means of increasing worker productivity so that higher wages can be paid and as a means of getting the work done with a smaller labor force. A part, at least, of the difference between the level of mechanization here and abroad is explained by differences in wage rates. As wages go up, it pays to use more machines and fewer men.

In recent years, for example, it took about 67 gallons of milk to pay for a week's hired labor on a midwestern farm, but only 39 gallons were needed for a week's labor in the eastern counties of England. Two tons of beets or 7.5 hundredweights of grain would pay for a week’s labor in the United States, compared with 1 ton and 3.75 hundredweights in England. These differences in the real cost of labor are reflected in differences in mechanization in the two countries.

The third economic factor has been the price of land. Although land values have been rising, land was still cheap enough in 1960 so that it could be left idle if it were not adapted to mechanized farming.

Large acreages of former cropland are now in trees, brush, or weeds. Cropland used for crops in the Northeast has declined from 23 million to 15 million acres, and in the Southern States from 116 million acres to 98 million. These lands are mainly stony, hilly, or not worth draining and poorly adapted to a machine agriculture. Vestiges of arable hill-farming remain, but commercial crop farming is moving rapidly toward the flatlands.

As crop production has moved out of the hills, the organization of hill-farms has been disrupted. Farmsteads have been abandoned and land has been left idle. Improved machinery for grassland renovation and management, together with cheap fencing and livestock facilities, might make it economical to develop livestock farms in these areas.

We need to have greater flexibility built into our farm structures so that farmers can take advantage of changing economic conditions without incurring heavy obsolescence costs. Perhaps buildings could more often be designed in modular or building-block units, to be taken apart and remodeled as needed.

The peculiar equipment needs of part-time farmers should be taken into account. Their places usually are small; equipment therefore should be adapted to small acreages. But they tend to value their time at off-farm wage rates; equipment capacity therefore should be high. Since the total amount of work done in a year is low, investment in machinery and structures must be kept down. These contradictory needs suggest that special study should be made of kinds of equipment and buildings that would come nearest to meeting requirements of part-time farmers. There are about one half-million part-time farmers, and improvement in their facilities would be worth while.

Work Simplification

Lowell S. Hardin

Work SIMPLIFICATION is the systematic development and use of easier, quicker, and more economical ways to do jobs. We study and improve our methods of working to get more and better work done in less time and with less effort.

The approach is simple: We want to eliminate unnecessary work. We simplify the motions of hands and body that are used in doing necessary work. We arrange convenient work areas and locations of materials. We try to use our equipment more fully and improve on its adequacy and suitability. We organize the routine so that machines and men are used effectively.
Work simplification has a place in the operation of a farm, factory, store, office, home—wherever human energy is used.

Efficient production involves two types of decisions.

The first includes the “what-to-do” decisions—what crops, what kinds of livestock, what feed, what fertilizer. The what decisions require understanding of scientific principles of production and business organization.

The second kind we call “how-to-do-it” decisions. They involve practices and operations. Most of us see wasted land, building, or storage space. Are wasted time, energy, and labor just as apparent?

Some persons spend most of their managing time studying what to do. They take the how for granted. Sooner or later, however, we are forced to think of how we do jobs. Work simplification suggests an early, orderly approach to the how decisions.

Robert M. Carter published one of the early and important work simplification studies as Vermont Agricultural Experiment Station Bulletin 503 in 1943. It was made before milking parlors were developed, but it has a lesson for us.

The Vermont farmer in Dr. Carter’s study had 22 dairy cows. He was already above average in efficiency. After 4 months of study and a change of chore routines and minor revisions in building and equipment, they showed this progress: The daily chore time had been reduced from 5 hours, 44 minutes to 3 hours, 39 minutes. The saving was 2 hours, 5 minutes a day. The walking was reduced from 3.25 miles to 1.25 miles—a saving of 2 miles a day. The saving of 760 man-hours and 730 miles of walking in a year was made at a cash cost of less than 50 dollars.

Four kinds of changes were made on the farm. The stable was rearranged. Tools and supplies were put in more convenient places. Needed small equipment—shovels, forks, feed carts—was provided. Work routines and methods were improved. Jobs were combined.

A new 4-minute milking routine was established.

The example shows what we can do with thoughtful action without spending much money. Labor and travel might have been further reduced by building a new barn or erecting a new milking parlor. At the time, the dairymen started with a stanchion barn arrangement and continued with a stanchion arrangement. His was not yet the ultimate in efficiency. It was, however, substantially improved, and work simplification had become a part of his thinking.

Savings thus may be made in time and in energy. They may be in quality of work and in total cost. Studies in agriculture show that most jobs can be done easier, faster, and more economically—if we want to give them serious analysis.

Systematic application of work simplification to industrial jobs has been going on a long time. Many firms have established motion and time departments.

Time study goes back to the work of Frederick W. Taylor, who in 1881 originated it as an aid in improving methods. He used a stopwatch, a keen eye, and his active mind and imagination to make important contributions.

His analysis of shoveling at the Bethlehem Steel Works in 1898 illustrates his use of time studies. Workers used their own shovels to lift 3.5 to 38 pounds per shovel load. Taylor’s research showed that 21.5 pounds on a shovel enabled a man to handle a maximum tonnage per day. Shovels were designed of the proper size to accommodate this load. Methods were prescribed. Wage incentive plans were developed. Workers did more, and their earnings rose, but the total cost of handling materials dropped.

Today we probably would move directly to a mechanical solution to such a problem of handling materials. Yet in many businesses we need to examine comparative costs of intermediate solutions that may fall short of complete mechanization.
WORK SIMPLIFICATION

While Taylor was adding the tool of time study to scientific management, pioneering work in motion study was being done by Frank B. Gilbreth and Lillian M. Gilbreth.

As employees of a building contractor, they discovered that bricklayers used three different sets of motions. One set was used for rapid work, a second for slow work, and a third to instruct someone else how to do the work.

They were challenged to discover whether any one of the three was best. They analyzed them carefully. They replanned the work place and improved the equipment. The number of motions required to lay a brick was reduced from 18 to 5. Again earnings rose as the workers’ output increased when they put the new method to work. Construction costs were lower.

Today the work of time-study and motion-study investigators is usually merged into a methods or motion and time study department that analyzes the work and time necessary to do a job.

Chore work with livestock has been especially responsive to their questioning processes. Even the work patterns in using the herringbone milking parlor, pipeline milking machine, and bulk tank on the dairy farm continue to be improved.

THE STARTING POINT in systematic analysis is observation. The necessary facts may be collected in several ways.

We usually break a job down into its parts by preparing a process chart, the key step.

Few of us know exactly how we do a job. It is easier to describe the method someone else uses than to record our own work. Important details escape us even though we do the job hundreds of times. A process chart is a step-by-step outline and description of each detail or operation involved in doing a job. It is helpful on this to record the distances that are traveled, the quantities or kinds of materials that are handled, and the time that is taken. Such a chart may follow the product or the worker step by step.

FARMERS DO NOT have a methods department on each of their operations. Some farm-supply and marketing firms have research departments, of which methods study is a part.

Alert, progressive farmers naturally believe in work simplification. The farmer’s research departments—the Department of Agriculture and the agricultural experiment stations—have spent most of their energies studying what to do, not how to do it. Young farmers have learned how to do jobs mostly from their fathers and from other farmers.

Because he recognized the need for systematic study of ways of doing farm jobs, Dean E. C. Young of Purdue University helped establish a national work simplification project in 1943. It was to deal primarily with agriculture. Agriculturalists in several research institutions learned the techniques of studying motion and time. They modified and adapted them to study and improve ways of doing farm and marketing work. Of a continuing flow of studies and results, some deal with farm production and some with processing and marketing.

You can use any ruled sheet of paper to make a process chart. Distances involved in each operation can be paced or estimated. The time should be checked. You can estimate or check weights of materials handled by sampling. Watch the job all the way through at least once before making the process chart. Then record each operation as it is done.

If you record the time, write down the consecutive time rating each time the worker shifts from one operation to the next. Make your descriptions of the operations brief. After the job is finished, go back and subtract your times to get the elapsed time per operation.

You may find a sketch of the layout of the building and work areas helpful. Once the sketch is made, you may draw in paths of travel. Some place pins in a
board on which the layout is drawn. Thread or string is used to join the pins to follow the path of travel.

Several opportunities for improvement become obvious once you understand how a job is actually done. Understanding of principles of effective work, however, prompts the key questions. It often is a good idea to see how others do similar kinds of work.

The second step involves analysis or thinking about the job as a whole now that you have described it. The thinking process, which gives us ideas for improvement, is again rather simple.

All of us do many things from habit. Some of the things that we do are not necessary. We therefore ask first whether we can eliminate or leave out some of the things that we are now doing. Livestock producers have eliminated frequent cleaning of poultry houses as they developed deep litter and roosting racks. Some livestock feeders have eliminated the hand feeding of silage by making trench silos self-feeding affairs. Someone always has to be the first to try doing a job in an easier way to see if it is a good way.

As we puzzle over the way we do the job, we discover that frequently jobs or parts of jobs can be combined. We can do two parts of a job at once. Crop farmers are ingenious in combining tools to make one trip do the work of two. Corn producers are experimenting with devices to plant corn at the same time that the field is plowed. More and more farmers operate two tractors in tandem from one set of controls. The principle here becomes one of doing two or more jobs or operations at once whenever an equally good job can be done.

If elimination or combination is not possible, we examine when the job should be done. That a job or a part of a job has always been done at a certain time of day or at a certain point in the routine does not mean that the time cannot be changed to advantage. The time when the jobs are done often determines the work required and the results accomplished. Cultivation when weeds are at the proper age for destruction may save added cultivations. Timing of spray applications may be the key to successful use of the material. Used oil will drain faster and better when a tractor is hot than when it is cold.

Chores can be organized so that another part of a job is taken up when the first part is completed. Backtracking and empty travel can be eliminated with a little head work. Even the time at which the dairy cow is milked can be adjusted to the family or work schedules.

Locations of feeds and supplies often can be changed to reduce the amount of walking and carrying.

Midwestern farmers have experimented with the grain bank idea. They deposit their grain in the local elevator. On call, the elevator man returns the grain, perhaps in a mixed ration, to the farmer’s self-feeder for the livestock. The plan changes storage and feeding practices and makes a new job for the farm-supply business. The grainman takes over certain feeding operations from the livestock farmer. The plan involves a new concept of the whole system of production, building needs, feed handling procedures, and locations of supplies. Much custom grain storage space has been constructed in our feed-producing sections. Should the quantities carried in storage under Government control be reduced, farmers and storage owners may develop further the grain bank system to use excess storage capacity.

Temporary feed storages may save miles of walking and hours of shoveling and hauling. Another way to reduce work is to keep shovels, forks, and other small tools in a definite place near the spot they are used oftentimes. People sometimes skimp on small tools. When small items of equipment are used frequently at different places, duplicates should be placed there.

Buildings and work places need to be arranged and located properly.
Almost any layout can be rearranged for greater convenience. New doors, new work centers, and revised storage areas may shorten travel and work routes.

Layout and arrangements of farmsteads are not easily changed. Changes in building interiors usually are less costly and result in more important changes in work methods than shifts in the locations of the structures themselves. One should provide for circular travel whenever possible. Uneven floors, obstructing sills, and other barriers to easy movement should be avoided.

The equipment you use may not be adequate and suitable. Young men sometimes believe all equipment their fathers installed is old fashioned—but they may not be the ones who pay the bills for the new equipment.

Equipment, however, does not need to be expensive to take hard work out of jobs. Water will run, feed will move by gravity, and rolling wheels will carry a load easier than man. Small equipment, such as carts and mechanical water systems and feed storages, often can pay for itself in labor saved.

The importance of substituting mechanical for human power is a continuing force, but that does not mean that we should have too many gadgets. Gadgets frequently prove to be places to spend time and money rather than to save it. Once you adopt key equipment, use it fully. That means keeping it in adjustment. You may need to add companion pieces or change the layout rather than acquire large machinery items themselves.

A hand job, too, can be made less tiring. Handwork has been most economical in harvesting some fruit and vegetables. For such repetitive work, small savings on each performance multiply to significant totals. Arrange hand jobs so both hands can work. Have tools or containers near at hand. Think about your own comfort and the comfort of those who work with you. It is no sin to sit, if almost as much can be accomplished by sitting as by standing.

Adjust work benches to the height of the worker. Small mechanical devices often speed such jobs as milking, hand harvesting, potato cutting, seed treating, egg cleaning, and chicken culling.

The ideas for improvement which result from using the questioning approach should be written down. You have now thought through what you are doing and why you do it that way. Questions have been raised about existing methods and procedures and why you use them.

The third step is deciding. Here we develop new routines and compare them with the present ones. We may copy good ideas, use our own good judgment, bring together ideas seen in many places, or budget a new routine we have created.

We sometimes organize the ideas for a new routine into a revised process chart. Times and distances as well as effects on quality of work can be spelled out on the new process chart alongside the old one. The aim of this step is to work out on paper or in one's mind the best possible improved method before actually trying it.

The fourth step involves action. Here we test and use the proved developments. A good idea is of little value until it is placed into use. Put to work the method described in the improved process chart. No method is so good that it cannot be further improved. Too often one change is made without giving thought to further improvement.

This thinking is typified by the farmer who kept his feed in one end of the barn and his livestock in the other end. When asked why he did not store the feed nearer the animals, he replied, "Oh, you should have seen where the feed used to be—over there across the road." He had made one improvement and thought he was finished. The search for a better method is a never-ending process.

These four steps are variations of a scientific method that suggest a way to improve—simplify—work. Principles,
however, are involved. Some of them are obvious and need no description. Yet they work for us and are worth our thought.

Here are suggestions that research workers have evolved from analyses of work simplification:

Develop a questioning attitude toward precedent as a sole guide to procedures, work methods, and equipment. View your own work as through a stranger’s eyes. Imagine that you have taken a moving picture of your work method. By seeing it there and laying it bare, you have defined the problems that give you trouble.

Go visiting. Read. Gather and compare alternatives for cost and for satisfaction. We can easily become so involved in doing our own work that we do not bring to bear on it the ideas and experiences that others would gladly share.

Take time to train yourself and to train others in good methods. Close study is often required before a best method can be recommended. Job training, even with family help, pays big dividends.

Examine carefully the present ratio of wage rates to the cost of equipment. These favor reasonable substitution of capital for labor. They do not preclude improvement of work routines within the framework of existing machinery, buildings, and work places. The key to work simplification is not necessarily the purchase of a pushbutton operation.

Select or develop equipment, forms, and procedures to fit the proper work process. Avoid building a method about a particular gadget, form, or precedent. The work method should be thought out independently of a particular machine, structure, or new piece of equipment. Once you have evolved a method that will be appropriate, efficient, and economical, the equipment and workplace should be modified or acquired to fit this process.

Examine each overall process for possible steps that may be eliminated and combined. Then determine whether each necessary step is performed where and when it is done most economically. Yes, this is emphasis on the obvious. Examine your own daily routine, however, if you doubt the tendency of people to retain habit-forming patterns beyond their time of usefulness.

Take small savings seriously. They accumulate. Much work is repetitive. Small savings accumulate to major earnings or cost reductions when multiplied by days, weeks, and years.

Make someone definitely responsible. Do not hesitate to delegate or accept delegated responsibility to do jobs and to study jobs. Work will not be simplified and management will not be improved unless someone assumes responsibility.

Insist that the system of payment you use rewards workers for quality and quantity of services rendered. It is not enough for us to get paid for merely being present on the job. Economic progress dictates that earnings be in line with productivity. This built-in incentive system helps each of us to become interested in simplifying our work and adding to the effectiveness of the project.

Remember that the most valuable of
Years ago, when the distance between the farmer and consumer was short, labor was abundant, and volumes were small, products were handled mostly by hand one item at a time. Milk moved from farm to consumer or to a milk depot, where the consumer brought his bucket to have it filled. Fruit, vegetables, poultry, and eggs were sold in like manner. As farms and their output expanded, distant markets were tapped and more handling was required. Wages rose, labor became scarcer, and the incentive for more mechanization was greater. Production tended to move into specialized areas. Farmers now produce for distant, unknown markets, but they must gear production to market requirements. Extensive facilities are needed to assemble, pack, process, store, and distribute the products to consumers. This section illustrates some aspects of modern marketing and research, which have changed greatly since the days when a farmer sold his melons from a 1907 model "High Wheeled Auto Wagon."
More than 50 million pounds of red tart cherries are marketed each year in this way: Pails filled by pickers in the orchards are trucked to a central loading place, where they are poured into tanks containing cold water. The tanks move to a receiving station, where they are transferred to bulk tank trucks, which also contain water.
Time and effort are saved when apples are put into pallet boxes in the orchard and then trucked (as in the photograph above) to the processing plant. A simple dumping arrangement empties the pallet containers at the plant. Other equipment that inverts the containers and returns them to storage also is available.
Peaches in baskets pass through a flood-type hydrocooler. Afterwards, workers select peaches of uniform size and good color and put them in cartons.
Water is removed from citrus juice in a concentrator or evaporator. Then the concentrated juice is blended with fresh juice to restore its proper flavor. It is chilled quickly. Machines like those in the picture below can fill and seal 400 cans of the concentrate a minute. The filled cans move to the freezer, where temperatures are below zero.
A belt-trough dehydrator, developed by engineers in the Department of Agriculture, reduces the moisture content of pieces of fruit and vegetables. Below, a worker loads trays of cartons of green beans into a plate freezer, in which the beans are quickly frozen.
Of the many operations performed in a sanitary, efficient, modern broiler dressing plant, one is shown in the picture above. As the chickens emerge from a washer, after they have been eviscerated, a worker clips off the neck, which is to be packed with giblets. An automatic machine (below) fills half-gallon cartons with three flavors of ice cream.
James M. Williams, Jr., an agricultural engineer in the Department of Agriculture, operates a new "flight-bar" cotton gin, which he developed. It separates cottonseed from lint six to eight times faster than conventional roller gins. In a Connecticut curing barn, leaves of tobacco of the cigar-wrapper type are hung on sticks.
Another development is a 1-day haying operation. On a farm in Ohio, hay is cut in the morning, raked in early afternoon, baled, dried in covered wagons overnight, and unloaded into the mow the next morning. Farm products are tested and inspected repeatedly at many stages. An example (below) is the electric moisture meter that determines the percentage of moisture in a rough rice sample.
Most products, as we have seen, do not move directly from the farms or processing plants to consumers. At some point they usually are stored in elevators (above) or warehouses before proceeding to market.
Farm goods are transported to market in several ways. Some go by truck. Pictured above is a refrigerated semitrailer, which hauls perishable products from the Rocky Mountain area to Chicago. Some products go by train. On an average day, 67 freight trains move into and out of Frontier Yard at Buffalo, N.Y.
Some products move by both. Piggyback truck and rail service has grown in recent years. A trailer is loaded at the warehouse and hauled by rail to its destination city, where a tractor pulls it to the door of the market or store. At least one loading and unloading operation is saved thereby. At New Orleans, La., grain is unloaded from rail cars and barges to an elevator and transferred to oceangoing ships.
Above, a city market in 1910. Below, watermelon time at the farmers' market in Cordele, Ga. Growers sell most of their melons to carlot buyers. The melons are loaded into trailer trucks and rail cars for fast shipment to market.
A grocery store in 1910; a supermarket in 1960. And so our story of farm production is almost told: This is the goal of the long chain of endeavor from farmer to consumer. But the farmer's power to produce derives not alone from his muscles, machines, land, structures, skill. At his side always to help him is a phalanx of researchers, engineers, and market specialists, whose work is exemplified in the pictures that follow.
An experimental machine, with an appropriate mechanism to feed eggs into it and remove the eggs after they are sorted, can sort 7,200 eggs an hour. A three-filter photoelectric reflectance measuring instrument (top right) measures the color of raw tomato juice. A recording shear press measures shear characteristics of farm commodities (bottom left). The horticultural spectrophotometer measures the maturity of fruit by transmitting light through the intact fruit to express the flesh color of the sample. Research engineers of the Department of Agriculture helped to develop these useful devices.
At the Agricultural Research Center at Beltsville, Md., a side-delivery rake is used to remove a heavy mulch sprayed with radioactive isotopes. Agricultural engineers and soil scientists designed this and similar tests to find ways of removing radioactive fallout from agricultural lands should the need ever arise. Below: Scientists load belt hoppers and monitor radioactive fertilizer in a fertilizer-placement experiment.
Animal responses, such as surface temperature, can be measured most easily and reliably in a laboratory, where the environment can be controlled. The picture above is of the Psychroenergetic Laboratory at the University of Missouri. The effects of air velocity on the physiological reactions of small animals are studied by means of a wind tunnel.
An evaluation of methods of improving an animal’s thermal environment must be made on some basis that is independent of the animal in order to reduce the time and effort of the evaluation. Shade materials were compared on a thermal basis to determine their relative effectiveness in reducing the radiation heat loads under them. Below: A portable bulk milk tank under test at Beltsville, Md.
Foundation and fill materials are tested in the Soil Mechanics Testing Laboratory, Albuquerque, N. Mex. Below: This Rainulator (rainfall simulator), developed by men in the Department of Agriculture and Purdue University, enables soil scientists and agricultural engineers to determine the effects of certain farm practices on soil erosion losses in just a few years instead of decades.
Scientists modified a potato planter to study effects of placing fertilizer in two bands 1 inch below potato seed and 7 inches apart. At the National Tillage Machinery Laboratory, Auburn, Ala., Carl Reaves watches what happens when a cultivating tool moves the soil. The tool (a chisel) remains stationary while the field (soil) moves. The white lines (wet facial tissues) show how the soil reacts to the tool.
With a Kelsh Plotter, a Soil Conservation Service research worker in Milwaukee, Wis., makes contour maps from air photographs. Below: An engineering drafting room, where farm machines are designed.
An experimental front-mounted corn planter is being assembled. Below: To learn the strength of the metals they use, engineers put a brittle coating on the front axle of a wagon and study the cracks that indicate stress.
Engineers prepare to drop-test a tractor front end and frame in a laboratory. Below: An experimental cucumber harvester developed at Michigan State University. The vines must be trained to form a row no wider than the pickup unit.
Agricultural engineers at the National Tillage Machinery Laboratory study the relation of soil characteristics to equipment design. A milling company maintains this 1-acre research and demonstration plant near Cayuga, N.Y. It has a unit for boars, a sow colony, farrowing house, nursery, and finishing porch.
all resources is the human resource. Not only is man the indispensable ingredient of farm or nonfarm business. He is the reason that business exists.

Each of us might well build into his approach to work a mental stop-and-go light. Such a mental light flashes red when we do a job in an ineffective, unsystematic, and wasteful fashion. It flashes caution as we think through how the job might be improved. The green light comes on when we have evolved a more effective, economical, and efficient process.

The average age of farmworkers is high. The accomplishment of younger workers is greater than that of older persons. Through simplification and mechanization, the less active farmer, however, remains productive.

In a study of 413 farmers in Indiana in 1957, those under 35 years of age had an average work output the equivalent of 32.7 productive work days a month. Those over 65 years of age had an average accomplishment about one-half as great—15.1 productive days a month. Many factors were involved, including health, size of business, and extent of mechanization.

The whole case for work simplification, however, is not in efficiency and reduction of cost. Part of it is in satisfactions—satisfactions to less active (even impaired) workers, who thereby can pursue the career and vocation of their choice.

The substitution of mechanical power and equipment for human energy continues to move forward more rapidly for crops than for livestock. Part of the explanation rests in the rigidities imposed by existing farm structures. When we make our buildings farm tools to reduce labor and costs, we do several things.

We are practicing closer confinement of livestock. Thus we move toward ever greater control of the environment and of the whole production process.

We are creating shells with flexible interiors and large, clear spans. This means that we often store supplies on ground level rather than overhead. We self-feed more. Greater use is made of concrete for feeding and storage areas. Present and future laborsaving equipment are integrated into the structure.

Nevertheless, further mechanization of chore work remains a major challenge. Automation in poultry production may well be a prototype for other classes of livestock. Processes for bulk handling of feed and forages are developing rapidly. Many farmers have eliminated “packaging and unpackaging” of hay (bales) and feed (bags).

Work simplification suggests careful analysis of alternate ways to obtain the use of the new technology. Outright purchase may be more costly than rental, custom, or exchange work.

The principles of work simplification apply also to nonfarm agriculturists—those who work in farm-supply, assembly, processing, and marketing firms. Notable successes have been achieved in simplifying the work of grain elevators, dairy plants, wholesale markets, and retail food stores. Improvements range from new checkout systems to warehouse layout and the design of new markets. Savings in marketing are important to all of us.

Sons of farmers look increasingly to nonfarm businesses for employment. The ability to analyze jobs and improve them stands people in good stead wherever they work.
The techniques of work simplification have been put to another use. Farmers suffering from heart impairments are being helped in their rehabilitation.

Research at Purdue University in energy requirements for work shows the average stress for farmwork to be moderate. Most work may be done with an energy expenditure 3 to 3.5 times the resting rate. Peak stresses, however, may be as high as 8 or 10 times that of resting. The peak stresses are most likely to trouble the cardiac patient. They are associated with such activities as lifting or carrying heavy loads; climbing, running, or chasing livestock; holding animals; and pulling or pushing heavy carts, doors, or machinery in hitching or positioning.

Most of the major physical stresses in farmwork can be reduced. Many can be eliminated.

The pace or rate at which we work is important. Some tasks, like shoveling, have built-in rest periods. We may reduce the pace to our own speed. The same is true of climbing stairs or walking up hills and in loose snow.

Easing or reducing energy requirements—while not increasing costs—is our goal. Store sacked materials on a platform level with the bed of the truck to avoid lifting. Use pressure water systems to avoid carrying. Maybe a mechanical silo unloader and feed bunk are not too costly if a large tonnage of silage is handled.

Stooping to milk cows is virtually eliminated in the two-level parlor. The cow’s udder is level with the worker’s elbow.

Some activities that use a tractor are relatively high in energy expenditure. Plowing and using a loader mounted on the front of the tractor are examples. Research suggests fitting the tractor with power steering and a comfortable seat. Power steering reduces the peak forces that must be exerted on the steering wheel. Steering shocks are also eliminated. A rough riding seat increases energy expenditure compared to a comfortable one. Modern farming demands long hours on the tractor during rush seasons. Steering and seat conveniences materially reduce driver fatigue.

In such changes as these, we attempt to ease work and increase effectiveness. We may also reduce physical stress by taking frequent short pauses to rest.

When we worked with horses, rest pauses were automatic. Now our mechanical horses need no rest. The worker, however, is not a machine. Several frequent short rest periods reduce stress more than infrequent, longer pauses involving the same total resting time.

The impaired worker, of course, will follow the advice of his physician in his rehabilitation program. The foregoing are only examples of the usefulness of the work simplification idea. Your physician has more specific suggestions. Jobs have been graded and rated according to energy requirements. You may need to avoid some jobs entirely by changing some of your what-to-do decisions. The research assures us, however, that reasonable, productive activity is often good for us.

We have seen here the diverse ways in which the work simplification idea is helpful. Early farm applications were centered about individual cases. Work methods were improved by self-analysis. This approach—observation, analysis, decision, action—is open to all of us, whatever our line of work.

Today we view work simplification in terms of the efficiency with which the labor resource is used. What-to-do as well as how-to-do-it decisions are involved. Capital labor substitution problems are continuously present. So also are the problems of training workers, their selection, and management.

The technique of analyzing and improving each job in its own setting makes a good demonstration and helps individuals to become their own job analysts. This approach, however, does not generally create a new method of doing the job.

For this reason, researchers have set
up semicontrolled situations. Experiments are conducted. Work standards are developed. If presented in detail, labor accomplishment using alternative layouts and methods may be predicted using these standards.

Such standards, however, need constant revision as new technology develops. Further, adjustments for differences among workers and in environment are difficult to make.

As an alternative to development of complete detailed time standards, Wilfred H. M. Morris of Purdue University and others have divided time requirements into fixed and variable components. This provides a tool for studying the effect of size of enterprise on labor requirements. Such data are helpful in farm planning and in budgeting alternative systems of organization and operation.

A word of caution, however: The value of time changes seasonally. An hour saved at the rush season may be worth more than a day saved when work is slack.

Technology in Homes

Earl C McCracken, Avis M. Woolrich, and Emma G. Holmes

A generation ago many of us thought farm living was substandard living. Farmhouses lacked comforts and conveniences. Farm wives had few labor-saving devices. Farm families usually were isolated.

Today things are different. Most farmers have automobiles, good roads, and communication. Farm homes commonly have the same conveniences as city homes.

We can thank technological advance-