. Most of the underfeed stokers use a worm screw or a ram to deliver coal to the furnace. The feed tube delivers the fuel through a head known as a retort. This retort is capped or surrounded by castings known as tuyere blocks. These blocks are perforated to permit entrance of the air from the fan supplying a forced draft. Most of the stokers are equipped with a clutch or a shearing pin that disengages the motor if an obstruction enters the feed tube. All stokers on low pressure boilers are operated by an electric motor. Most of them use a separate motor to run the fan providing the air for the forced draft. Many of the stoker installations have plates inserted at the side of the fire box in water leg fire boxes as a protection.

One of the principal advantages of stoker firing lies in the automatic control. This may be provided by a thermostat located somewhere in the building. In a few of the cheaper installations control is provided by a pressure gauge operated from the steam pressure in the boiler. Some stokers have a timing device which causes them to operate often enough to keep the fire alive during warm weather. Others are equipped with stack (chimney) thermostats to provide the same results. The stoker should have a surplus capacity of about 30 to 40 per cent above that of the furnace served by it.

Stoker Economies

Manufacturers of stokers contend that stokers are economical in that all coal is consumed. They claim that clinkering is eliminated, but most janitors contend that this latter claim is not borne out in practice. The stoker having proper controls does provide regularity in the production of heat. If adequate ventilating facilities are provided this heat may be adapted to changing room conditions in the school rooms. The stoker does save time for the janitor and releases him for duties in other parts of the building. Stokers burn a cheaper grade of coal than it is possible to use with hand firing. In computing the possible savings made by the stoker, consideration must be given to depreciation and to the cost of electricity for operating the stoker and the fans.

Operation

The stoker should be supplied with a type and size of coal adapted to it. Worm and ram type stokers usually take only small pieces of coal and some stokers operate successfully on slack coal. (Note—slack coal does not mean black dirt.) The janitor should keep sufficient fuel in the hopper. All moving parts should be oiled. Controls should be checked often and kept properly adjusted. The stoker fed boiler for school buildings should be equipped with an automatic device that shuts off the feed if the boiler water gets low. Some have automatic devices that add water as needed. These are assets but the janitor should visit the furnace room often to check the water level and should not depend too much on the automatic device. A peep port or hole giving the janitor an opportunity to observe the flame is of value in controlling the rate of combustion.

In some school buildings the janitor regulates but does not shut off the stoker at night during cool or cold weather. In other buildings the stoker is shut off at night and starting fires in the morning may become quite a task. Some janitors have found that it pays to hand fire the furnace until it has developed to a point that all firing may be left to the stoker. Cleaning stoker fired furnaces often becomes a difficult task where the stoker is located directly in front of the furnace. In these cases the ash pit doors are usually closed and cleaning must be done through the fire doors. In many cases this cleaning may be made more difficult if the stoker and furnace are in a pit. A few janitors have made ash pans with wide lips that extend out over the feed pipe. Ashes and clinkers are raked out through the doors and fall into the pan or on the extended lip from which they slide down into the pan. If one end of the pan is properly sloped the ashes are then easily removed with a shovel.

Draft

As stated in the section on fuels and combustion, good firing is impossible unless sufficient air is supplied to complete the oxidation of the fuel. The chimney is provided to help create the draft needed through the furnace. In forced draft furnaces this movement is aided by the draft from the fan. If the fire had a direct passage to the chimney, as in a fireplace, most of the heat value of the fuel would be wasted. In order to make use of this heat the smoke and hot gases are forced to pass through winding or tortuous passages of flues where much of this heat is absorbed. The effect of the draft is easily affected by the condition, height, and size of the smoke chimney. It is also affected by the amount of fresh air available in the furnace room. Many janitors have noticed that opening a window or a duct in the outer wall of the furnace room will cause the fire to burn more freely.

Damper Control

Dampers are installed on furnaces to enable the fireman to control the rate of combustion and the heat generated without having to remain by the furnace adding a small amount of fuel as heat is needed. Most furnaces are equipped with four dampers. Too often the janitor-fireman has little knowledge of the importance of and the proper use of each damper. He should know that dampers cannot be fully effective unless the chimney, breeching and furnace are tight and free from cracks, and unless doors fit snugly. In up-draft furnaces a major part of the draft comes from the ash pit through the grates and the fire bed. If this draft is not sufficient the fire is sluggish. If it is excessive, cold air may pass through the fire bed and strike the flues with a chilling effect.

Proper damper control is often said to be a measure of the janitor's efficiency as a fireman. The use of the dampers listed in the following paragraphs refer to usage when firing and not specifically to their use when starting and banking fires.

1. Smoke pipe or turn damper

   This damper is often called a turn damper. It is similar to the smoke pipe damper found in some of our older heating stoves. It is usually located in the furnace breeching and should always be located between the furnace and the by-pass damper. It is operated by a lever outside the breeching. It is used to regulate the flow of gases to the chimney. It should always be open when the fire box door is open. It should never be completely closed when firing with a coal containing much volatile gas. It may be partly closed to offset the excess draft or chimney pull on windy days. When so used the janitor should watch carefully that a lull in the outside wind may not result in a smoking furnace. While this damper has a definite place its use will probably be needed less frequently than will that of the other dampers.

2. Feed door damper

This damper is sometimes called a fire door damper. It is usually a perforated slide or a revolving disc in the face of the fire door. The purpose of this damper is to admit air over the fire bed to aid in the combustion of the volatile gases arising from the fire bed. It is usually best to keep this damper open or partly open when firing with a coal rich in volatile gases, to aid the combustion of these gases. Many janitors fail to understand the value of and to make the proper use of this damper. Too much air through this port may cool the gases, while too little air prevents complete combustion of these gases.

3. Check damper

This damper is often called a by-pass damper. This is probably a better name for it as it is used to by-pass furnace room air into the chimney without having it pass through the fire, thus checking a part of the effect of the chimney draft. It is usually a shutter or lifting lid. In many cases it is connected by chains and a lever to the ash pit damper in such a manner that when one opens the other closes. The lever between the two dampers is usually controlled by a thermostat. This damper is closed when firing and open when the fire is banked. It is usually located on the side of the breeching, and should be located between the breeching turn damper and the chimney. It too is important and the fireman should know how to make use of it.

4. Ash pit damper

This is a lift door or a slide with the lift door preferred, since it is easier to operate. It is usually located in the ash pit door but may be located over an opening in the side of the furnace base. The purpose of this damper is to admit air to the under side of the grates. Its use is vital to proper combustion. Its use is also vital to grate protection. Theoretically, if the furnace is air tight one could provide complete control of the rate of burning by regulating the air flow with this damper. However, such use might destroy the grates. The grates are subject to intense heat from the fire above them. The air coming through the ash pit helps keep them cool enough to prevent destruction. In fact, many janitors keep the ash pit doors open a considerable part of the time and use the by-pass damper to regulate the fire. However, leaving the ash pit doors open may admit too much air to the under side of the fire. If the ash pit dampers are closed suddenly on a big fire with little protective ash above the grates the fire may warp them.

Ash Removal

Ashes are the non-combustible residue from the solid fuel burned. In hand fired furnaces with movable grates the ashes are dropped into the ash pit by shaking the grates. In straight grate furnaces and from the top grates of down draft furnaces the ashes are worked through the grates by sliding a "T" bar between the grates and the fire bed. Janitors find it desirable to retain some ashes on the grates to protect the grates from the direct heat of the live coals. The thickness of the ash bed will vary with firing conditions and the type of coal used. It may vary from two to about five and one-half inches. The janitor should avoid shaking the grates too vigorously. Red hot coals in the ash pit are a waste of fuel, a menace to the grates, and oftentimes a liability to the fire above the grates.

Ashes should never be permitted to pile up under the grates. They choke off the air needed for combustion and for grate cooling. For school furnaces it is desirable to have an ash pit that is slightly depressed below the floor level with a slope at the front door to make cleaning easier. After each cleaning the janitor can run some water into this pit. This water will cool ashes and embers falling into it and will moisten the ashes thus eliminating much of the dust when cleaning. If the ash pit is not depressed the janitor may wet the ashes before removal. The water should be applied at the base some time before removal. When applied in this way no water should be permitted to come into contact with the grates or other hot metal. To do so might cause breakage. Water or wet ashes standing for any length of time in contact with metal furnace bases may start a corrosive or rusting action. They seem to have little effect on the concrete pit.

The janitor should have a long handled shovel for removing ashes. He should remove ash accumulations from the rear of the pit. When the ashes are removed they should be placed in a metal ash can or a wheelbarrow for removal to a fireproof ash bin. They should never be piled on the furnace room floor or placed in combustible containers. The floor should be cleaned after the ashes are removed.

Clinkers

There are two types of clinkers, the soft clinker, and the hard clinker. The soft clinker is sometimes confused with the crust over hot caking coals. They are similar but the real clinker is the result of ash fusion. Coal ashes are a combination of waste and various metallic oxides. Some of these oxides do not melt or fuse readily unless in contact with other oxides which fuse more readily. This explains why clinkers grow. A clinker may start and as other ashes and oxides come into contact with it they are fused and adhere to the mass. Soft clinkers may start as small pieces and by this addition gradually shut off the air supply through the grates. As this air supply is shut off, the ashes are subjected to more heat from the fire above and more clinker develops. This soft clinker may stay soft while on the grates. In fact, it may run down and choke the openings in the grates. It usually becomes hard when deposited in the ash pit.

As stated, clinkers are the result of ash fusion. This ash fusion point varies with different coals. For the better anthracite coals it is usually above 2500°F., but for some of the bituminous coals it may be as low as 1800°F. Coal ashes containing more iron and magnesium seem to fuse more readily. Fusing and clinkering are much worse under forced firing. They seem to develop more rapidly when excessively heavy fire beds are maintained. However, a considerable part of the clinkering is caused by the method of firing. Bottled or excessive heat, poor draft, puddling, and the burning of rubbish are common causes. Ashes stirred up into the coal bed may become heated to the fusing point and melt into a clinker. The janitor-fireman in an attempt to force or crowd the fire should never use the slice bar (better named clinker bar in this case) to slide it under the fire and pry the coals up, for this mixes the ashes and coals. This forms clinkers, choking off the draft and makes it necessary to clean the fires.

Smoke Control

Smoke is generally thought of as the result of incomplete combustion. This is not always true; however, black smoke is an indication of fuel waste. It usually contains some unburned carbon and probably some tarry matter together with some fly ash visible to the eye. Theoretically the smoke product of perfect combustion is colorless. In general, black smoke contains a considerable amount of gases that have been distilled from the fuel more rapidly than they can be mixed with the proper amount of oxygen above the fire bed at ignition temperature. A clear chimney is not always an indication of good combustion, but may indicate excessive draft through the fire bed. In general, it is considered good practice to have a slight haze showing above the chimney.

Most school buildings in the southern and central states are permitted to cool off during the night. Rapid or forced firing in the morning often causes heavy smoke loss. Several smoke consuming devices have been developed. Some of these are placed in the chimney. One is an oxidizer admitting air over the back part of the fire bed. The best smoke prevention comes through proper firing methods and proper use of the dampers to aid in burning the gases in the fire box. A large combustion chamber aids in consuming the smoke gases before they are cooled by coming in contact with the flues or crown sheet. The janitor should remember that only those gases that are consumed in the furnace proper are of much value in producing usable heat.

Starting Fires

One of the first things that the janitor does after coming to the building on a cold morning is to fire up. Before starting his fires he should test the water level in the boiler and check the pump and the pump by-pass valves. The method of starting the fire will depend on the nature of the fire bank. If the fire has been properly banked close the by-pass damper, open the smoke pipe turn damper if closed, open the ash pit door damper, and break the bank. It may or may not be necessary to shake the grates depending on the condition of the fire. It is usually better to let the fire burn until the coals are red before adding fresh fuel. Adding fresh fuel on unburned coal may smother the fire and produce much smoke. It is often desirable to admit air over the fire bed through the fire door damper or by leaving the fire door slightly ajar until the fire has started if firing with high volatile coals.

There are two general methods of starting a new fire. In the regular or ordinary method the kindling is placed on the grates and a small amount of coal is sprinkled on this after the fire has started to burn. This method usually produces much smoke. The other method is called the upside down method. Many janitors find this method satisfactory for updraft furnaces. In using this method a bed of coal is placed on the grates. The kindling is placed on this and ignited. After it has developed a good blaze more coal is sprinkled over the fire. The coal below will be heated and ignite. The gases coming from this coal will be forced to pass through the hot blaze and more of them will be consumed. As a result there is usually less smoke when firing up.

Banking Fires

The first step in banking a fire is to have a good bed of coals. Some janitors let the fire die down about one-half an hour before school closes and then attempt to bank the fire without having a satisfactory bed of coals when they leave one or two hours later. In making up a work schedule the janitor should know how long heat will probably be needed each evening and then plan the banking accordingly. The fire should be banked with fresh coal and not with ashes. The by-pass damper should be open and the ash pit damper closed. Use of the turn damper will depend on draft conditions. It is usually found practical to bank with the conical or coking method. The practice of leaving the fire door open on banked fires is hazardous and should be discouraged. Banking methods will vary with the type of coal used. In some school buildings a night man is kept on duty. In some of the northern cities a flying firing squad of night firemen visits each building one or more times each night during cold weather. In either case, the building is not permitted to cool down and banking fires is not necessary. It is felt in these schools that the night cooling of the building is more expensive than the added help.

Bottled Heat

Quick dampering, defective dampers, poor baffles, a wind shift, insufficient furnace volume, or excessive firing may develop heat more rapidly than the furnace and the exhaust system will care for it. This may create an intense furnace heat sometimes known as bottled heat. It may cause clinkering and in severe cases may destroy grates and furnace linings.

Firing with Other Fuels

A number of school buildings are heated with gas or oil. These provide clean fuels with a constant flow, requiring little firing attention from the janitor. However, water and pump problems may develop as quickly with these fuels as when firing with coal, and there should be no neglect of the furnace room. Each of these fuels may cause some soot to be deposited on the flues, but the oil is a little worse in this respect. As with coal a proper air supply for combustion is essential. Damper control of incoming air should be automatic. Ample combustion chambers are needed.

The hazards from leaks and explosions are always present. Oil lines should have a siphon or trap in them as a protection against back firing. Both of these fuels are delivered to the furnace under pressure. The furnaces must be watched closely for leaks. If for any reason the fire goes out or is snuffed out it should not be ignited again until all gases or oil puddles have been removed. In lighting these fires a torch made of asbestos wrapped around the end of a rod and soaked in oil or kerosene is desirable if there is no pilot light. Lighting one of these fires with a match may cost a janitor his eyebrows and perhaps his life. The janitor should learn to estimate the condition of the fire by the flame and to adjust the air supply accordingly.

Cautions and Economies in Firing

1. Watch temperature and steam pressure. Excess heat and steam pressure are wasteful.
2. Have a clean heating system and furnace room.
3. Adapt firing methods to weather, fuel used, and type of furnace.

4. Watch for air, gas, or oil leaks.
5. Watch water level in boiler.
6. Have a good draft. Control it by proper use of dampers.
7. Watch room humidity.
8. Break up large lumps of coal. Shake grates only as needed. Avoid smothering fire.
9. Burning garbage, forcing fire, or too much poking of fire may induce clinkering.
10. Provide large combustion chamber. Use it.
11. Bank with coal—not ashes.
12. Keep ashes low (no live coals) in ash pit. Dampen if possible before removing.

Chapter 15

Care of Heating and Ventilating Systems

THE JANITOR-ENGINEER should know the principles of heating and ventilation. He should know the various fuels and the principles of combustion. He must be familiar with the methods of firing the furnace. He also needs experience and an opportunity to study the plant he is to operate. He should be familiar with the building and the time schedule of the various school activities in it. He should have enough mechanical skill to enable him to make most of the adjustments and repairs needed in the heating and ventilating systems. In fact, he should be a man who is able to demonstrate to school officials and the public that he is a skilled workman who knows his job and who is doing it in a satisfactory manner.

Some of the problems involved in efficient plant operation, maintenance, and protection are outlined on the following pages. Since plants and conditions vary, there can be no rule of thumb regulations that will apply alike to all systems. In many cases, the procedures outlined represent the experiences of several hundred active operators who have found these practices satisfactory. A part of the discussion to follow will cover operating practices and other parts will cover repairs, adjustments, and alterations.

Temperature Control

The purpose of a heating plant in a school building is to provide proper temperature. It would be possible to supply an excess of heat and to permit the teacher to use as much as needed. The surplus might be permitted to escape through the windows. Such procedure is neither practical nor economical. Better results are obtained with a temperature definitely controlled within fixed limits at all times. Many factors must be considered in attempting to provide the temperature regulation needed in all rooms. The janitor should be familiar with the principles involved in temperature regulation.

Regulating Devices

Pneumatic heat regulating devices have pumps and air lines. While most of these operate in a satisfactory manner, none of them are infallible. Motors get dirty, air lines develop leaks, and thermostats get out of adjustment. Teachers may complain that the temperature regulation leaves her room too hot or too cold. Some of the larger companies selling pneumatic controls have service men who visit installations to make adjustments. If no service man is available, the janitor may detect air line leakage by the speed and time of motor operation. By shutting off some lines this leakage may be located in a certain line. Sticking valves may be detected by watching the room thermostat and the radiator or suspected inlet. Excessive temperature for any room may be decreased by resetting the control thermostat for that room.

Limiting Factors

In many cases ample heat is supplied to the room without satisfying the occupants. After checking the janitor may find that the air in the room is stratified with the heated air at the top. A condition of this type may usually be corrected by circulating the room air. He may also find that a room temperature of 70° F. does not provide the comfort desired because of a lack of air moisture. In these cases he may be able to satisfy the occupants by providing more moisture. The janitor cannot provide efficient temperature control in an economical manner unless he can regulate some uncontrolled room heat losses. It is anticipated that some heat will be lost in room ventilation. This can be measured and enough heat supplied to counteract the loss. Window caulking, weather stripping, and the closing of other cracks will aid in regulating the uncontrolled losses.

Ventilation Controls

Heat regulations must be closely associated with ventilation. Certain amounts of heat are lost through ventilation. On the other hand, the ventilating air is used to diffuse and distribute the heat in the rooms and thus to overcome the tendency towards air stratification. The general purposes of the ventilating systems are to remove odors, provide fresh air, regulate heat, and in general to contribute to the comfort of the occupants. Even though there is some heat loss through the ventilating ducts, this does not justify closing the ducts with card board or dampers when pupils are in the rooms.

The ventilating system is supposed to aid in controlling air humidity, and to provide clean fresh air, with the changes needed, without objectionable drafts. In some systems the janitor may provide moisture for the air by a controlled spray of water in the air stream. This is possible only when the air current is of warm air. In other cases the air current is passed through a curtain of falling water, and at other times it is blown across coarse burlap cloth over which water is allowed to drip. The last two methods also aid in cleaning the air. In buildings heated by direct radiation evaporating pans on the radiators provide about the only means of supplying artificial humidification. Some janitors have speeded the evaporating process by making evaporating pans to fit the radiators. Humidification with the spray or with an evaporating pan is easily provided with any hot air heating system. In any case, the moisture added should not be enough to make the walls and other room surfaces damp.

Air Flow

Air flow can be controlled by deflectors in the windows or in the room delivery ducts. If the air speed from fans seems excessive it can be directed toward the ceiling where it will not blow directly on the pupils. Fan speed should be regulated so that there is no appreciable noise or whistling in the ducts. A floor level air speed of about 40 F.P.M. may be noticeable with cool air, but is little noticed when moving warm air. Air flow to or from special rooms may be controlled by fan speed and vent duct damper control. Mixing dampers in ducts or in unit heaters should be checked frequently. The use of room fans will aid in diffusing the heat over the rooms. This method is used in old basement rooms having only ceiling radiators.

Clean Air

Air cleaning is not easily controlled, except where air washers are used. In some of the newer ventilating units oiled or mesh screens are used to filter out the dust. These filters should be cleaned as often as needed to make them effective. Some of the filters are cleaned by immersion in an oil bath. Any system of air movement through dirt laden ducts may throw much dust into the classroom air. Corridor ventilation may stir up dust if the air flow speed is sufficient. Hence, all ventilating ducts, corridors, or other air passage ways should be kept free of dust.

Furnace Drafts

No furnace may be expected to operate efficiently without sufficient and controlled draft. The impetus for this air flow comes from the chimney. Its effectiveness may be governed by the shape, arrangement, and condition of the furnace.

Chimney Draft

Some chimney and boiler breeching conditions which make them less efficient are: holes in breeching, loose connection with chimney, turn damper closed, soot piled up in the breeching and smoke pipe, breeching entering chimney on a down slant, breeching extending too far into the chimney, and obstructions in the chimney. All of these difficulties are easily removed. There are certain other draft difficulties that cannot usually be corrected until the heating plant is idle. Some of these are: broken chimney linings, chimney cracks, and a lack of chimney height above the roof line or parapet walls which may choke the draft or at times cause a back draft. Chimney cracks and holes can usually be detected by a smoke test. (Build small fire of smoke producing material, cover top of flue for few minutes and watch for leaks.) The holes and small cracks can be filled with mortar. The large cracks and broken linings may have to be repaired by a bricklayer. All breechings and soot boxes should be cleaned several times each year.

Furnace

Efficient combustion results depend on the draft and the control of air flow in the furnace. Leaks in the furnace walls or through the ash pit make it difficult to control the air flow. Loose fitting dampers or doors, or cracks in the furnace lining may admit air where none is needed. Dampers will be more effective and the draft more easily controlled if all of these cracks are closed. Many of them can be closed, at least temporarily, by a mixture of cement and asbestos fiber.

After the air enters the furnace it should follow a prescribed route in order that it be of greatest value in combustion without exerting a cooling effect on the boiler or hot air furnace. The air should be directed up through the fire bed. After passing through the fire bed it must mix with the gases. With these hot gases it should pass through the flues. If the air and gases enter the flues too soon some heat is lost. This combustion requires a rather high combustion chamber. It is estimated that a furnace large enough to heat 5000 feet E.D.R. should have a space of at least 18″ below the grates and a space of 42 to 48″ between the grates and the crown sheet. In many cases improved combustion has been secured by raising the furnace. In some furnaces, the hot gases pass back under the boiler or heating unit before entering the flues. In such instances they may pass over a fire wall. The hot gases should be directed up against the boiler before they lose too much of their heat. The fire wall should be built up until the open space between it and the boiler is only about 12 to 15″ for a majority of the school plant installations.

Furnace Grates

Air entering the ash pit passes into the fire bed through perforated or slotted iron grills called grates. These grates are made of cast iron and are of several types. The older brick set and some of the older portable furnaces are equipped with fixed grates of long slotted bars running lengthwise of the furnace.

Most of the newer furnaces are equipped with cross grates. Some of these extend all of the way across the furnace. In some of the larger furnaces the grates from each side run only to the middle where they rest on a "T" bar. They may be classified as shaking, rocking, or dumping grates according to their action. Most school furnaces are equipped with shaking grates which are controlled by levers at the front of the furnace.

Grate Control and Protection

Most of the grates installed for use with bituminous coals have only one-half inch slot openings. This is usually sufficient to admit the air necessary for grate protection. Most janitors find it advisable to maintain a bed of ashes of two to four inches between the grates and the live coals. When this bed of ashes becomes too thick some of it is shaken down into the ash pit. The grates should be shaken often enough to control the ash bed, but if shaken too often or too vigorously the ash protection will be lost and live coals will drop into the ash pit. The grates should be protected from clinkers. If shaking does not remove the clinkers they may be removed by using a slice bar or a "T" bar run under the fire bed. If soft melted clinkers have run into and closed some of the openings they should be chipped out as soon as possible. Heavy banking with the ash pit doors closed, may create enough heat on the grates to warp them.

Operation

The shaking grates are slightly convex at the surface to protect the fingers from the intense heat. The grates should not be shaken so strenuously that the ends (trunions) may be jerked out of the slots in which they rest. In those furnaces where the grates are divided down the center only one side is shaken at a time. In furnaces where the rear and front sections shake separately the rear sections will probably be shaken more often, particularly if the coking method of firing is used. After shaking the grates the janitor should place the shaking bar in such a position that the grates will be flat. If the edges or fingers are permitted to stick up into the fire bed they may be burned off. Most shaking bars have latches or slots that mesh or lock holding the grates in the proper position. These should be checked and properly meshed each time the grates are shaken.

Warping and Growth

Grates of cast iron absorb some carbon when heated. Thus grates that seem loose when first installed may expand to fill the full space provided for them. Grates subjected to intense or bottled heat may warp or sag. Dumping large quantities of live coals into the ash pit may also cause warping. Probably the most common cause of grate failure is caused by ashes which choke off the draft through the grates. With proper protection one set of grates should last as long as the furnace.

The Steam Heating System

The use of steam for heating requires a specific type of heating unit. Unless properly cared for the steam may create certain hazards. The fact that this steam condenses and must be returned to the furnace to be reheated requires that all steam lines have the proper slope. If the water is to be heated quickly and economically the heated gases must have direct contact with the metal separating the hot gases and the water.

Care of Flues

Boiler flues are of a comparative soft iron having power to conduct heat rapidly. If these flues become coated with a carbon soot which is not a good conductor their efficiency is reduced. A soot coating of one-thirty-second of an inch may cut efficiency as much as ten per cent, while a coating one-sixteenth of an inch thick may reduce efficiency as much as twenty-five per cent. This soot must be removed. In high pressure boilers a steam jet is often used to remove the soot. In a few schools having a vacuum cleaning system the flues are vacuum cleaned. In most schools, the flues must be cleaned by using a brush and a scraper. If used every day, a wire brush may keep the flues clean. If they become very dirty, the scraper should be used. When cleaning the flues the damper should be open. Flue cleaning is more difficult if the space at each end of the boiler does not permit free use of the cleaning tools. The use of a flexible or jointed cleaning rod is a dirty process, but regardless of how dirty the task is, the flues should be cleaned.

Some janitors use a chemical like salt to aid in consuming the soot. This probably has more effect in cleaning the fire box than in cleaning the flues. However, many janitors feel that the use of salt may have a corrosive effect on the metal. The janitor should be able to replace or rebead leaky flues, or to plug, temporarily, a leaking flue with a wood plug.

Daily Operation

Before firing up each morning the janitor should check by inspection the water glass and by test the try cocks. He should check the pump and by-pass valves. After he starts the fire he should not leave the furnace room too long at a time. As soon as he has about two pounds of steam pressure he should test the pop off valve. It is a mistake to try to fire up too quickly. A gradual warming without having to force the fire is preferable. In the evening the process is similar but in reverse order. After banking the fire and before leaving the building the pump by-pass valve should be opened. The chain connecting the ash pit and by-pass dampers should be disconnected, the fire door closed and tools put away.

Boiler Water

The steam heating system uses water or steam as a medium of heat transfer. The fact that the water evaporates creates a number of problems such as the depositing of the water carried solids inside the boiler, foaming from impurities in the water, boiler deterioration, and the danger of explosion.

Water Level

If the boiler water level gets below the top flues or the crown sheet and then fresh water is run on to the hot metal an explosion may ensue. Most school heating boilers are so arranged that about four inches of water is retained above the crown sheet. If the water glass is properly located this will mean about one-third to one-half a glass of water. The janitor should inspect the glass often to determine the amount of water in the boiler. The valve or pet cock at the bottom of the water column should be opened frequently to know that the two ports of entry, top and bottom, to the column are not closed. He should test the try cocks often as a counter check. A surging or rapid fluctuation in the water glass is often an indication of water difficulties. If the water gets dangerously low in the boiler the fire should be smothered and the boiler permitted to cool down before any make up water is added. The pop valve should not be opened to reduce steam pressure when the water gets low.

Foaming and Priming

Oil, organic matter, and dirt may cause the water in the boiler to foam. When this happens water is boiled over into the steam mains. This water is of little value in the radiators and may lower the water in the boiler. When this happens the janitor must watch the boiler closely until the difficulty is corrected. If the boiler has a skimmer the water may be brought to the proper level and some of the surface waste drawn off. Heavier waste may be blown off at the blow-off or mud valve. If these are not effective a thorough cleaning may be needed. One of the best methods of cleaning is to remove the pop off valve or some other top connection and to connect to this port a waste pipe leading to the sewer or to the outside. A fire is started and after the water is heated but before it steams the make up valve is opened slightly. The feed water should be admitted slowly enough that the overflow water is hot. Priming often occurs when the water level is too high or the load heavy. Reducing both may aid in checking the tendency to throw boiler water over into the steam lines.

The blow-off valve should be opened often to rid the boiler of sludge and other solids. If possible, the janitor should watch the water glass when the blow-off valve is opened. It should not be left open long enough to lower the water to the danger point. Many janitors claim better results if the blow-off valve is opened and closed quickly to start the water to surging and then opened again for the blow down. If the water is dirty or if boiler water compound is used it may be necessary to blow down daily.

If water does not return readily to the boiler the janitor should inspect the pump and the radiator traps to determine the difficulty. It may be necessary to provide bleeders connecting the steam line to the return lines. Free flow of both water and steam is essential. The water glass should be kept clean. It can be removed and washed in a cup of hot water to which has been added a small amount of muriatic acid. Some janitors drain the glass and open the top water column valve to blow out the water and warm the glass. The top valve is then closed and the cup of water and acid is held over the bottom of the tube. By opening and closing the top valve the solution is drawn up in the glass several times until it is clean. The glass should then be washed out by opening both valves. The drain is then closed. Both top and bottom valves should be left open.

Water Ills

The water used in the boilers contains many impurities. When the water turns to steam the solids are deposited in the boiler. These elements may injure the boiler in several ways. One of the most common difficulties is the deposit of scale. This scale may be deposited any place up to the water line. It seems to be deposited more around the flues and over the bridge wall. A heavy scale prevents good heating. It may also completely coat the safety soft plug. It is estimated that a scale of one-sixteenth inch may reduce efficiency by fifteen per cent, a scale of one-eighth inch twenty-five per cent, and a scale of one-fourth inch about forty per cent. Scale is a precipitation of the salts of such minerals as calcium, magnesium, and iron. It may also affect hot water heaters and hot water lines. It may lead to boiler buckling. Another difficulty arises from corrosion or pitting. Strangely enough, this difficulty is not confined to mineral laden water. Rainwater has been known to cause severe pitting. A combination of free acid and oxygen seems to form a sort of carbonic acid bubble on the flues. After this has started a small pit, other similar bubbles seem to collect there, each adding its corrosive effect to the weak spot. Exterior corrosion may occur on unpainted outer boiler surfaces or around leaks. Fire box or ash pit corrosion occurs more rapidly if wet ashes are in contact with the metal.

These difficulties may become serious. Scale can be removed by opening the boiler and chipping the scale away with a hammer. This removal is difficult in some of the smaller heating boilers. Pitted flues can be replaced. However, continued water difficulties may lead to caustic embrittlement of the metal structure of the boiler. There is no one cure-all for these boiler ailments. The addition of soda ash when no caustic or alkali is needed may aggravate the trouble. A water test made at one time may not be valid later as the water composition changes in rainy or dry seasons. A number of janitor-engineers have learned how to use a titration test to determine the amount of scale forming elements contained in the water. Some of the men have several tests made by commercial laboratories and at the same time make their own tests by determining the amount of some water breaking compound needed to precipitate the solids. These rough tests can give only approximate results. It is often possible to have the water tested by the chemistry department of the local school or that of the state university. For others who cannot or do not trust their ability to test the water, chemical testing laboratories are available in nearly all cities. Some of these companies sell a yearly service of testing and treating boiler water.

Boiler Safety

Even if he is not an efficient fireman or a skilled engineer each janitor should realize that the boiler is a potential engine of destruction. He cannot afford to trust the often quoted but erroneous theory, that the low pressure boiler with a steam pressure of only a few pounds cannot do much damage. He should remember that this pressure is quoted at so much per square inch and that the total concentrated energy is immense. He should carry no more steam pressure than needed. The fact that the pocketed lines block free steam movement is not a valid excuse for high pressure. The lines should be re-sloped. He should watch the water level and the pressure gauge. The pop off valve should be set at a low pressure and tested often. The janitor who adds extra weights to the level control of the level pop valve should be replaced. He should watch the vacuum pump and the check valves. Any sticking valves should be repaired or replaced. The soft plug is a second safety valve located in the crown sheet. It should be inspected often.

Radiator Care

Having steam pressure in the boiler room is no guarantee of room heat. Blocked radiators, stuck traps, and trapped lines may cause difficulties in the distribution system. Often radiators are painted with a bronze or aluminum finish. This reduces their radiating efficiency. Exposed steam mains may have their steam partly condensed before it reaches the radiators.

Radiator Blocking

One of the most common complaints is that certain radiators won't heat. In one-pipe lines, partially closed intake valves may cause the water to remain in the radiator until it becomes water logged. In other cases, the air valve on these radiators does not permit the cold air to escape. In either case, the live steam cannot enter the radiator. Some of the air valves on one pipe radiators are adjustable. It is possible to hasten steam flow to those radiators farther from the boiler by setting the air valves on these radiators to permit a more rapid air flow. In two pipe and vapor vacuum jobs, the radiator trap may stick, preventing the passage of cold water and air, thus blocking the ingress of fresh steam. At other times, certain lines may be water trapped or air locked, either of which may prevent the free passage of steam. Radiators may be tilted the wrong way, thus blocking the steam. Gurgling and pounding or hammering in the radiators or lines are other common difficulties that can be corrected by the janitor who knows his heating system.

The remedies are usually simple. Loss of heat from exposed lines can be eliminated by covering and protecting the lines. Cellular asbestos insulation for any size of pipe with metal strips for attaching in place can be purchased. Water trapped lines can be relieved temporarily by bleeders draining back into the return line and permanently by resloping the lines. Air blocks in one pipe lines can be removed by bleeders. In two pipe lines they can be eliminated by regulating or replacing the line air valves. Sticking traps may often be repaired by reseating the valve or by inserting a new thermostatic unit. A spirit level used on radiators and on steam mains will aid in locating low spots or a wrong slope. These changes will not make a ceiling radiator heat the floor air of a room, nor will they make up for a lack of radiation. A relocation of these units with new return lines is sometimes necessary. The tasks and changes listed vary so much in different situations that no attempt is made here to describe each change in detail. However, the efficient system should warm all radiators with a low steam pressure and without pounding or gurgling.

Summer Care

As soon as the boiler and furnace are retired for the summer they should be put in condition for the vacation period. This task should not be left until July. One of the first tasks in laying up the system for the summer is to clean it. The furnace chimney and flues should be cleaned first. The grates should be removed and all ashes removed from the hangers and corners.

The flues should be scraped. The chimney, soot box and breeching should be cleaned. After the dust from this rough cleaning has settled the janitor should go over it again with a brush. He should remember that most of the coal burned may contain sulphur. A small amount of sulphur and water may form an acid that is corrosive on metal.

He will then be ready to clean the inside of the boiler. All water should be drained off; clean out plugs, hand hole, and man hole covers should be removed. In removing the latter he should attempt to preserve the gaskets. The inside of the boiler should be washed with a hose and thoroughly cleaned. All scale and sediment should be removed. The soft plug should be removed and examined. It may be replaced with a new one of Banca tin bearing an approved label. He may then wish to fill the boiler and run in a solution of some mild substance that will form a protective glaze on the inside of the boiler. (Some use a sodium silicate or a similar solution.)

If the boiler room is damp he should fill the boiler to the top for the summer. If the boiler room is dry he may drain, remove hand and man hole covers, and leave air dry. An oil stove set in the fire box for a few hours will dry it out. A fire should not be lit for this purpose in an empty boiler. The boiler and furnace will then be retired and should not be used for burning paper or garbage during the summer. Neither should the furnace be used as a storage place for paper to be burned later. Someone might decide to burn it now. The inside of the fire box can be painted or oiled, and an oiled rag pulled through the flues will give them a protective coating. Fire doors should be left open.

The janitor will then be ready to prepare the rest of the system for the summer. The pipe and boiler covering will be painted, valves reseated, pumps repaired and drained, and cylinders oil coated. Hot water tanks will be drained and cleaned. Fan housings will be swept and washed. Dust will be blown out of motors, and all ventilating ducts will be cleaned and dusted. Brass and nickel finish should be polished or coated.

Putting into Service

When the janitor is ready to put the boiler into service in the fall he should treat it almost as he would a new boiler. If it has been filled with water this should be drained off and new water added. If it has been dry he will replace all plugs and man hole or hand hole coverings and fill. He should warm it up slowly to permit even expansion. He may find it desirable to take one or two days to bring his plant into active operation. As it warms up he should test all valves, gauges, and pumps. Fans and motors should be run for short periods and stopped for inspection. It may be necessary to redrain the boiler after warming up the first time. This try out should be done at a time when the building is not in use. The furnace flues, fire box and flues may smoke while the oil is burning off, and accumulated dust in air and ventilating ducts may be blown out into the rooms.

Care of Hot Air Systems

All previous suggestions concerning the care of the furnace, fans, motors, and air ducts will apply to the care of a hot air furnace, as will those on temperature control, air flow, and humidity. A few additional suggestions seem worth while. Uncontrolled hot air systems are subject to losses from open windows. They are also subject to variations from wind pressure. Few suggestions other than continued watchfulness in duct damper control can be offered. If the system has automatic controls the difficulties may be cared for by resetting the room thermostats. In operation a hot air system may be warmed up in the morning without taking in much outside air. After the pupils arrive full recirculation should not be practiced. The janitor should not close ventilating ducts in order to conserve hot air. Air speed should not be sufficient to cause room drafts or whistling in the pipes. Enough moisture should be added to prevent the air from becoming too dry. Odors from the hot metal in the air stream are obnoxious. The furnace should be checked often. A small seam or crack may permit smoke and gases to enter the air stream. All ducts should be cleaned often enough to prevent any dust from them entering the air stream. Air that picks up dust from corridors or rooms should be washed or discarded. Rooms and corridors may need to be cleaned often to prevent accumulations of dust that might enter the air stream. For the same reason floor registers for either warm or cold air in school rooms are not desirable.

Miscellaneous Operating Problems

Pumps

Pumps should be oiled as needed. All valves should be properly seated. The vacuum gauge in vacuum pumps should be checked. By-pass valves should be opened at night. The pump should be clean, and the floor around it free from oil drippings.

Oil Burners

Oil burners are of two types. The spray nozzle feed is controlled by a butterfly valve. The hinged door type of burner gets hot and the valve may stick. Before starting the burner the fire box should be examined for any accumulations of oil. When the burner is shut off the fan should be run long enough after the oil is shut off to clear the nozzle.

Gas Burner

If this burner is adjusted to give a proper air mixture little trouble may be anticipated. The janitor should be alert in watching for leaks. He should not be smoking when he enters the boiler room for the first time in the morning. In case of doubt he should open windows and give all free gas an opportunity to escape before lighting the burner. After the burner is turned off it should not be relighted until free gas has had an opportunity to escape. A pilot light for starting the fire is desirable.

Cleanliness

Many other problems will arise in the care and management of the heating plant. The alert capable janitor-fireman will detect many of them before they become serious. He will maintain a heating plant that operates freely and efficiently. His furnace room will be clean from ceiling to floor. It will not be a catch-all for rubbish. The floor will be free from ashes, coal, or oil. The furnace or boiler room covering will be clean. Exposed metal will be painted. All tools will be in good working condition and properly stored.

Chapter 16

Miscellaneous Duties

Care of Furniture

A SCHOOL ROOM WITH good floors and walls may have the natural attractiveness of the room marred by dirty, scarred, or squeaky furniture. One of the tasks of the janitor is to clean the room furniture. Pupils come into contact with the furniture surfaces and leave deposits of grease and dirt from their hands. In cleaning furniture the janitor must find and remove these dark accumulations. Since some of this dirt will accumulate in spite of the daily dusting, more effective cleaning is essential. This periodic cleaning usually involves washing or the use of some cleaning fluid. In cleaning, the janitor should be careful not to mar the finish. Strong soaps or cleaning fluids should never be used. A neutral soap may be used in washing. The washing may be done with a sponge or with a cloth. The first washing should be followed with a second sponge or cloth to remove streaks and surplus water. All soap should be removed. The janitor should not use sufficient water to fill the joints or cracks. He should also avoid using water hot enough to mar the finish, or the sprinkling of water on the floor. Many janitors find it desirable to wash furniture once or twice each year.

Polishing

Washing alone does not leave the finish desired for furniture. After the washed surface has dried it should be polished. In addition to the polishing after washing, frequent polishing during the year may be necessary. Some janitors use a polish which also acts as a cleaner, thus making it unnecessary to wash the surfaces often. In polishing furniture the janitor should use a polish that does not leave an oily or sticky surface to catch dirt and dust. He should also avoid the use of a polish that leaves a high gloss surface that reflects too much light into the eyes of the children by using suitable furniture polish on the duster.

Polishing Materials

There are a number of polishes available for use on furniture. One of the most common of these polishes is a mineral oil such as paraffin or a mixture of benzine or turpentine and paraffin. After being applied these must be wiped off. The polish used should be stable. One that oxidizes easily may leave dark surfaces, and one containing too much alcohol may leave white spots on varnished surfaces. Such vegetable oils as cedar and linseed are also used in polish. Wax is gaining in favor as a polish. The school may purchase suitable polishes or the janitor may prepare his own. One combination of wax and oils may be made by using: 1 pint raw linseed oil, 2 pints turpentine and 1 or 2 ounces of beeswax. The beeswax is dissolved in the warm oil. The mixture is cooled and the turpentine added. It should be shaken before using. One polish that has been used by the United States Navy department is made up as follows: cider vinegar 1.25 parts, petroleum spirits (paraffin oil) 2.26 parts, turpentine 1.35 parts, denatured alcohol .22, boiled linseed oil 1 part, raw linseed oil 1.25 parts. If each complete part is one pint this will make about one gallon of polish. Because of the acid vinegar content it should not be kept in a metal container.[1]

[1] U. S. Department of Commerce, *Washing, Cleaning and Polishing Materials.* Pp. 43–44.

A polish containing more wax may be prepared by using 2 parts (by weight) carnauba wax, 2 parts ceresin, 2 parts turpentine, 3 parts gasoline. The waxes are melted over a water bath and the turpentine and gasoline added. Another may be made by using ½ lb. carnauba, ½ lb. beeswax, and 1 gallon of turpentine. The wax is melted in the liquids in a water bath. Avoid open flame. An emulsion wax polish is made to include an abrasive in the form of tripoli. This wax contains gasoline 4.4 parts, carnauba or beeswax, .9 parts, tripoli .2 parts, water 4.4 parts, neutral soap .1 part. The wax is dissolved in the gasoline over water bath and the other parts added. Many janitors prefer the wax over the oil polishes since it does not leave a sticky surface. The waxes containing some soap help clean the furniture. The wax also provides some protection against ink stain. It may leave a surface with too much gloss. When polishing, friction created by rubbing is important. After the polishing is completed the sheen may be maintained with the treated duster.

Refinishing

Most schools have an organized program for furniture replacement, but the refinishing of desks and other furniture is too often neglected. In many cases the desks are scarred and marked. For badly scarred desks sanding is usually essential. In a few cases the worst cuts may be removed with a smoothing plane. The hand sander may then be used to smooth the surface. The sander may also be used to remove chipped varnish. In other instances, the old varnish may be removed by a commercial varnish remover. The janitor can make his own varnish remover by mixing 1 quart benzol and ½ pint acetone heated separately. Into this is shaved 2 ounces paraffin. After this has cooled 1 pint of gasoline and 1 quart of denatured alcohol are added. Another remover can be made by dissolving 1 lb. lye, adding 2 ounces of corn starch, and the same amount of China clay. This is applied as a paste.

To remove old varnish from fixed seats, many janitors prepare a dipping tank with a derrick or pulley and dip the whole desk. This requires a tank large enough to dip the seats. The tank solution should be hot. It may be set over a fire or heated with a steam coil. For this purpose a caustic alkali (industrial alkali) of some such substance as caustic soda and soda ash (ratio about 2⅓ to 1) may be purchased already mixed at a small cost. The seat should not be left in the bath for more than 1 and ½ to 2 minutes. If left too long the glue in the seats may be destroyed. As soon as the seats are cool the old finish is removed with a stiff brush. The seats should then be thoroughly rinsed, using a hose. The hands should not come in contact with this solution. After the seats are dry the surfaces are sanded before finishing.

After the old finish has been removed and after the surface has been smoothed a new finish coat should be applied. If a color is desired the stain will be applied first. The stain should not be too dark. If varnish is applied the first coat may be cut to 80 per cent varnish and 20 per cent turpentine. The surface is then sanded lightly or buffed and the second coat, cut 10 to 15 per cent, is applied. In many schools a clear bakelite finish (similar to gymnasium floor finish) is applied instead of the varnish. The finish should not be too glossy. The suggestions given here apply to wood furniture. The finish for metal furniture is usually an enamel. The treatment for this finish will vary little from that for wood.

Care and Maintenance

It is anticipated that the teacher and pupils in the room will be careful to avoid marring and breaking furniture. In spite of this care furniture will deteriorate. Seat bolts will loosen. Desk glue may cease to hold. Splinters on seats are harmful to stockings and clothing. The janitor should watch seats and other equipment for loose joints or bolts. A little prevention may avoid costly breakage. Fixed seats should be securely attached to the floor. Loose joints may be reglued with hot glue. Some of the older chairs get loose and squeaky. If they cannot be repaired otherwise they may be wired and tightened by partially concealed wires under the seats.

Chairs and movable furniture may mar floor finish. This is particularly noticeable on linoleum or mastic flooring. The janitor should attach suitable gliders to the legs of such equipment. There is now available on the market a glider with a large rectangular base. This attaches to the leg of the chair and seems superior to the smaller gliders, which might gouge holes or cut the surface.

The janitor is often required to refinish table tops on science tables. An acid proof finish may be applied in the following manner.

First coat is a solution of 125 grams of potassium chlorate and 125 grams of copper sulphate to one gallon of water to be heated and applied hot. Second coat is applied after the first coat is dry, and consists of the same solution as the first coat, but is applied cold. This is followed by two coats of a solution composed of 120 CC Analin oil, 180 CC of hydrochloric acid to 1000 CC of water. When dry they should be given one coat of raw linseed oil which should be polished and allowed to stand for at least eight hours. The surface is then washed with hot soap suds and water and is again rubbed with linseed oil as above. If any black comes off, the surface is again washed and oiled in the same manner. This treatment should be continued until no black comes off in the rubbing.

Termites and Termite Control

Many janitors have at one time or another had to contend with termite infestation of their school buildings. Others have buildings in which termites are now plentiful, without realizing that termite damage is being done. Janitors often fear termites as they would a plague because they do not know how to combat them. While termite damage is often exaggerated, it is true that termites may and do cause untold damage in school buildings each year. Termite damage occurs principally in wood but may be found in papers, books, or cloth stored in favorable places. It is possible for termites to practically destroy floors, or to eat out the inside joists or studs until they will collapse when subjected to unusual strain. The termite works under cover and may do much damage before being discovered.

How to Detect Termite Infestation

In many cases the janitor discovers evidence of termite damage by accident. The discovery may come after serious damage has been done. There are some signs that indicate that termites are present. The janitor should know and watch for these indications. If other buildings in the neighborhood have termites there is a possibility that they may reach the school building. This is in no wise a sure sign or indication. One sign that may be visible is the presence of dirt or mud tubes leading from the ground up the wall or a pier to some wood. At certain times during the year (in the central Mississippi Valley States this swarming is more likely to occur during the spring and autumn months) the termites may come out in a swarm in an attempt to start a new colony. The swarming termites, sometimes called flying ants, are an indication of the presence of a mother colony. At other times books that have been stored for some time in damp or musty places may show evidence of termite damage. Spongy floors may be but are not always an indication of such infestation. If the janitor suspects that termites may be present in any particular piece of wood he should test it by tapping it with a hammer or by the use of an ice pick or knife point. Wood that is seriously damaged gives off a dull sound when tapped. The ice pick or knife point will indicate a soft spongy condition. However, further examination may be necessary since other causes may be responsible for the deterioration. An examination of all pieces of wood extending from the ground up to other wood in the building may indicate whether the termites have used this piece of wood as a pathway to the building.

Nature of Termites

While it is not possible to outline here a complete history and description of termites, there are a few basic facts with which janitors and others in charge of school buildings should be familiar. There are many types of termites. Some are known as desert, carton nest, and soil dwelling or subterranean termites. The workers of the termites which may injure school buildings are grayish white in color. Those that swarm are somewhat yellow with rather white wings. They resemble ants but do not have so pronounced a waistline between the thorax and abdomen. The termites are able to thrive on the cellulose found in wood. Those that are often found in school buildings, avoid the light, and if no wood reaches from the building down to the ground may build small air-tight mud tubes up to the wood. Those found in school buildings also seem to need water. The tubes in the ground lead down to moist earth. This need for water makes it possible to destroy them by cutting them off from their water supply.

Entrance

Termites almost invariably come into the building from some outside source. Places where wood is imbedded in concrete or wood in contact with the ground offer opportunities for entrance. Cracks in the concrete or brick foundation offer a means of entrance. Basement windows, wood piers, or wood steps offer an easy path. Wood floors on concrete subfloors which rest on the ground offer ready entrance if the building settles sufficiently to cause a crack in the subfloor. One other source of entrance is the small dirt tube that the termites erect up the side of masonry to the wood.

Controls

There are three possible means of controlling termites and in preventing excessive building damage. They are: prevention, extermination, and elimination. All buildings having wood in the lower story will be subject to termite damage.

Prevention

The best method of prevention is in the manner of construction. In buildings having good tight concrete foundations with no wood closer than twenty-four inches from the ground the danger of infestation is lessened. Likewise, fire resistive construction so reduces the available food supply that termites do not thrive. The elimination of any building wood in contact with the ground cuts off a possible easy means in ingress. The use of metal shields extending out from and turned down from the top of the foundations and piers aid in preventing the erection of tubes up the walls. Anti-termite treatment, if permanent, of all wood near the ground aids in preventing infestation, or assists in their later control.

Extermination

Several methods have been developed for the use of certain gases and chemicals to kill the termites in the building. It is possible to kill the termites if the gas or chemicals is introduced into the wood under pressure. However, unless the chemical thoroughly impregnates the wood the treatment does not last. Commercial or home treatments on the surface of the wood are usually not lasting. One of the chemicals used in impregnating the wood is zinc chloride.

Elimination

Elimination as outlined here is really one method or form of prevention. It is now quite well understood that each infestation is a special case and should be given special study. There seems to be no one universal method of elimination. Elimination methods used may be successful but not permanent. Many chemicals and fumigants are temporary and unless those in charge watch carefully new infestations may occur. One common means of elimination is to destroy the tubes that lead from the ground to the wood above. The termites usually found in school buildings need moisture. When the termites in the building are cut off from the soil they seem to die and others will not reach the wood until new tubes are constructed.

Other methods of elimination that are of value are the destruction of old stumps near the building, and the removal of pieces of building wood in contact with the ground which might provide an easy means of entrance. Closing cracks in foundation walls and the painting of walls where tubes have been found with creosote, discourage termite entrance. In a few cases custodians have been able to locate the termite colony nest and to destroy them with chemicals or hot water. Termites usually have their nest outside the building. They travel through ground tubes to the building. If trenches are dug around the building at points of entrance and the soil treated with some chemical toxic to the termites further infestation may be averted. There are several such chemicals available. It is desirable to select a chemical that does not have an odor particularly obnoxious to man but which is obnoxious to termites. Kerosene, creosote, orthodichlorobenzine, and paradichlorobenzine may be used. The latter two seem to last longer than the kerosene-creosote treatment. In applying these treatments the kerosene and creosote are mixed in the ratio of 3 to 1. One gallon of the mixture will be needed for each eight to ten feet of trench. A part of it can be poured into the trench and the remaining part mixed with the first soil returned to the trench. Orthodichlorobenzine is applied in the same manner, about one gallon to each ten feet of trench. Paradichlorobenzine is mixed in the ratio of one and one-half pound to one gallon of kerosene. About one gallon will be required for each ten feet of trench.

Janitors should remember that eternal vigilance is necessary. Adequate ventilation in damp basements and under floors may discourage entrance. Once infestation has been detected, immediate elimination should be brought about to prevent further damage.

Miscellaneous Helps

Metal polish—A good metal polish may be made by using chip soap, 10 parts by weight, silica dust 20 parts, tripoli (fine) 20 parts, pine oil 2 parts, water 40 parts. Dissolve soap in hot water, add other parts. Don't fail to use some power in polishing. When leaving polished metal for summer, coat with vaseline.

Warming up building—Retaining fire (heat) over night saves time in morning firing. Firing up on Sunday may prevent a cold Monday with damp walls. Warm up boiler slowly. Avoid turning on oil or gas full blast at first. Lock window rails at night to save heat. Caulking and weather stripping also conserve heat.

Saving water—Shut off water from automatic flushing tanks at night and over the week-end. Repair leaky valves.

Removing oil stains from marble—Make poultice of benzol or gasoline and a dry powder, or can use fullers earth.

From wood—soak cloth in hydrogen peroxide. Dip another in ammonia and lay over first.

Javelle water—Janitor can make by mixing ¾ lb. chlorinated lime and 3 lb. soda in warm water. Stir and add enough water to make ten gallons. Strain or draw off clear liquid. Keep in stone jar. When using dilute 1 part to 4 parts of water.

Removing shellac—Rub small spot at a time with denatured alcohol.

Paint brush—Clean in kerosense—wash kerosene out with gasoline—rinse in water.

Boiler—Wasting hot water to sewer is fuel waste. Always open steam valves slowly.

Paint—If dulled by washing, sheen may be restored by rubbing with oiled cloth. Paint applied on green or damp walls will probably peel. Alkaline spots should be treated before painting.

Light bulb tool—An old plumber's friend with long handle may be used to loosen or to replace light bulbs in high sockets. A corrugated cardboard in hollow will take up slack space.

Washing inkwells—Place in pail of water with some T.S.P. Shake. Use brush if necessary to complete job.

Fire extinguishers—Test to see that tube is not choked. Can use straw or can blow in tube.

Treated mop—Use brush block and two or more treated mop heads.

Paste or glue—On blackboards or walls—use hot water to remove. Spray naphtha on waxed crayon to remove.

Roaches and other pests—Roaches eat garbage and sewer waste. Use borax or sodium fluoride to kill. Remove rotting wood as breeding place. Stop cracks. Mosquitoes—oil pools—watch for old cans containing water. Punch holes in them.

Gas line—Paint heavy soap suds and watch for bubbles to find leak. Test joints with feather suspended on string. Do not use matches.

Machinery—Oil is a wearing film on friction points. Use it.

Steam and electric lines—Tag or mark to show rooms served.

Glass breakage—Loose glass in doors breaks more easily than that securely fixed. Reset moulding and save breakage.

Carpet stains—Ink—can use ammonia on spots. Talc or cornmeal for blood. Can dissolve with ammonia.

Paint—Cornstarch film saves paint. Can wash off and replace as new finish. Will not absorb smoke.

Fruit stain—Warm water—use ammonia if needed.

Candy—Use clear warm water. If chocolate use alcohol or ammonia.

Grease spots, cloth—Soap and water. Can use gasoline or carbon tetrachloride. Work to center to avoid spreading.

Glue—dry—Can use white vinegar to remove.

Floors—Sawdust instead of sand in play box will prevent carrying sand to cut floor finish.

Walls—A piece of cloth or felt, or paper towels cut into small rectangles and placed as a pad on a board by the mirror in girls' dressing room helps protect walls from lip stick smears from fingers of girls.

Window glass—Clean old putty out. Put new bed back of glass before setting. Knead new putty to make pliable. Hold pane with glaziers points, then apply new putty. Make neat job.

Ink—from wood—Use ½ oz. oxalic acid, ½ pt. water—apply with cloth, rinse.

Ink—from marble—2 tablespoons sodium perborate in 1 pint water. Add whiting to make paste.

Iron stain from marble—Dissolve ¼ parts sodium citrate crystals in 1½ parts water, add equal part glycerine. Mix in whiting to make paste. Apply. Repeat if necessary—rinse.

Shovel—Can extend shovel handle for removing ashes from ash pit by using 1 or 1½″ gas pipe.

Tools—Keep separate hammer, saw, and hatchet if necessary to lend to teachers and pupils.

Erasers—An old bristle brush with bristles cut off to 1″ or less and nailed to board may be used as eraser cleaners.

Floors—If pupils won't clean mud off shoes, sawdust kept at the door mixes with mud and prevents it sticking to floor. Good, but cleaning shoes is better.

Floor traps—Anti-freeze or salt may prevent freezing.

Chapter 17

School Building Maintenance and Repair

THE PROBLEMS CONNECTED with school building maintenance are so numerous and cover such a wide field that it would be impossible to describe here the various tasks that need to be performed. Hence, the discussion in this chapter will be devoted primarily to the principles of maintenance, the organization of the maintenance force, and the recurrence of certain maintenance tasks. Some attempt will be made to list the major fields of maintenance and repair for public school buildings and to outline some of the general problems involved. It seems probable that more detailed instructions should be made up in the form of a separate volume or manual or in the form of job sheets. The type of detailed instructions necessary will depend in part on whether skilled or non-skilled workmen are used for many of the different repair tasks. In school administration there has always been some difficulty in determining the difference between maintenance, repairs, capital outlay, and operation. In the discussions outlined in this chapter, the word "repair" will refer primarily to the replacement of broken pieces or worn out parts, or to the mending of broken joints and connections. The term "maintenance" will cover all repairs and replacements and the general upkeep of the plant but will not include major remodeling jobs such as removing partitions to make one room out of two, or to a change in the style of the building or roof structure. The term "capital outlay" as used here will refer to remodeling tasks that change the building structure, that provide new additions, or that replace a building with a new structure. The term "operation" will refer to the daily, weekly, and monthly activities necessary to provide the heat, ventilation, sanitation, cleanliness, and attractiveness so essential to the school organization.

It is difficult to overestimate the importance of the maintenance program. For many years schools have been expanding rapidly and most of the funds that could be provided were needed for program extensions. Most schools have been limited in the funds available for operation. This was particularly true during the depression years. The maintenance program is not one that is usually backed and supported by a group of interested patrons. In addition, it usually includes tasks which can be deferred for a short period of time, so, maintenance programs are often neglected because of demands for other activities. In many cases maintenance tasks are deferred, and often the same tasks are deferred from year to year until the whole plant shows the results of neglect and the lack of suitable maintenance. The large sums of money now invested in school buildings may be dissipated too rapidly if the buildings are neglected. The lack of suitable maintenance may permit buildings to deteriorate to the point that public pride in these buildings lags. Pupil comfort and pupil safety may likewise be jeopardized through the lack of proper maintenance.

We usually think of the life of a school building as about fifty years, yet many European and some American buildings are much older. In many cases, proper care with some remodeling to replace obsolete features will add many years of useful life to these school buildings. During the last few years in one state several school buildings, each less than twenty years old and representing a total original value of several hundred thousand dollars, had to be replaced because the maintenance program had been neglected. While it is true that most school districts need to limit annual expenditures, it is also true that building neglect is oftentimes poor economy. The old proverb of "A stitch in time . . ." and that trade slogan used by one paint company of "Save the surface and you save . . ." are both applicable to school buildings. In many cases minor repairs, replacements, or improvements such as painting will prevent deterioration which might later mean replacements or a lack of service.

It is essential that some plan be followed in the maintenance program. That the program may be spread over a period of years; that funds may be made available at the proper time; that too many things will not be left undone it is desirable even in the small schools to have some regular plan of making repairs and replacements. One of the first steps in organizing the maintenance program is to determine how repairs are to be made. Several different plans are followed in various school districts. Under one plan the board hires all repair work done. In some instances the board supplies the materials and hires men by the day to make the repairs needed. This practice has not generally proved satisfactory. In many cases the men selected to do the repair work are not skilled mechanics and oftentimes there is insufficient supervision and planning of the things to be done. Another plan that is sometimes followed is for the board to let all repair work on contract. This probably has some merit over the selection of day laborers. However, most boards of education do not know how to make up detailed specifications setting forth the type of work and the quality of materials desired in the repair and maintenance program. One consequence is that bids are not comparable since the bidders do not have adequate information. Neither of these practices has proved fully desirable for the school districts.

Some school districts maintain central repair shops and have a regular force of repair men who do all of the repair work needed in the district. These men are available on call for emergency repairs in any building. When not making emergency repairs they are making other changes set up in their regular maintenance schedule. This plan has the advantage in that trained men familiar with the buildings are available at any time. This method is not practical for small school districts. During recent years the plan of having a central shop with a roving mechanic or repair man hired by the rural schools of the county has been introduced. He is provided a shop and a truck. During part of the year he may have assistants who will help him in the repair work. These men visit all buildings needing attention in order to make the necessary repairs. They are also available on call for emergency repairs. In some city districts where a central shop is maintained, the repair men working out of the general shop make only those emergency repairs that cannot be handled by the local building janitor. At other times they are used on building alterations and on heavier repair tasks.

In some districts the local building men do all of the repair work. It is often difficult for the district to obtain a man who can do all types of repair work and who is at the same time able to take care of the heating plant and to take care of the cleaning duties in the building. Probably the most satisfactory plan that has been developed is a combination of the central shop and the building janitor plan. School boards like to employ well trained men for all buildings. It is realized that there is more possibility of holding a good man if he has year round employment. If the district selects men who have some ability to handle tools and to do repair work it is possible in the smaller towns and school districts to arrange the work so that the men can help each other. In this way, it may be possible for the local school janitorial force to do all of the repair work. This is now done in many school districts. In other districts, the local janitor does most of the repair work and a special workman is called in for occasional assistance. If a competent school janitor is employed, any plan of maintenance that makes use of the local building men has some advantages. The janitor is on the job and can make repairs when needed. He has a definite interest in the building and in maintaining it in a satisfactory condition.

As stated previously, one of the first requirements of a good maintenance program is that it must be organized. Repair work should be on a schedule. The janitor on the job should keep a list showing repair and maintenance tasks that need attention. It may be desirable for him and some of the school officials to make an annual or semi-annual inspection of the building to check other repairs and improvements needed and to make arrangements for the work to be done. If the local custodians neglect plant maintenance or fail to show results for their efforts they may find that outside men are called in for this work. The janitor should remember that many of the patrons think that summer months are a vacation period for the schools. Many of the patrons do not realize that the employee who draws salary during the summer will obtain results justifying the salary paid. The janitorial force doing maintenance work should have a schedule of activities so that the time of all men may be used profitably and so that satisfactory results may be obtained. While many of the building repairs and many of the maintenance tasks will of necessity be left until summer, not too many of these tasks should be left until the vacation period.

In making up a schedule of the repair work in the system, the janitorial force should know about how often certain repair tasks will be anticipated. Some janitors have found that attention must be given more often to the care of floors, the care of stairways, the drains, roofs, and doors than to any other parts of the building. However, it is probable that painting is one of the most costly maintenance activities. Cost of maintenance will depend somewhat on the type, age, and condition of the building. In some buildings glazing or the replacement of broken glass will entail considerable cost each year.

Typical Maintenance Problems

It is not feasible to give here detailed instructions on all the repair tasks that the janitor may have to perform, likewise, it probably is not feasible to try to select a few tasks and to ignore hundreds of other problems that he must face each year. Maintenance problems do, however, fall into several general groups. In the following paragraphs attention will be given to several of the groups or types of maintenance problems. In practically every case, those maintenance tasks which may be cared for by the building janitors or by some one in the janitorial or maintenance force will be stressed. In some instances, attention will be given to the importance of repairs and of adequate maintenance in some particular part of the building.

Roof Repairs

Leaky roofs permit water to enter the building in places where it may do much damage to the finish, to the structure, and to the equipment in the building. In many cases, the janitor cannot afford to wait for roofing specialists to come to make repairs and must make the repairs when they are needed. In fact, he probably should in most cases anticipate leaks before they occur and should make it a point to prevent the leaks if possible. There are several points at which roof troubles commonly occur. The janitor should watch these points and should know what repairs are needed at each. He should know how to re-paste flashing up on the parapet wall and around ventilators and skylights. He should know how to set or reset and anchor counter flashing. He should not permit gutters and valleys to be choked with leaves, snow, or ice until water backs up over them and through the roof. Many janitors have learned how to re-level gutters and how to close broken or open joints in gutters or down spouts. Any janitor who is handy with tools can waterproof the inside of parapet walls. He can caulk the joints between the pieces of coping on top the wall. The janitor should know the composition of the roof and should have the material available that he may make repairs as needed. He should know how to slit large blisters and to paste down the pieces so that the roof covering will not be broken. Frequent attention to the roof may prevent later building damage.

Building Structure

School officials and school janitors have too often thought that after a masonry wall has been erected no further attention is needed. As a result, many walls have been neglected. The exterior walls of a building are no better or no more stable than are their component parts. Buildings settle, foundations and walls crack, making it possible for moisture to enter and accelerate the process of deterioration. Mortar in walls may deteriorate, permitting water to seep through the walls. There are three major types of masonry wall repair to which janitors must give frequent attention. In some cases he has found it necessary to dig under the wall footings and to install new footings to prevent excessive settling. In many cases, the janitors have found it advisable to repaint cracks that have appeared in masonry walls in order to prevent water seeping into the walls. The third major problem in maintaining exterior masonry walls is the prevention of seepage. Some janitors have found it advisable to dig a trench around the building and to lay farm tile to prevent excessive moisture coming through the basement and foundation walls. In other districts, janitors have removed the dirt from around the building and have coated the basement walls with a water-proofing. In some cases, the upper walls are treated with a transparent waterproofing in order to prevent moisture coming through the walls.

Many janitors find it necessary to do some concrete work around the walls. Some of them lay walks or put in curbs and gutters. Others find it necessary to mix concrete for anchoring flag poles or playground equipment, and for the resurfacing of tennis courts or play areas. It requires only a short time for the janitor that is skilled in the use of tools to learn how to mix the concrete, and how to provide the surface desired on walks and play areas. Janitors also find it necessary to make repairs to the inner structure of the building. The floor screeds next to the ground or floor joists without sufficient protection may give way and the floor may have to be relaid. Door facings may be destroyed by termites or by rotting. In a number of the school systems janitors retread wood stairs, do all rough plastering, relay floors, and finish walls at a cost to the district which is much below that usually paid for helpers hired on an hourly basis.

Care of Windows and Doors

Janitors are called on frequently to loosen tight doors or tight windows. Some of them make the mistake of attempting to plane off the door or window when other measures might be used, only to find that after the door or window has dried out, it is too lose. The janitor should know how to reset the latch or the strike in order to make proper contact. He should know how to reswing doors and how to tighten hinges. Unless the local regulations make it necessary for the janitor to call a repair man from the central shop, each janitor should be able to remove windows and to replace weight cords. Neglect or delay in caring for tasks of this type might result in pupil injury. The janitor should understand how to take window shades off the roller that they may be washed. He should be able to replace window stop nails with adjustable washers and screws that these stops may be moved as the necessity arises. One of the biggest tasks that the janitor has in the care of windows is that of glazing. It is essential that the window openings be closed. The janitor who is not able to replace the glass may nail a cardboard over the window. This practice might be accepted as a temporary measure provided the temporary measure lasts only a few hours. It is essential that the janitor know how to replace glass. He should know how to soften the putty, how to prime the wood so that the putty will not dry out too rapidly, how to lay a bed of putty before the glass is installed, and how to hold the glass in place while applying the last putty. Most janitors realize the hazards that might arise from broken glass in doors and cases. As a consequence, most janitors attempt to keep glass tight in these places. Glass in doors is usually fastened with a wood moulding and it is comparatively easy for the janitor to set these mouldings so that they fit snugly against the glass.

Janitors often neglect the building hardware. Panic bolts fail to operate freely. Door checks have lost their tension. Door holders fail to catch or lock and are not easy to operate. The janitor should understand that building hardware is placed in the building to provide service. Door checks should permit the door to close rapidly until the door is nearly closed, and then close slowly without slamming. Panic bolts which are developed for the purpose of permitting free and easy egress fail to satisfy this purpose if the panic bolts stick or do not work freely. While it is not possible to outline here each of the steps necessary in adjusting building hardware, the building janitor should understand that this is one of his tasks. In a few school districts, extra checks are purchased and when one is out of commission it is taken off and sent to the general shop or to one of the janitors who is skilled in this type of work. He repairs the check and has it ready for use when needed. If all of the checks in the system are of the same make, he may not need to return the check to the building from which it came. It requires little attention on the part of the janitor to learn how to care for building hardware. He should take the time required to study the problem.

Electric Service Maintenance

There is no general agreement on the amount of electric service repair work that should be done by the janitor. School janitors often find that if they do not make the repairs, replacements, and extensions necessary, that pupils and teachers with no electrical training may attempt to make them. The janitor who is careful and handy with tools can make a number of repairs on the electric service system. He may be able to repair and to adjust clocks, bells, and signals. He should make all fuse and lamp replacements in the building. He should know how to blow the dirt out of motors and how to clean motors and fans. Janitors can learn from the local electric service men how to make wire splices, how to make extension cords and fuse testers, how to repair and install lamp sockets, and how to make trouble lamps. While it does not seem desirable for all janitors to attempt to make extensive electric repairs, it is possible for each man to make some repairs and to make frequent inspections to determine what repairs are needed.

Heating Plant Maintenance

Many modern school buildings have as a part of the heating and ventilating systems, complicated engines and machinery that would have puzzled the old time janitor. Some of these machines are delicately balanced and do not give the best service unless given proper attention. Many parts of the plant may have automatic devices to provide definite mechanical controls. However, the present day janitor has learned that even with these newer systems much personal attention is needed. Heating and ventilation system regulation must be constant and the janitor cannot always call a repair man when something goes wrong. He must be able to make immediate repairs and adjustments on pumps and radiator traps, and in the replacement of broken water glass. He should be able to clean air filters and oil strainers. He should be able to replace fan belts, pump valves, and gaskets. He should be able to pack valve stems and to reseat leaky valves. At times he may find it necessary to plug, temporarily, leaky tubes, to rebuild fire walls, install new grates, or to replace fire box baffles or linings. He should be able to replace insulation on pipes and on the furnace. He will have occasion to replace boiler flues, to adjust ventilating duct dampers, or to repair cracks in the furnace. Where the electric current is uncertain the janitor may find it necessary to install a by-pass around the pump. At other times radiators or steam lines must be resloped.

It is not probable that the janitor can make all of the repairs and replacements needed to maintain the heating system. The janitorial force in many school districts do reset hot air furnaces, install bleeders on steam lines, and do all other ordinary repair work. However, unless some of the janitors have enough training to enable them to supervise the alteration program, a skilled mechanic should be employed to make all major heating and ventilating system repairs.

Plumbing Maintenance

Some of the tasks connected with the maintenance of the plumbing system recur so often that the janitor comes to think of them as a part of his operation program. The cleaning of traps and the opening of clogged stools might be termed operation. On the other hand, neglect of these duties might call for a maintenance or repair job. Many things can happen that make it essential for the janitor to know how to make plumbing repairs immediately. It is poor economy for the janitor to permit waste of water through leaky valves because of neglect in replacing valve washers or fuller balls. The capable school janitor should be able to make all valve replacements. He should be able to adjust needle valves and to repair self closing valves. He should be able to make temporary repairs on bursted pipes or to place clamps around bursted hose. It is essential that he know how to replace parts in flushometer valves or in flushing tanks. He should be able to adjust the float control in lever or automatic flushing tanks. He should be able to open closed drains and sewer lines with a plunger, the wire auger, or the suction pump. If necessary, he should be able to take up and relay certain sewer lines. It is sometimes necessary for him to take up and reset stools and urinals. He should understand something of the types of piping used in toilet rooms and should know the types of wrenches or clamps to use on each. During cold weather the janitor may find it necessary to thaw frozen pipes and traps. At other times he may find it necessary to use an anti-freeze of some type in exposed traps. He is frequently called on to adjust fountain valves or to replace broken toilet seats. The capable janitor will be able to maintain plumbing service in good working order without excessive cost to the district.

Painting

Since painting is one of the major tasks of school plant maintenance and since it is one of the tasks most commonly done by the regular janitorial force, it seems desirable to give some attention to the principles and problems involved in schoolhouse painting. Many school districts do not have a schedule showing when certain rooms should be repainted. Those which do not have a schedule seem to practice repainting exterior surfaces about every three to five years. Those schools having a schedule seem to repaint interior surfaces at about three to six year intervals. Of course, the frequency of repainting will depend to a considerable extent upon the use, the exposure, the location of the building, and the type of paint used. Many school districts now practice painting interior surfaces and immediately covering the job with a coat of starch. Then at the end of a certain period of time, often two years, the starch coat is washed off and a fresh coat of paint remains. Other school janitors make it a practice to paint a part of the building each year. Some of them then wash the paint every first or second year, depending on the amount of dirt, and repaint after two washings. If the janitor is to handle his painting program in an economical and sensible manner, it is desirable that he know something about paint and something about the method of handling paint. He should know the difference between water mixed paints and oil paints. He should understand that the paint is usually made up of pigment and of a vehicle or liquid which contains the drying oils and the thinners. The amount of dryer determines the speed at which the paint dries. He should know the characteristics desired in an exterior paint. It should not soil too readily; it should have a good tint retention. When oil paint gives away, it should fail by slow, even chalking, leaving a good surface for repainting. Paints that check, scale, and alligator do not leave a good surface for repainting, and it may be necessary to remove old paints before new coats are applied. It is desirable that the janitor have some knowledge of the difference between lead, zinc, and lithopone paints. For interior paints, it is desirable to have a surfacing material that will stand washing and which will provide the attractive surface desired. It should provide the reflection factor desired for school use without excessive gloss. It should provide in schoolrooms a wall surface with a reflection factor of from thirty to fifty per cent and a ceiling reflection of not less than seventy per cent of the light which hits it.

Usually it is not desirable to paint over masonry until the walls have thoroughly cured and until the mortar and other mixtures used in preparing the wall have become chemically stable. Any moisture that is in the wall will come to the surface and it may lossen the paint film when it reaches the painted surface. It is easy to test wall alkalinity (hot spots) with a mixture of one dram of phenol-phthalein and four ounces of grain alcohol. Alkaline mortar will show a bright tint when touched with this mixture. If the moisture has been taken from the wall, the wall alkalinity may be neutralized by a washing of zinc sulphate and water applied with a brush. At times the janitor will find paint peeling from knots in wood. He can overcome this by giving the knot a treatment of shellac or other substance that prevents bleeding from the knot through the paint. New paint should not be applied over old paint covered with blisters. In general, new paint should not be applied over old paint that is badly checked and cracked. Old paint that is chalked and dusted to an even texture may have new paint applied after brushing off the loose powdered paint. In general, light colored paint does not fully cover up older dark paints unless several coats are applied.

Furniture and Equipment Maintenance

The janitor is frequently requested to make repairs on school room equipment. Seats get loose or parts are broken. In many cases, he may be able to replace broken parts with a piece taken from his supply of parts from dismantled seats. He may need to sandpaper chair legs to remove rough spots harmful to clothing. Movable chairs should be equipped with gliders. Loose chair legs should be tightened, and loose seats should be made secure. Opera chairs and other fixed seats on masonry floors may need to be reset. The janitor should be able to make all of these repairs. He should also be able to plane and sand rough spots off desks. If desk tops are loose he should reglue the parts. He should be able to apply acid proof coatings to laboratory tables, to resurface, and refinish table tops. The janitor who can maintain all school room furniture in an attractive condition ready for use is a real asset to the school system.

Miscellaneous Maintenance and Repair Tasks

In addition to the repair and maintenance tasks listed in the previous paragraphs the janitor will find many others that should be done. In most cases if he does not make the improvements, they will not be made. While it is not possible to describe the procedure to follow in making these improvements, some of the yard and playground maintenance problems, tool repairs and replacements, and other miscellaneous repairs will be listed.

The janitor usually has the responsibility of caring for the playground and the playground equipment. He erects fences and barriers. He often has to set anchors and posts for giant strides and other fixed equipment. He can remove stones from around horizontal bars and ladders. He removes old stumps, and places shields on teeter boards. In some instances he paves or resurfaces a part of the playground.

If the school has a work shop and suitable tools some member of the janitorial force may be assigned the task of making and installing storm doors and window screens, or of making track hurdles. Many janitors sand or resurface slate blackboards. Others make shelves, window boxes, and storage cases for room and closet use. In one school visited recently the janitors had made library tables, stage reading desks, and sand (saw dust) tables. The janitor should be able to reglue loose asphalt tile or linoleum floors. In many cases these items are not included when the building is erected. If the janitorial and maintenance force cannot make them they often are not provided. It is not anticipated that every janitor be a cabinet maker. However, many schools are now selecting men who are sufficiently skilled in the use of tools to make simple pieces of equipment.

Making Tools

In many cases the janitor has need for tools that are not provided by the school. In some instances these tools can be purchased more cheaply than the janitor can make them. If the tools are not provided the ingenious janitor often finds a way to make them. Oftentimes he can make some of these tools from scrap material that would otherwise be wasted. In a few cases, he can make tools that fit his need better than do those he can purchase. Below is given a partial listing of some of the tools that are made by some janitors. Many janitors make their own window jacks out of 2″ x 4″ and 1″ x 6″ lumber. While these are often heavier than the ones purchased they do answer the purpose. Other janitors install hooks for window straps. Some janitors make their own ladders and step ladders. They also make nonslip feet for these ladders.

Most janitors know how to make a mop pail screen out of hardware screen, and a mop pail scooter from scrap wood or tin and some small casters. Some men make grass trimmers for the edges of walks, and walk scrapers from a garden hoe. Some men make their own snow shovels if none are provided. Practically all janitors replace broken handles in hammers and other tools. A few men have spliced shovel handles to enable them to clean the back of the ash pit with ease. Coal trucks for use in bringing coal to the furnace, or dump coal trucks for transporting coal to the stoker hopper may be made on the job. Foot scrapers, concrete tampers, miter boxes, and eraser cleaners can be made by almost any janitor. The janitor who can sharpen his own saws or lawn mowers will find this task easier than that of using a dull tool. It is not expected that the janitor will or should make all of these tools but, in many instances, it is better for him to make them than attempt to do without them.

The various repair and maintenance tasks listed in the preceding paragraphs are only a part of those performed in a satisfactory manner by many janitors. The methods used vary as do the results obtained. It is probable that the janitor should not attempt tasks for which he does not have tools or the necessary skill. Poorly done work is often not economical. However, many janitors neglect maintenance and repair tasks that they can do. The janitor that does not have and will not develop the ability to do ordinary maintenance and repair jobs around his building may not be able to justify summer employment. He may be replaced by a man who does not neglect the building, or who does not need to call for outside help for minor repair jobs. It is understood that in some districts local regulations, city ordinances, or labor conditions make it advisable for him not to attempt certain repair or replacement tasks. In other districts all major repairs are cared for by a repair squad. Even in these districts the janitor is usually permitted to make many minor repairs and replacements.

Tools

If the janitor is to maintain his plant in an acceptable manner he should have the necessary tools. Some of the tools that may be needed are listed here:

- axe
- blow torch
- brace and bit set (wood and metal)
- carpenters pencil
- crow bar
- chisels—cold
- chisels—wood
- drawing knife
- files
  - 8″
  - 3 cornered
- funnel
- gimlet
- glass gutters
- hammers
  - ball pein
  - claw
  - stake or post
- hatchet
- hose
- knives
  - wood heavy
  - jack
- ladders
  - extension
  - step
- lawn mower
- lawn roller
- level—spirit
- nail set
- oil can
- paint brushes
- paper fork
- pick
- planes
  - smoothing
- pliers
- plumber's friend
- pump
  - pressure
  - suction
- punch
- putty knife
- reamer
- rulers and tapes
  - folding
  - steel square
  - "T" square
  - tape 50′
- sander
- saws
  - cross cut (hand)
  - hack
  - rip
- screw drivers
- shovels
  - No. 2
  - snow
  - spade
- soldering iron
- tin snips
- trowels
  - plasters
  - masons
- trouble lamp
- valve seating tool
- vise
- wheelbarrow
- window jack
- wire cutters
- wrecking bar
- wrenches
  - monkey
  - "S" set
  - stillson

Not all of these tools will be required by each janitor, but a majority of them should be available for a complete maintenance program. These tools should be owned by the district. The janitor should be held responsible for their condition and preservation. He should provide a suitable case for them and should replace them each time after using. Many janitors paint the background of a hanger case with a diagram the shape and size of each tool to be hung on pegs. The tools are then put in a certain place each time they are stored. A hasty glance shows which tools are missing. As stated elsewhere, other tools may be provided for teacher and pupil use.

Maintenance Supplies

The janitor should have available supplies that are used often and which may be needed at any time. He should dismantle old seats and store the parts. Large sheets of glass should be saved to be cut and used later. Supplies should be sorted and stored in suitable boxes or containers. It is desirable to provide a case with some open pigeon holes and some drawers for supplies. Some of the supplies often needed are:

bolts—carriage	nails—assorted	tubing—copper
bolts—stove	plastic wood	tubing—rubber
candles	sand paper	washers
glue	screws—assorted	wicking
gummed tape	solder	wire—copper
heavy cord	sponges	wire—iron

Chapter 18

Improving Janitorial Service

THE IMPROVEMENT OF janitorial service has not kept pace with the improvements made in the types of school buildings or in the teaching methods. Many factors have contributed to this lack of improvement. There have been no generally accepted standards of janitorial maintenance. In a few cases a man has been retained on the job many years because he was considered a good fellow but without rendering adequate service. Some of these men would have been willing to do a better job if they had known what was expected of them. On the other hand a lack of tenure has been a factor in the slow rate of improvement. Lacking adequate measures of proficiency men of ability found less incentive for improvement. At the end of each year some of them had to compete with untrained men on a price basis in order to retain their jobs.

During these "dark ages," (dark floors, dingy walls, and grimy windows,) the school officials repeatedly expressed a desire for better building service. However, they, like the janitors, did not know how to set up proper standards, or to secure the service desired. The last fifteen or twenty years have brought a great change in janitorial work. Trained men are being employed and retained on the job. The program of work is outlined to give employment for the full twelve months of the year. Prospective janitors as well as those now employed are encouraged to make a study of the tasks to be done.

Training for Janitorial Service

The older practice of learning by a trial and error method was slow, inefficient, and costly. The modern school building has in it costly and intricate machinery, as well as finishes that might be injured by some blunder by untrained men. The janitor plays such an important part in protecting the health and lives of the children that useless experimentation should not be permitted. The logical conclusion is that competent men must be trained for the job. Those now employed who can and will take training should be given an opportunity to secure such training. Those who will not train for the job should be replaced by men who will qualify.

Training Methods

Several methods have been tried in an attempt to improve janitorial training. One method that has found favor in the larger school systems is apprenticeship training. When a new man is selected he is required to serve as a helper with experienced janitors. He may work under the direction of several men before being placed in charge of a building. This system of training has proved to be more practical in schools where the men are given an opportunity to meet occasionally to discuss their problems.

Evening Schools

In some districts evening schools are conducted for all janitors. Many of the janitors are required to work long hours and find it difficult to attend the evening sessions. In many cases evening activities in the school buildings are held at the same time the janitor classes are scheduled. The evening classes have at times been directed by instructors not skilled in janitorial work. The short time allotted for the classes has often prevented an exchange of ideas among janitors. This type of training may have value if properly directed. It has not generally proved popular with the janitors.

Part Time Schools

Probably the most popular type of janitorial program is the part time school. The men are given time off at stated periods each year when all can attend the school. This type of school overcomes to a great extent that handicap of isolation for janitors. Many janitors and administrators now realize that most janitors work in buildings where they have little opportunity to confer and to discuss problems with other men having similar problems. This type of school where all men assemble for several days in training classes not only provides training in technique but also aids in building a desirable morale and a pride in the job. Most training schools of this type are conducted during the summer months when all janitors may be free to attend. Some city districts hold schools each year.

State and Regional Schools

During the last ten or twelve years many part time schools have been developed as regional or state schools. The Minneapolis and Colorado schools were early examples of this type. In most cases these schools are directed by some one from the state department of education or from one of the state colleges or universities. In a few states one school is held each year at some central point and regional conferences are held during the year at various points in the state. These central state schools have proved popular. In some cases 500 to 600 men attend each year. (The Iowa and Oklahoma schools are excellent examples of the central school plan.)

In at least two states (Missouri and Kansas) the state wide schools are conducted on a regional basis. At selected points in the state, schools are held each year. The regional schools probably do limit to some extent the contacts that each janitor can make with other men in the state. They may also limit the courses that may be offered unless a minimum enrollment is required in order to obtain a school. They do offer an opportunity for men to attend without having to travel to the center of the state. They also offer an opportunity for the ambitious janitor to attend more than one school each year.

Instruction and Attendance

In a majority of the schools all instructors are janitors who have been trained in the methods of teaching. This instruction is sometimes supplemented with lectures by specialists on some technical points. Classes are usually held in school buildings. In most cases the classes are small so the instructor may aid in setting up the job to be done and then have the men do it under his supervision. This practice or laboratory period is usually followed by a general discussion. The classes are open to all school janitors and others who wish to attend. In many of these schools all costs of instruction are paid from state and federal funds and there is no cost to the janitor. Many school boards give their men time off with pay while attending these schools. In fact, some school boards pay all costs of transportation and lodging for their men attending the schools. A few host schools open their cafeterias and their buildings that the men who bring cots may stay in the building if they wish. The fact that many men travel one hundred and fifty to two hundred miles to attend these schools indicates something of the interest of these men in learning more about their jobs, and the more efficient methods employed in custodial service.

Program of Study

There is still a difference of opinion concerning the type of material that should be offered. In a few training schools, basic courses in arithmetic and English are offered. In general, most training school directors have found it desirable to limit the courses to specific janitorial problems, duties, and obligations. In some of the earlier janitor schools the men were taught a little about all of their duties at each school session. The newer courses are organized on a unit basis, and are so organized that each janitor may complete one unit during each session. Some of the schools now offer one or more courses in housekeeping and floor maintenance, and one or two courses in heating and ventilation. One or two schools now offer courses in repairs, replacements, and maintenance, as well as one course in safety and fire protection.

The courses should be so outlined that the janitor may complete at least one unit at each school held. The completion of certain units should be followed by an examination and an inspection of the work done by the janitor in his building before a certificate of proficiency in these units is awarded. The courses should be so organized that the janitor may proceed from one course to another. In one state an itinerant instructor is employed to inspect the work done in the various buildings and to consult with the janitors on their problems. In another state the completion of all prescribed courses, plus inspections, and approval of local school officials leads to a "Master Janitors'," certificate of proficiency.

Evaluating the Work of the Janitor

It is difficult to make a valid evaluation of the quality of work done by the janitor. Some men do a part of their work in an excellent manner and ignore other duties or perform them in slipshod manner. Some men are on duty long hours and have such a heavy work load that some duties must be neglected. On the other hand some men have no plan of work and because of a lack of system waste much time. Some of them who spend 12 to 14 hours per day on the job could do all of their work in much less time.

During recent years a number of score cards have been developed for the rating of janitorial service. These have been of much value in calling attention to the various tasks to be done. At first their value was limited to school administrators since they were seldom placed in the hands of the janitors. Some of them were too complicated for frequent use. At the present time there is much interest in school building care and janitorial service. Janitors are making a study of their jobs. Because of these changed and improved conditions it has seemed desirable to develop a new type of check on the quality of janitorial service rendered.

In developing a method for evaluating janitorial service, it is desirable to consider the work load, the age and condition of the building, the amount of community use, and the possibility of contamination from smoke laden air and muddy yards. It is also desirable to limit the number of items to be checked. A check list should probably give more attention to results and conditions found than to methods and materials used. However, certain practices that consume time without bringing satisfactory results should receive some attention. The check list or score card should be simple in form that all checking may be done rapidly. It should be so arranged that the janitor can check his own work without having to make minute evaluations of the quality of work done. It should be so arranged and developed that it is adaptable to any building or janitor. If any particular item does not apply to that building it should be deleted without affecting the comparative score. It should be possible to fill blanks with a check (X or √) mark. Since certain conditions may be very bad the check list should provide a penalty in the form of a minus or negative score for such conditions.

The check list found on the following pages is one that is now in use. While it omits certain items, it does list many items that must be considered in evaluating janitorial service. It does provide a penalty for poor work or conditions. It calls attention to the necessity for planning the work and for certain necessary records. While it probably places too much stress on certain duties and conditions, it does place emphasis on results.

Check List of Janitorial Service

Place a check in the column that best describes the methods used, conditions found, or time used. In the first column, check items that are superior. In the second column, check items that are acceptable but are not superior. In the third column, mark with an 0 those items which do not apply to this situation. In the fourth column, check inferior work or results.

It is difficult to prepare a check list that serves as a rating scale for all janitors and all buildings. The number of items under each section does not in all cases indicate the importance of this item. On the other hand any attempt to give point value (such as 1, 2, 3, 4, etc.) may make the check list too complicated for regular use. However, several superintendents and janitors do use this check list as a score card by evaluating in the following manner. All items checked in column one are rated at *four points*. All items in column two are rated *two points*. Items in column three are not rated, and for items checked in column four deduct *three* points each. They develop a comparative per-

Check List

_______________ Town _______________ Date

_______________ Janitor _______________ Building

Load for this janitor.

Type of school __________ No. enrolled ______, No. cl. rms. ______

Types of floors, cl. rm. __________, aud. __________, libr. __________,
Corridors __________

Sq. ft. floor area for this janitor: cl. rms. ________, Corridors ______
auditorium ________, Total ________ Condition __________

Yard, area sq. ______ ________ surface material __________
Does it get muddy __________

Walks, sq. ft. __________

Plumbing fixtures, No. stools ______, urinals ______, fountains ______,
lavatories ______, sinks ______.

Blackboard, sq. ft. __________

Heating plant. Type of fuel __________, automatic feed __________,
automatic temp. reg. ________ No. of motors ________.

No. monthly night meetings in building, ______ is extra janitorial night help employed __________, total average number hours daily this janitor ______.

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
1. The janitor				
Health				
Training for job				
Dress				
Relations—teachers and administrators				
Relations—pupils				
Relations—public				
Attitude toward work				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
2. Safety and Protection				
Protects self from injury				
Exits—open for egress				
Stair—handrails, treads safe				
Corridor—no obstructions				
Building protection—theft				
Frequent inspections				
Fire hazards—reduced				
In furnace room				
In store rooms				
In attics				
In electric service				
Part in fire drill				
3. Daily cleaning				
Floors				
Tools used				
Methods of work				
Time done				
Time required				
Condition—classroom floors				
Condition—corridor floors				
Condition—special rm. floors				
Dusting				
Methods				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Frequency				
Condition of desks				
Condition of walls				
Condition, doors, cases and windows				
Toilet rooms				
Methods used				
Odors present				
Condition of plumbing fixtures				
Condition of floor, walls, ceiling				
4. Cleaning Special Rooms				
Tools used				
Condition, auditorium				
Condition, gymnasium				
Condition, offices				
Condition, shops				
Condition, dressing rooms				
5. Occasional cleaning				
Glass				
Methods used				
Frequency				
Condition windows				
Condition doors and cases				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Blackboards and erasers				
Methods used				
Frequency				
Condition of blackboard				
Condition of erasers				
Furniture cleaning				
Methods used				
Condition				
Polish				
Wall cleaning				
Methods				
Frequency				
Condition				
6. Floor Maintenance				
Floors sanded				
Floors sealed				
Surface treatment adapted to use				
Condition corridor floors				
Condition classroom floors				
Condition special room floors				
Color and sheen on floors				
7. Work Program				
Has a schedule				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Uses it				
Faculty aware of schedule				
Records				
Has supply record				
Has record of tasks done				
Has record of equipment				
Reports				
Supplies used and needed				
Of repairs made				
Of breakage or rule infractions				
8. Care of Supplies and Equipment				
Supplies				
Storage of				
Use of				
Equipment				
Storage				
Condition				
9. Yard Care				
Condition of lawns				
Condition of hedges and shrubbery				
Condition of walks				
Rubbish or paper on grounds				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Washes and gullies filled				
Condition of fences				
10. Miscellaneous duties				
Condition of window shades				
Care of flag				
Radiator cleaning				
Helps to teachers				
Care of toilet room supplies				
Care of electric service				
Fusing				
Switches protected				
Load per circuit				
Condition of lamps				
11. Repairs and Replacements				
Plumbing—valves and traps				
Furniture				
Condition of seats				
Condition of desks				
Condition of playground equipment				
Building hardware				
Condition panic bolts				
Condition door closers				
Condition locks and latches				
Building				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Condition of roof				
Condition of walls				
Leaks found				
Replacements				
Window cords				
Window glass				
Plumbing parts				
Work shop				
Storage of tools				
Condition of repair tools				
Rubbish in room				
12. Heating and Ventilation				
Furnace room				
Clean				
Tools in place				
Firing the furnace				
Methods used				
Condition of fuel bed				
Amount of fuel used				
Care of ashes				
Clinkering				
Use of dampers				
Temperature control				
Care of heating plant				
Safety measures				

	Superior	Acceptable	Not Apply in This Case	Neglected or Inferior
Condition of flues				
Condition of grates				
Condition of exterior				
Condition of pumps				
Condition of traps				
Condition of water glass				
Condition inside of boiler				
Condition breeching and chimney				
Pipe insulation				
Lines trapped—pockets				
Condition thermostats				
Care of fans and vents				
Ducts open				
Fans used				
Dust in ducts				
Humidity supplied				
Condition of motors				
Condition of air washers				
Regulation of unit heaters				
Total checks in column			0	
Total score of column	×4	×2		×3
Grand total score				

Possible score (sum of checks columns 1 and 2, minus sum of checks in column 4.) ______

centage score by dividing the total score for each man by the possible score.

This list shows a total of 133 items with a possible score of 532, divided as follows: the janitor 28 points, safety 44, cleaning 144, floor maintenance 28, work plan 36, supply and equipment care 16, yards 24, miscellaneous 36, repairs and replacements 64, heating and ventilation 112. If, in making a check of the work, 60 checks are placed in the first column, the total score for this column would be 4×60, or 240 points. Forty checks in the second column would give 2×40, or 80 points. Eighteen 0's in the third column would indicate that these items do not apply. Fifteen checks in the fourth column would give 3×15, or 45, which is to be subtracted from the sum of the scores of the first two columns. Thus 240 plus 80 gives 320. This, minus the score of 45, gives a final score of 275. If it is desired to obtain a percentage rating, multiply the number of checks in columns one, two, and four by 4 (in this case 115×4, or 460), to find the maximum possible score. Dividing the actual score (in this case 275) will give the percentage rating, which, in the example given, would be 60%.

Column	Items Checked	Score for Column	
1	60	240	
2	40	80	
3	18	0	
Total to date			320
4	15		45
Building score			275
Items checked columns 1–2–4,		115	
Possible score 460			
Percentage—275 divided by 460 equals .60			

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