Well Drilling and Latrine Construction In Rural Burma

By CLARENCE J. FELDHAKE, C.E.

BURMA'S PLANS for improving the quality of the drinking water supply began to materialize in 1952 when a hand pump tube well was drilled in one of the villages. A group of government officials, on an inspection tour in the area, viewed the well, and on the basis of their report, the Prime Minister requested that the rural well drilling project, planned at first on a modest scale, be extended to all the States in Burma.

The well drilled in Taukkyan, a village of 500 families about 20 miles northeast of the capital city of Rangoon, was the first drilled installation to be completed in Burma's new environmental sanitation program, organized and operated through the first 2 years with the assistance of public health technicians from the United States.

Before the United States sent the technical assistance mission to Burma, the Directorate of Medical and Health Services, Burma's national health agency, did not have a sanitary engineer on its staff nor environmental sanitation in its program. A division of environmental sanitation and sanitary engineering, created on the recommendation of the mission, is now established in the health agency. The rural well drilling and latrine construction project, planned with the mission's aid and initially financed with matching Union of Burma and United States funds, is proceeding under Burmese direction with funds appropriated by Burma.

But before the first well could be drilled and the first latrine constructed, the need had to be assessed, the project plans presented and approved, and an administrative agency organized. The equipment had to be assembled, part of it from the United States and part from Burma. Much of the drilling equipment had to be adapted to local geologic formations. Probably most important, a health education program had to accompany the well and latrine construction phases to obtain acceptance by the villagers.

Assessment of the Need

A survey of the general living conditions in Burma was the first step. In the spring of 1951, at the request of the Burmese Ministry

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Mr. Feldhake completed in May 1953 a 2-year assignment as chief sanitary engineer with the United States technical cooperation mission in Burma. Recently, he was assigned to a similar mission in Afghanistan with the Foreign Operations Administration, which administers all the technical assistance programs of the United States. In previous assignments, Mr. Feldhake, commissioned as a sanitary engineer in the Public Health Service Reserve Corps in 1942, has assisted in the Department of Agriculture's housing project for foreign agricultural workers in New England and the Atlantic Coast States and in Oklahoma's malaria control program. In 1948–51 he was assigned to the Bureau of Indian Affairs to assist in setting up an environmental sanitation program on the Navajo Indian reservation.

of Social Services, some 20 United States health specialists were sent to Burma to survey the health needs of the country and recommend projects. (The program was administered in turn by the Economic Cooperation Administration, the Mutual Security Agency, and the Technical Cooperation Administration. All have now been succeeded by the Foreign Operations Administration.)

The specialists visited representative cities, villages, and rural areas to survey environmental conditions, such as water supplies, sewage disposal, and public food markets, and to assess the need for such facilities as hospitals and health centers.

The environmental sanitation program is one of the four major projects that developed from the survey findings. Burma is also conducting hospital construction, malaria control, and health education programs.

The mission found that safe water supplies and municipal sewerage systems were virtually nonexistent in Burma, even in the cities.

Rangoon, with a population of about 750,000, obtained its main water supply from a large lake about 40 miles north of the city. This supply was piped into the city and was chlorinated at the point where the main pipe lines entered the system of distributing mains. Frequent tests at various places in the city at no time showed any residual chlorine.

Pressure was maintained in the system for only about 16 hours a day. Use of water stored in unsanitary tanks installed in the top floors of the better homes and office buildings and the possibility of back siphonage in the pipes from these supplies when the pressure was off created a constant health hazard.

Three or four of the next largest cities in Burma had a piped water supply in which the conditions were similar to or worse than those in Rangoon.

There were no municipal sewage treatment plants in the entire country, and Rangoon was the sole city with a sewerage system. It served, however, only about 10 percent of the population. Most of the government units, such as the hospitals and the central government buildings, and many private homes had septic tanks, with the effluent discharging into nearby ditches or streams.

In the rural areas the villages depended on shallow dug wells, ground tanks, ponds, and nearby streams for their water supplies. A few of the dug wells were capable of supplying potable water, but most of them were so poorly constructed that it was impossible to protect them from surface and underground contamination.

The alternate dry and rainy seasons in Burma increase the hazards of water supply contamination. During the monsoon from mid-May to mid-October, when the total rainfall ranges from 90 to 200 inches, there is heavy surface contamination. The dry season, from February through April, usually ends with a water shortage because of the shallowness of the dug wells and the heavy use of water from the surface tanks. Water from ponds, drying-up streams, or other surface sources is used.

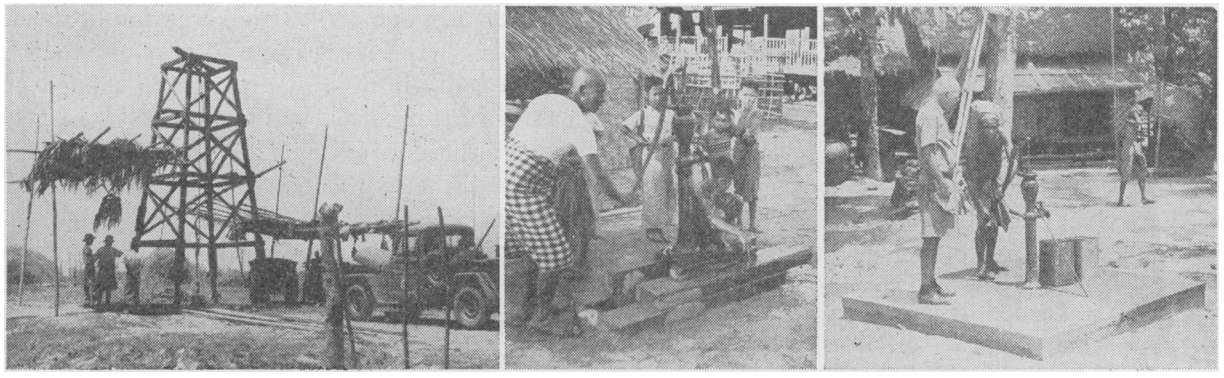
The extremely poor excreta disposal in the villages was a major factor in water contamination. In some villages, no more than 10 percent of the families had latrines—the nearby jungle being much more convenient and less trouble than the construction and maintenance of a latrine.

The mission estimated that in the rural areas about 40 percent of the children die before they reach the age of 6 years. The high mortality rate among adults from waterborne diseases, such as typhoid, diarrhea, and dysentery, also reflected the unsanitary surroundings and lack of healthful drinking water.

Organization

As a first project in environmental sanitation the mission recommended that a well drilling and latrine construction program be carried on in the rural areas of Burma. Burmese crews were to be trained in the techniques of tube well drilling and of the installation of deep well hand pumps as the wells were drilled. The villagers were to construct latrines with tools and concrete squat slabs supplied by the program.

Administering the program was the new environmental sanitation division, set up within



Left: One of the wells in Burma project in drilling stage, at this time about 230 feet deep. Drilling rig in right foreground is used for raising and lowering the jetting pipe. Shade mats on the teakwood derrick protect workmen from the sun. Center: Villagers getting water from a well before the concrete platform was installed. Right: Completed well used constantly by about 50 village families, who formerly had to carry water a quarter of a mile.

the health agency. The health education division carried on the necessary health education work connected with the well drilling and latrine project. American technical advisers headed the divisions until Burmans could be trained for the positions.

Existing governmental authorities in Burma cooperated in the rural sanitation program. The Ministries of Defense, Education, and Construction, and the Directorate of Medical Health Services were kept informed about the plans by the Ministry of Social Services, which had approved the program. In the operational phases, district officials and village headmen were consulted about details of the project and took part in the work. The 6 States of Burma are each divided into 6 to 10 districts, each with a district commissioner responsible for practically all the governmental activities in his district. Under him are various deputy district commissioners. And in each village is a headman, although one headman may act for several small villages. The headman acquires his status by right of seniority and speaks for the villagers in all matters.

Selection of Project Sites

The unsettled political conditions in some of the districts in Burma narrowed the selection of project sites. Insurgent factions were continually waging war on each other and on the Government. The districts on the eastern border were especially subject to guerrilla raids. In this state of fluid warfare the project had to be conducted within the protective range of the Union of Burma Army. Through the Ministry of Defense, the mission was kept informed about the areas in which security was being maintained and the work could be done without endangering the lives of the crewmen or the risk of property loss or damage.

The second consideration was the selection, from the safe areas, of villages in which the water supply was recognized as a health hazard.

Three districts, Insein, Hanthawaddy, and Pegu, within a radius of 50 miles of Rangoon, were chosen for survey to determine in which of the numerous villages the work should be started. There were about 40 villages in this area, ranging in size from 100 to 1,000 families.

A questionnaire was used in obtaining as much pertinent information as possible about the type and use of the water supply in the community, the number of latrines, and the morbidity and mortality rates. Among the items on the questionnaire were:

Tube wells. Number in the community, size, depth, condition, and yield.

Dug wells. Number, depth, construction, condition, protection from contamination, and distance from latrine.

Surface water supplies. Source—ground tanks, lakes, or streams—type of use, condition during dry season, and the number of families using each source.

Latrines. Number of dwellings with latrines, type, condition, and type most acceptable.

The questions on health sought information on the number of families and number of per-

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sons in the community; the number of deaths during 1950 and 1951 among infants up to 1 year and children up to 5 years of age; and the number of cholera, typhoid, diarrhea, and dysentery cases and deaths from these causes among the villagers during the same years.

Personnel from the offices of the three district commissioners made the survey, filling in the questionnaire with information they received in interviews with the local health officers and the village headmen.

Drilled wells were allocated to villages in which the data indicated high sickness and death rates attributable to waterborne diseases and lack of adequate water supplies. The information was also to be used in a future survey, after the wells had been installed and used for several years, as a base from which to determine whether the improved water supplies and excreta disposal had helped improve the health of the villagers.

Each drilled well was to supply 70 to 80 families with water for drinking and cooking. The number of wells allocated to a village was determined on this basis. Burmans use large quantities of water for personal bathing and clothes washing, and they were expected to continue to use the dug wells and surface tank supplies for these purposes and for watering livestock and for fire protection.

Typical of the villages selected were Taukkyan, in the Insein District, allotted 6 drilled wells, and Dayebo, in the Pegu District, in which 2 wells were to be drilled. Taukkyan had a high death rate from waterborne diseases, the dug wells were in poor condition, and there was a definite water shortage during the dry season. Similar conditions existed in Dayebo, a village of about 150 families, 10 miles from Taukkyan. During the dry season water had to be hauled several miles.

Eighteen additional wells were approved for villages in the Pegu District as crews became experienced and equipment available, 10 of them in Hlegu, operational headquarters for the district.

Method of Well Construction

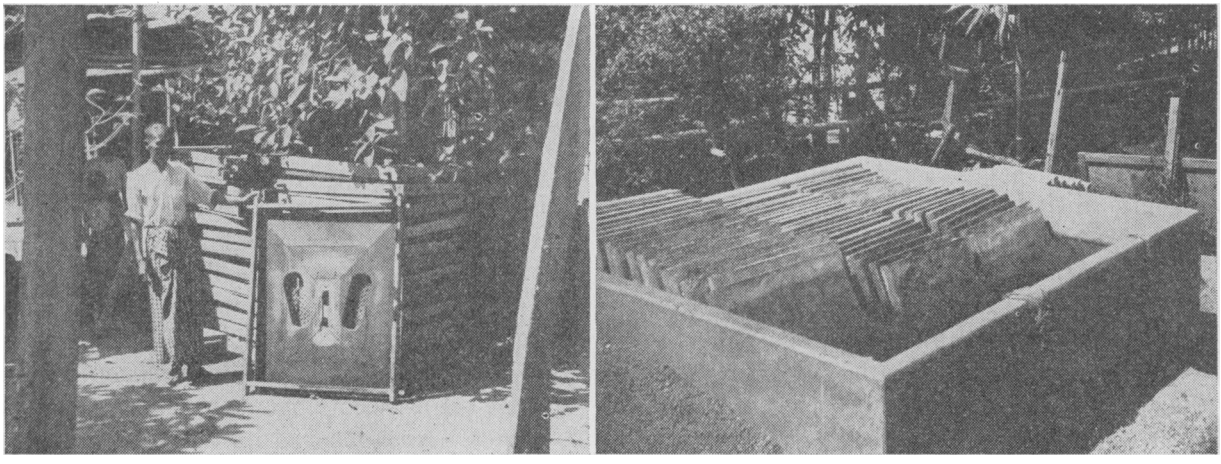
Little or no well drilling had been done previously outside of a 10-mile radius of Rangoon. In fact only one drilled well was found in the three districts surveyed—a 30-year-old well in Hlegu badly in need of repairs. Although no detailed information was available on the geologic formation of the underground strata in the area, the experience of the Rangoon well drillers, a test well at Aung San, and the general topography indicated an underlying stratum of sedimentary origin in southern and central Burma.

The 4-inch diameter, medium-depth tube well was selected for installation. This type, it was believed, would supply enough potable water for 70 to 80 families in the villages. And the jetting method of well drilling, used in Burma, was selected as the most practical and economical technique for drilling through an underground formation that had no hard rock, shale, or clay. This method follows:

A steel well casing pipe is started into the ground. Inserted into the casing is a 1½-inch to 2-inch pipe which carries water under high pressure against the formation ahead of the casing. The casing has some 400 ⅜-inch perforations in the first 5 feet and a toothed cutting edge at the head of the pipe. The jetting water pipe, which has a fishtail head and sharpened vanes, is rotated, raised, and dropped, thus loosening the material ahead of the pipe. As this material is washed up and out of the well casing, the workmen rotate the casing with chain tongs or long pipe wrenches.

Equipment used by the project for this type of drilling consisted of:

1. A wood derrick about 30 feet high. This derrick, made of teak, had to be sturdy since at times a heavy strain was placed on it to raise pipe that had become frozen in the clay strata. It was constructed so that it could be taken down easily and reassembled at a new location.
2. Two gasoline operated centrifugal water pumps. One is used for jetting enough water under great enough pressure to carry the different types of underground cuttings up and out of the casing at depths of 200 feet. The other is used to pump water to the jetting pump from the sump in which used water is collected or from an auxiliary source.
3. Two hundred feet of 1½-inch or 2-inch heavy pipe for the jetting, cut to 12-foot lengths for easier handling. Thirty-five feet of 2-inch armored hose for use in lowering pipe into the well hole.
4. Four-inch standard well casing cut to 12-foot lengths and rethreaded, with a coupling for each length. Smooth surfaced couplings are required since they offer a minimum of resistance as the well casing is forced down into the jetted hole. One of these



Left: Teakwood forms used for making the concrete squat plates in the latrine construction program. Right: Curing tank for latrine squat plates in which plates are submerged in water for 10 to 12 days after they have set for about 4 days.

couplings has cutting teeth and is used as the cutting edge of the first pipe.

5. An air compressor of about 60 to 70 cubic feet per minute capacity able to maintain a maximum pressure of 200 pounds per square inch.

6. Two hundred feet of 1-inch galvanized pipe to be used as the air induction pipe. This requires an eductor pipe. The 1-inch air pipe is given a U bend into a 2-inch pipe and the unit lowered length by length into the drilled well hole and 4-inch casing. The air under pressure rising in the pipe carries the water up out of the well. This pipe is used after the water bearing strata has been reached and the water is standing in the casing about 15 to 30 feet from the surface of the ground.

Each installation was fitted with a hand pump of the type usually installed on individual farm wells in the United States, and a concrete well platform was constructed.

The drilling rigs originally sent to Burma for the project were augering machines designed for drilling through soft rock formations and dense clay and were of little use in the area. The auger advanced through the semiliquid clay, and sand and clay, with comparative ease, but as it was withdrawn the hole filled with the material. However, some use was made of the rigs in drilling a preliminary hole and in placing and handling the casing on the derrick.

There were no supply houses in Burma which stocked the odds and ends of equipment necessary for well drilling. The cutting heads, pipe clamps, jetting nozzles, and a variety of other items had to be made in the local machine shops. Specifications were drawn up for such pieces, and the machinists were shown how to make them.

Starting as the mission did from scratch, the first well took about 3 months to complete. But during the construction of this first well, the main problems of drilling method, equipment assembly and adaptation, organization for operation, and training procedures were solved for the area. Subsequent wells could be completed in about 2 weeks.

Installation of wells in the Shan and Kachin States to the north and in the eastern area required other methods. Two heavy cable and two rotary type well drilling rigs were ordered as a start toward extending the program into such areas. The Burmese Government also expected to develop better water supplies for the larger communities and cities after the rural needs were filled. And these rigs could be used to drill large-diameter wells of 6, 8, and 10 inches, capable of yielding an adequate water supply for a larger population.

Training of Crews

The first crew consisted of the foreman and 8 workers, all Burmans, who had some experience with the method of tube well drilling used in the area. Working with this crew was a secondary crew of 8 men who were to be trained in the proper use of the machinery and equipment. When the second crew obtained enough experience to work independently of the first

crew, it was equipped for drilling and assigned to a well project. Each experienced crew was assigned 8 more workmen to train. As the new crews became proficient in the work, usually during the drilling of 3 to 4 wells, they in turn were outfitted and assigned to drilling jobs in other localities.

Supervising the drilling operations in the field were the chief well driller and three assistant well drillers. It was also their job to keep the crews supplied with equipment for drilling and for the installation of pumps as the wells were completed.

The equipment for each crew included:

1 heavy truck; 1 pickup truck; 1 air compressor, serving 3 crews; 2 jetting gasoline operated centrifugal water pumps or displacement pumps; and miscellaneous items such as wrenches, jetting nozzles, swivel heads, water hose, air hose, and pipe clamps.

By May 1953, 4 completely outfitted crews were drilling and 4 crews were in training. The objective of the program was to have 25 completely trained and equipped crews working in the field. Enough equipment had been ordered to outfit that number of crews within the following year.

Latrine Construction

Proper excreta disposal necessarily accompanies a safe water supply. The existing sanitary conditions observed and the information obtained from the survey questionnaire made it evident that disposal of human excreta was going to be a major sanitation problem. Surveys of the various villages had shown that the bored hole latrine was acceptable, but the villages had few bored hole or pit latrines. The earlier construction of a model latrine in some of the villages had little or no effect in inducing the other villagers in the same community to construct their own units.

It was essential that the environmental sanitation division conduct a latrine construction program simultaneously with well drilling if the program was to have a widespread effect in the control of disease.

The bored hole type of latrine was selected for installation. The latrine holes, about 20 feet deep, were bored with 16-inch augers. The reinforced concrete slab squat plate, designed for the project, was similar to the type of plate being used throughout Burma and in the rural sanitation work in India, Iran, and other countries. The slab, generally 2½ feet wide by 3 feet long by 2½ inches thick, sloped toward a 4-inch by 14-inch slot at the center. Two raised foot plates were properly located.

The villagers drilled the holes under the supervision of a district sanitarian or other person trained in the work so that the latrines were properly constructed and located. The augers were lent them by the rural sanitation agency and the project contributed the squat plates.

Funds were approved by the Burmese Government for the labor and materials used in the latrine project. A crew was hired to make the squat plates, and the necessary cement, sand, gravel, and reinforcing mesh were provided. Four carpenters were hired to make the forms used in casting the plates. Since it would require 4 to 5 days for the concrete to harden in the forms, 100 forms were needed to produce 25 plates each working day.

As the program progressed manufacturing facilities were enlarged to increase production of the plates, and 300 standard latrine augers were ordered to supplement the 100 on hand.

By May 1953, about 1,500 plates had been completed and several hundred more would be ready for delivery after a 2-week curing period. Eight hundred latrines had been constructed.

Health Education Program

Acceptance by the villagers of a sanitary type of latrine and cooperation in its construction, maintenance, and proper use was necessary to the program. To insure this cooperation, a rural sanitation and health education program was conducted in each of the villages in which the wells were being drilled.

Arrangements for the program were made by the health education division, and a representative of the division was assigned to the project.

The Mass Education Organization, set up by the Ministry of Education in Burma to promote better living conditions among the rural population, was instrumental in assisting the health education division with the work among the villagers.

In each village where the wells were to be drilled, the health educators met with the village headman and the elders to explain the purpose of the program and to point out that if the village was to obtain wells, it would be necessary for the villagers to drill the latrine holes and erect the superstructure, usually made with bamboo posts and bamboo matting. The headman and village council appointed a health and sanitation committee, made up of leading citizens in the village, to promote the project. In one village a wheelwright, who made bullock carts, a school teacher, two shopkeepers, and a midwife were on the committee. The committee members, supplied with information and placards, were able to explain the project to their fellow villagers much better and gain more support for it than could the health educators.

At general meetings of the villagers, cartoon films and flip charts showed how water is contaminated and the health benefits of pure water. A film entitled "The Tale of Two Villages" was also made during the project to demonstrate how a village could obtain a well. A public demonstration of the proper method of drilling the bored hole latrine, the mounding of dirt around the latrine, and the construction of the superstructure was an important feature of the education program.

Progress

At the time the first well was started, November 1952, the latrine manufacturing crew was also assigned to Taukkyan to make squat plates. The village headman had been informed of the plans and preliminary health talks had been given to the villagers. All of them agreed to construct latrines as fast as the squat plates were available.

During the following 3 months the 6 wells at Taukkyan and the 2 at Dayebo were completed. The latrine construction program was going ahead faster than the well drilling program. Numerous villages in the vicinity were sending delegations to obtain squat plates with the agreement that they would construct proper latrines throughout their villages. Every effort was made to meet these requests, even for villages in which no drilled wells were planned.

After completion of the first well, the Prime Minister formed a Rural Water Supply and Environmental Sanitation Board to plan for the extension of the rural well drilling and latrine construction program to all of Burma. Members of the board were the Ministers of Social Services, Education, Defense, Housing, and Finance, the Director of the Mass Education Organization, and the Technical Cooperation Administration medical chief and chief sanitary engineer.

At the May 1953 meeting of the board, it was announced that the cabinet had approved the revised program plans. An appropriation of 1,500,000 rupees ($315,000) from the Burmese treasury, not from counterpart funds, had been approved. And 500,000 rupees ($105,000) had been deposited for continuing the program.

Venereal Disease Conference for Nurses

A working conference for nurses on the public health aspects of venereal disease control will be held May 10–15, 1954, in Chapel Hill, N. C., under the sponsorship of the University of California School of Public Health, the North Carolina State Board of Health, and the Public Health Service.

The purpose of the conference is to provide current information related to the changing concepts and newer developments in venereal disease control. It is open to public health nurses, supervisors, and instructors in schools of nursing in the southeastern United States. For further information regarding applications and costs, contact the director of public health nursing in your State health department. A limited number of scholarships are available. All applications must be in by May 1.