FOREST DEVELOPMENT CORPORATION OF MAHARASHTRA LIMITED

(A Government of Maharashtra Enterprise)

No. Desk-PLN/R&M/FSC/C.R.29/24-25/1081 Dtd: 18 JUL 2024

CIRCULAR

Subject : International Labour Office (ILO) guidelines to Safety and Health in Forestry Work.

Forest Stewardship Council (FSC) has formulated its own policy and issued the guidelines regarding the Standard for India for certificate holders **(Encl: FSC-STD-IND-01-2022 EN)**. According to the point number 2.3 of the said document, the organization shall implement Health & Safety practices to protect workers from occupational safety and health hazards.

In this regard formal instructions have been already circulated vide this office letter dtd. 1st December, 2023. In continuation to that the guidelines under the heading of "GUIDE TO SAFETY & HEALTH IN FORESTRY WORK" published by the **International Labour Office, Geneva** has been reprinted and the copy of the same are enclosed herewith as **Appendix - A** for ready reference and further necessary action. Hard copy is being circulated separately.

Encl : As above

(Sanjeev Gaur)
Chief General Manager (Planning)

To,

The General Manager, Nagpur Region, Nagpur

The Regional Manager, Chandrapur Region, Chandrapur

The Divisional Managers, Forest Project Divisions,

Nagpur / Bhandara / Yawatmal / Chandrapur / Markhanda / Pranhita / Depot Div. Ballarshah

Registered Office : FDCM Bhavan, 359/B, Hingna Road, Ambazari, Nagpur - 440 036
CIN : U45200MH1974SGC017206 **PAN :** AAACF2982K **GST No.:** 27AAACF2982K1ZD
Ph. No.: 0712-2811905 **E-mail :** md@fdcm.nic.in **Website :** www.fdcm.nic.in

INTERNATIONAL LABOUR OFFICE

GUIDE TO SAFETY AND HEALTH IN FORESTRY WORK

GENEVA

Guide to Safety and Health in Forestry Work

INTERNATIONAL LABOUR OFFICE
GENEVA

First printed: 1968
Second impression: April 1969
Third impression: May 1971

Price: 10 Sw. frs.; £1; $US 2.50

PRINTED BY ATAR, GENEVA (SWITZERLAND)

FOREWORD

The International Labour Organisation's concern for the safety, health and welfare of forestry workers goes back to before the Second World War. The International Labour Conference passed a resolution dealing with these matters in 1938. After the war this concern was shared by new international organisations, and in particular the Food and Agriculture Organisation of the United Nations (FAO) and the Economic Commission for Europe (ECE). The three organisations soon began to co-operate, and the first concrete result of their co-operation was the preparation by the ILO of a law and practice report on occupational safety and health in forestry operations, which was completed in 1957. Consideration of this report led the three organisations to recommend the preparation of a code of practice or a manual on safety and health in forestry operations.

The present guide grew out of an outline made by a Study Group on Vocational Training and Prevention of Accidents in Forest Work of the FAO-ECE-ILO Joint Committee on Forest Working Techniques and Training of Forest Workers. The preparation of the draft guide itself was entrusted by the ILO to Mr. B. STREHLKE.

In his work Mr. Strehlke was assisted and guided by the Study Group of the Joint Committee, and the completed text was reviewed and revised by the Group at its Fifth and Sixth Sessions (December 1963 and August 1965). It was then circulated to the countries represented on the Joint Committee and due account was taken of their observations in the preparation of the final text. At the suggestion of the ILO more extensive treatment was accorded to conditions in tropical countries. The text was circulated to the FAO Regional Forest Offices in Africa, East Asia and Latin America, as well as to a number of logging experts working in tropical countries.

CONTENTS

PART II

Tools, Equipment, Machines, Materials

TABLES

ILLUSTRATIONS

INTRODUCTION

For the purposes of this guide forestry is taken to comprise all operations undertaken to establish or maintain forests, to harvest wood, and to transport it when harvested. Woodworking undertakings such as sawmills, pulp mills and chipboard plants are outside its scope.

Because of differences of climate, terrain and industrial development among others, forest operations are carried on in a wide variety of conditions and by a wide variety of methods in different countries. There will be little resemblance, for instance, between the logging of heavy timber in the virgin forests of the Pacific North West of the United States and the harvesting of small trees in plantations. Selective cutting at rather frequent intervals as practised in Central Europe presents far more technical difficulties than clear cutting of large areas after the crop has reached maturity. There is a great contrast between conditions in flat country and in the mountains. Methods of transport will depend on the extent to which waterways can be used. The level of local economic development and the quantity and quality of the available manpower are factors that will influence technical progress and in particular the replacement of hand tools by machines.

Nevertheless, many features of forestry work, and especially logging, are the same all over the world. Usually the workplaces are scattered and often a good way from the workers' homes; moreover, they are constantly shifting. Much of the work is seasonal, and it is hard and dangerous, for nature itself is a source of risks: lightning, fire, wild animals, snakes, poisonous plants and disease-carrying insects, etc. Such statistics as are available suggest that logging is one of the most dangerous of all occupations.

Because of its characteristics, forestry is one of the industries in which the promotion of safety is most difficult. The need for

safety does not, however, diminish with the years, for to the natural risks modern technology is adding those due to machines, electricity and even chemicals. Power saws, tractors, motor trucks and cranes are increasing in numbers, and pesticides are being increasingly used.

There are some means of promoting occupational safety and health that are universally recognised as essential in all industries. They include laws and regulations, technical standards, education and training, and, last but certainly not least, supervision and safety organisation in the individual undertakings. It is the employer who has to bear the responsibility for the day-to-day enforcement of safety principles in his undertaking, for state and other outside inspectors and advisers can at best spend only a few hours in the year there. It is with the safety activities of the individual undertaking that this guide is mainly concerned. It is hoped, however, that it will be found helpful not only by employers, supervisors and workers, but also by government agencies, safety associations, vocational training centres and all others who are working to make forestry a safer industry.

PART I

THE FOREST WORKER AND HIS ENVIRONMENT

1. Physiology of Heavy Work

Job Energy Requirements

As already pointed out, forest operations involve much heavy physical work. This is particularly true where only hand tools are used. The introduction of machines undoubtedly helps to decrease the physical effort, but there are a number of jobs where it is difficult, if not impossible, to relieve the workers from heavy physical strain.

For this reason it is useful to have an acquaintance with the physiological principles of heavy work and the ways and means of applying them to forest operations.

A worker can spend only a certain amount of energy on his work. Extensive research in different temperate countries has shown that the average daily expenditure of energy on work should not exceed approximately 2,000 kilocalories, which corresponds to an average of 4 kilocalories per minute (kcal/mn) for the average man, and 1,600 kcal/day or 3.2 kcal/mn for the average woman. For short periods these values may be exceeded provided that the excess is compensated for by sufficient rest or by lighter work.

The above figures apply to healthy workers with an average weight of about 145 lb (65 kg) for men and 120 lb (55 kg) for women. Observations and studies of workers with similar

anthropometric characteristics, although of different races, inhabiting tropical countries, indicate that more or less the same energy limits exist there.

For countries where the adult male population has only an average weight of 120 lb (55 kg) and the adult female population correspondingly less—as, for instance, in certain regions of East Asia—the permissible average daily expenditure of energy can be assumed to be lower than the values given above.

In forestry there are many operations in which this energy limit can be exceeded considerably. For instance, working with axes, hand saws or similar tools requires up to twice or three times as many kilocalories per minute as are ordinarily available. Breaks are then necessary to restore the energy balance. Light work like conditioning tools also helps to do this.

In felling and cross-cutting operations it has been found that the total energy consumption per day reaches the permissible limit or even exceeds it. Power saws help to speed up these operations and require less energy than hand saws or axes. The gain, however, is at least partly lost owing to the heavier weight the power-saw operator has to carry through the forest.

In manual planting work the situation is more favourable. Here the energy consumption per day amounts to an average of about 3 kcal/mn, which is below the limit for women. Male workers who over a certain period might have surpassed their energy limit in heavy work can compensate for this by means of planting work.

In any case, the nature of each job has to be taken into account. The driver of a machine such as a tractor, for instance, will usually not be overworked physically but may suffer from fatigue caused by vibration. In skidding operations, however, his helper may be required to pull the cable from the tractor winch over long distances on difficult ground to fasten the trees. On such a job he will consume up to five times as much energy as the tractor driver.

Table 1 shows a few examples of typical forest operations of different degrees of heaviness.

TABLE 1. EXAMPLES OF ENERGY REQUIREMENTS IN DIFFERENT FOREST OPERATIONS

Physical degree of heaviness	Kind of operation
Very high	Climbing trees Carrying loads uphill Pulling winch cable Spraying with portable power-operated machines
High	Tree felling and cross-cutting with hand and power saws Axe work Breaking up loam soil with spade Scything of weeds
Moderate	Tractor driving Crane operation Manual planting of trees
Low	Manual weeding in nurseries Maintenance of tools and equipment

As a rule, every opportunity should be seized to lighten heavy work. Mechanical appliances—for instance haul-back cables in skidding—can be a considerable help, but they are not the only means of reducing the workload. Such simple things as avoiding every unnecessary step or movement and keeping tools in good condition can save much energy. Efforts to afford relief should not be confined to the work itself: the journey from home to the working site—whether paid or not—should also be made easier. If the workers have to walk long distances the provision of motor transport can save much energy for the work itself. Felling operations in large stands should be organised in such a way that the working site is reached with the least effort.

Manual lifting and carrying of loads deserves particular attention. Workers should be relieved of these operations wherever possible. Means to this end include shortening manual skidding distances, improving the accessibility of forest stands for

animals and machines, and using carts which have either a low loading platform for stacked wood or hydraulic lifting devices. Heavy work which cannot be abolished should be done in conformity with certain physiological requirements.

Not infrequently, the worker himself will fail to devise or will even oppose measures which may help him to do his work more easily. It should be one of the main aims of vocational training to teach him how to make use of anything that will ease his job and help to keep him in good health, at the same time safeguarding high earnings and high output. This is particularly important for countries with limited food resources where as little energy as possible has to be expended on each job.

Static Work

The first necessity is, as far as possible, to avoid static work, i.e. work that does not allow the muscles to alternate frequently between contraction and relaxation. A typical example is keeping the arm stretched horizontally: the circulation of blood is hindered and as a result the arm will get tired very quickly. In dynamic work, where the muscles are relaxed at frequent intervals, the blood circulation is stimulated, and the muscles are able to work for a long time before the worker feels tired.

Static work can occur in many different forms and involve the muscles of the neck, arms, back, abdomen and legs. Cross-cutting with a power saw, for instance, is a form of static work for the arms, back and neck if the saw is not supported on the tree. Carrying loads with stretched arms—e.g. buckets—is an example of static work.

Where static work cannot be avoided, short rest periods will help to relieve strain on the muscles. Very often, however, it can be avoided altogether by simple means such as carrying buckets on yokes or by shaping machine handles so that the hands can reach them in a relaxed position.

Posture

The second necessity is the right working posture, which will help to reduce the stress on the body; the wrong posture may have serious effects on health.

Generally, the worker should always try to adopt a relaxed posture, and to use the most appropriate muscles. A twisted position and excessive strain on the joints, the back and the muscles of the abdomen should be avoided (figs. 1 and 2).

When the work has to be done in a standing position, the worker can exert more force with less fatigue if the feet are set apart and the knees slightly bent. To assist in lifting, the strong muscles of the legs should be used and the head and back kept straight. When loads are carried, the head and back should be kept straight and the load close to the vertical axis of the body. Pulling or pushing is best done with legs and arms extended and the body leaning forward.

Quite frequently certain muscles can be supported by others to reduce muscular strain. In sawing with hand saws, for instance, the load should not be carried entirely by the arm muscles but they should be supported by other muscles in a swinging movement of the whole body. A rhythmic and swinging movement in many other operations can have a similar result, as for instance in certain methods of planting. The strongest muscles should usually carry most of the strain (fig. 3).

Fairly often a job has to be done close to the ground, as in planting or tree felling. Here, too, the worker's posture is of great importance. Working in a bent position imposes considerably more static strain than working kneeling; in addition, heavy strain is imposed on the back. Work in a bent position should therefore be avoided, and squatting or kneeling should generally be preferred (fig. 4). This is especially important for women. However, if a technique combining the movement of arms, back and legs can be used, static strain can be largely reduced and a bent position may then be advisable.

Fig. 1. Planting with a hoe.
The right hand and the knee are used to lever the hoe, reducing the stress on the muscles of the back and abdomen.

Fig. 2. Portable brush-cutting machine.
1. Padded frame to support the engine. 2. Handles which can be adjusted to permit work in an upright position. 3. Cutting tool support to reduce static work.

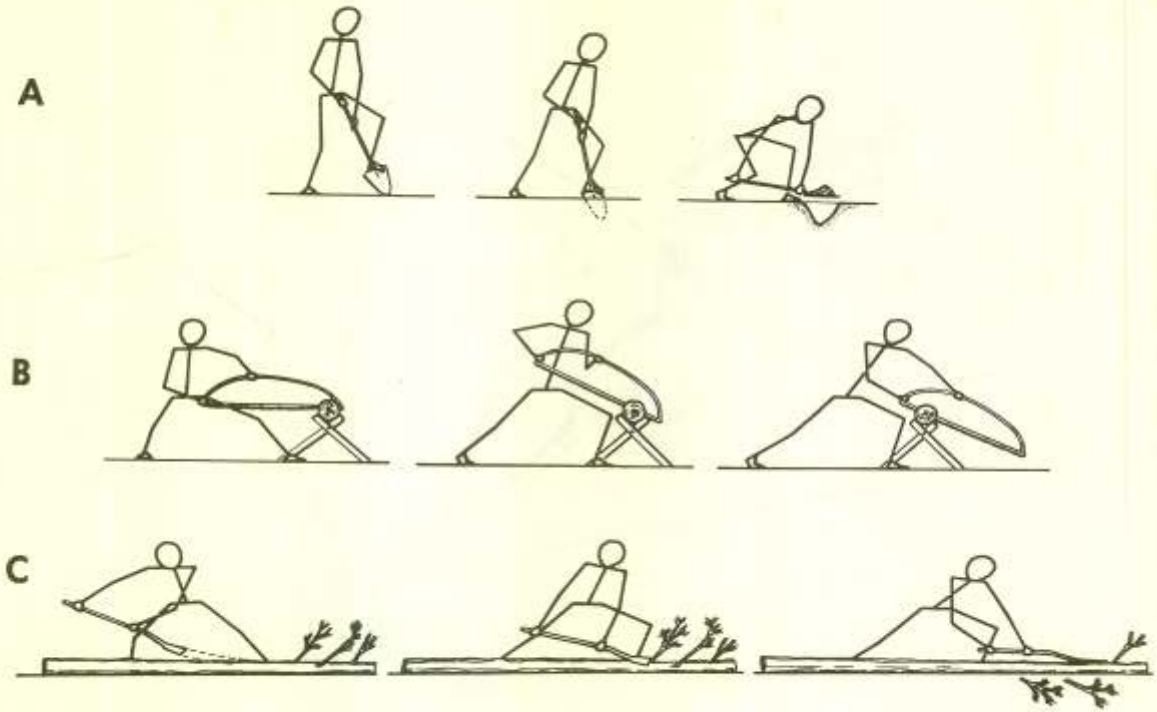

Fig. 3. Correct working positions.
A. Breaking up soil with spade. B. Cross-cutting wood with bow saw. C. Barking and branching a small tree.

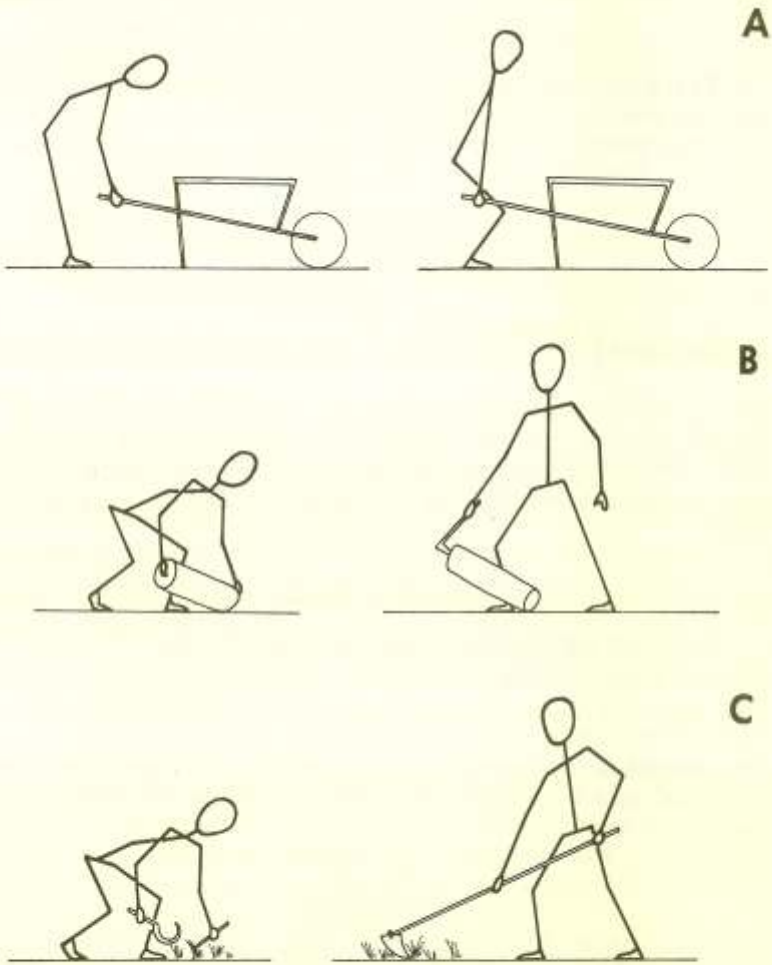

Fig. 4. How to avoid work in a bent position.
A. Lifting should be done with a straight back using the leg muscles. B. Hooks should be used for handling short lengths of wood. C. Cutting weeds is much easier with a scythe than with a sickle.

Tools

The shape and choice of tools may do much to ease the working posture. Long-handled tools instead of short-handled ones may permit work in an upright position. The use of short hooks for stacking wood will also not only make the work easier but accelerate it.

Speed of Work

Another important point is the right working speed, e.g. in manual sawing of wood or hewing with an axe. Depending on the type of work, there is always an optimum speed at which the job requires the least amount of energy. The actual working speed should be close to this optimum—neither too fast nor too slow. The experienced and skilled worker adapts himself to the right working speed, and in so doing may set an example to others.

Change of Work

Frequent alternations between heavier and lighter work occur in many forest operations, for instance when tree-felling, branching, measuring and tool-sharpening are done by the same person. This can be considered a great advantage. If a heavy job involving few changes in the working posture, or little rest time, has to be continued over a long period, it may be advisable to provide for regular changes of work.

2. Nutrition

The food consumption of a population, group of people, or individual varies greatly according to factors such as the available food supply, regional eating habits, climatic conditions and heaviness of work. Where food is provided entirely by the

employer, as in logging camps, it is possible to determine the optimum amount and composition of the food, but this will be very difficult if the worker feeds himself. The following considerations will therefore only apply to a limited extent, but vocational training should help to inculcate wholesome feeding habits.

Calorie Requirements

It has already been said that forest work is usually very heavy. In the aggregate, 2,000 kcal can be spent on the daily work of an average male worker with a body weight of 145 lb (65 kg). Since an additional 2,000-2,500 kcal are needed to maintain biological functions at rest times and out of working hours, for heavy work like tree-felling the total energy requirement amounts to approximately 4,500 kcal/day. This value can be exceeded for some time, for instance when the duration of tree-felling is restricted by climatic conditions. In some cases values of more than 7,000 kcal/day have been recorded.

The figure of 4,500 kcal is valid for a temperate climate with an average temperature of about 10° C (50° F). In a colder climate higher caloric requirements are needed to keep the body warm, but proper clothing and heating facilities can do this to a certain extent.

On the other hand, in a warmer climate caloric requirements are less, because less energy is needed to maintain body temperature at its normal level, but physical activity diminishes owing to heat stress, in particular on the circulatory system.

If the body is not supplied with the required amount of energy for a certain job, a falling off in working performance and a loss of weight can be observed.

A worker who does a heavy job and needs 4,200 kcal/day will be able to achieve 100 per cent. output if he is supplied with an amount of food equivalent to 4,200 kcal. A supply of only 3,000 kcal will lower his performance on the same job to 55 per cent. if he is to maintain his body weight (fig. 5).

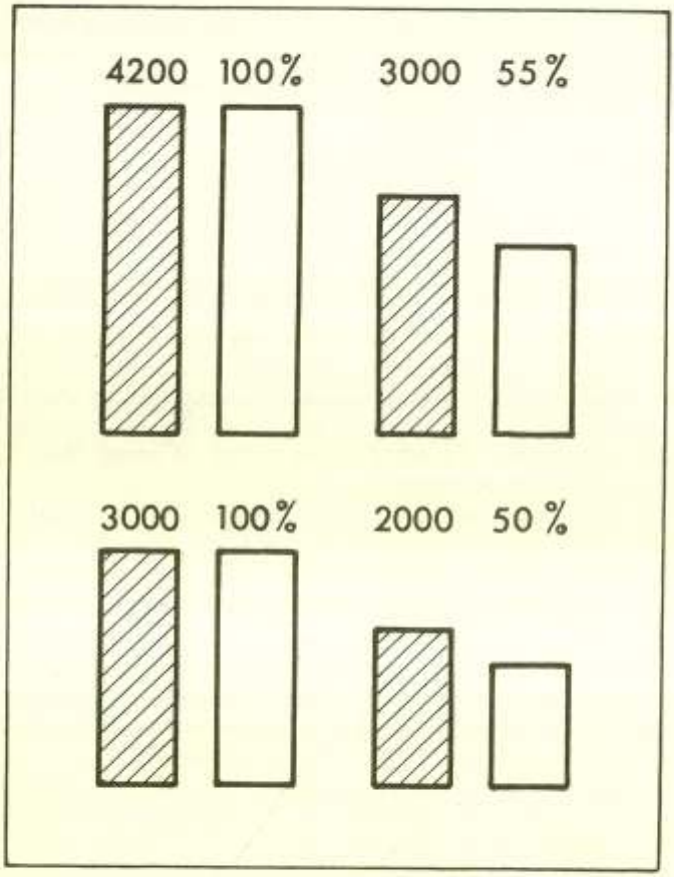

Fig. 5. Relative calorie requirements and outputs for heavy work (above) and moderately heavy work (below).

These considerations are of particular importance for developing countries, in which the average diet of the population is deficient in calories and consequently capacity for work may be considerably reduced. In a traditional way of life, an undernourished population adapts itself more or less to its low work capacity by slow movements frequently interrupted by pauses, or by shorter working hours. Thus a balance between food intake and energy expenditure is maintained.

This balance can be greatly disturbed if workers from such populations are recruited for forest operations, where the energy requirements are considerably higher. If food supplies are not improved, the increased strain on the worker will impair his working capacity and lower his resistance to disease. In such circumstances he easily tires, and for this reason may frequently interrupt his work for one or more days or give up working altogether. During work he will be more liable to have an accident than a well-fed worker whose working capacity is fully developed, whose energy reserves are intact, and who does not tire so easily. High rates of accidents, of absenteeism and of labour turnover, which are sometimes wrongly attributed to indifference and laziness, can often be explained by an unbalanced food supply.

Hence the employer should make certain that the workers' nutrition corresponds to their caloric requirements. Money spent on food will be repaid by a higher production rate, as has been shown by a number of careful studies of industrial work. If undernourished workers are recruited for forest work, their general nutrition should be improved for some time before they are fully employed on heavy work. This can best be done in logging camps. If the worker provides his own food, he can be given additional rations at the working site.

Composition of Diet

Apart from its calorific value, food should have a certain composition. Carbohydrates and fats are the main source of energy. Proteins are important as body-building substances, and part of the protein intake should be of animal origin. Further-

more, certain minerals and vitamins are needed. Although carbohydrates and fats can replace each other in practice, both should be present in the food pattern. If heavy work is being done, a larger proportion of fat is necessary, because carbohydrates alone would be too bulky, since they provide only half as many calories as fat for the same weight.

The composition of food may change within certain limits. According to the heaviness of work, certain items should not be insufficient, or a decrease in efficiency would result in spite of a sufficient calorific value. For heavy work, the protein consumption should amount to approximately one-and-a-half times as many grammes as the worker weighs in kilogrammes, that is about 100 g for a person weighing 145 lb (65 kg). Furthermore, a daily supply of about 0.8 g calcium, 2.5 mg vitamin B_1, 2 mg vitamin B_2, and 80 mg vitamin C are necessary. The worker who performs a heavy job may—depending on his feeding habits—consume 200 to 400 g of fat per day, corresponding to a value of about 1,600 to 3,200 kcal. Carbohydrates should make up for the remaining caloric requirements.

These requirements in nutrients can be satisfied by a wide range of different foods that can be found locally. Milk, cheese, fish, meat and eggs are the main sources of protein. Fat will be available from plants (olive oil and coconut fat) and from animals (butter, cheese, fat meat). Bread, potatoes, flour and rice consist mainly of carbohydrates. Vegetables and fruit are rich in vitamins. It is most important that the diet should be varied, including, for instance, protein and fat from both plants and animals. Generally, the food should be fresh.

Just as in Western Europe at the turn of the century, in many developing countries feeding habits and available food resources are at present far from guaranteeing a sufficiently varied supply of nutrients. Even if the diet contains enough calories, it will be inadequate if it lacks proteins or vitamins, and the resulting malnutrition will be reflected in reduced working efficiency and a greater susceptibility to disease. These effects are particularly pronounced if such malnutrition (lack or deficiency of certain

substances in the diet) occurs together with undernourishment.

Malnutrition is a common problem in many countries, especially in Africa and Asia. It is very prevalent when people cultivate only one major staple food, and live mainly on rice, maize, wheat, millet, potatoes, bananas or cassava. These products are rich in starches but lack proteins. Provision should therefore be made to supplement them with proteins.

If the employer provides part of his workers' food supply, this should by no means consist only of staple foods, but rather include those elements in which the diet has been deficient. For bigger forest undertakings it may be necessary to introduce agricultural products rich in proteins, such as pulses or groundnuts, stimulate the production of meat and eggs, improve local fishing industries, subsidise the sale of food items that cannot be obtained locally, and teach nutrition to the whole population.

In tables 2 and 3 examples are given of recommended daily food allowances for a male forest worker who performs moderately heavy or heavy work. These tables are only intended to give an idea of the requisite variety and amount. There are numerous other possible combinations.

TABLE 2. EXAMPLE OF DAILY FOOD ALLOWANCE FOR A WORKER WEIGHING 65 KG DOING MODERATELY HEAVY AND HEAVY FOREST WORK IN A TEMPERATE CLIMATE

Foodstuff	Moderately heavy forest work 3,000 kcal/day [1]	Heavy forest work 4,500 kcal/day [1]
Milk	0.5 l	1.0 l
Fish, meat	150 g	200 g
Cheese	20 g	20 g
Eggs	1	2
Butter and other fats	70 g	100 g
Bread	300 g	400 g
Farinaceous products	60 g	90 g
Potatoes, unpeeled	350 g	500 g
Jam	40 g	50 g
Sugar	35 g	40 g
Fruit	200 g	200 g
Vegetables	200 g	200 g

[1] 1.0 l = 1.76 pt U.K.; 2.11 pt U.S. 100 g = 3½ oz.

TABLE 3. EXAMPLE OF DAILY FOOD ALLOWANCE FOR A WORKER WEIGHING 55 KG DOING MODERATELY HEAVY AND HEAVY FOREST WORK IN A TROPICAL CLIMATE

Foodstuff	Moderately heavy forest work Approx. 2,700 kcal/day	Heavy forest work Approx. 4,000 kcal/day
Rice	500 g	600 g
Other cereals	100 g	200 g
Fish, meat	200 g	250 g
Eggs	1	2
Fats	40 g	50 g
Sugar	40 g	50 g
Fruit	200 g	200 g
Vegetables	200 g	200 g

While the caloric requirements are large for heavy forest work, the distribution of the meals plays an important part, too; generally, not more than 800 to 1,000 kcal should be consumed at one meal, so as not to disturb the process of digestion. This calls for a rather even distribution of the calorific value among four or five meals a day, starting with a substantial breakfast. At lunch time, a heavy meal should not be taken if there is only a short break of half an hour, or the body will be overloaded at work.

When possible, warm food should be eaten at lunch time, or at least tea, coffee or milk should be warmed up. Thermos containers are useful.

ALCOHOL

Alcoholic beverages should be generally prohibited at the working site since, even if taken only in small quantities, they immediately have a tiring effect and decrease the speed of reactions. No alcohol should be consumed at the site even when the daily work is finished if the worker is required to go home on public roads and drives any kind of vehicle. Heavy consumption of alcohol on a Sunday evening can have disastrous consequences on the way to work, or during work on Monday.

Liquid Requirements

Work in hot weather requires an intake of liquid of 5 to 7 pt (3 to 4 litres) a day or even more. An excessive protein consumption should be avoided under such conditions, since it may raise the body temperature. Precautions against the loss of salt when perspiring freely will not normally be necessary in temperate climates.

In a tropical climate the sweating rate for heavy work will be around 1 gal (5 litres) a day and may even reach 2 gal (10 litres) or more. It is essential that a sufficient amount of fluid should be restored to the body during working hours in order to maintain working efficiency. Drinks should not be confined to meal breaks but should be taken at more frequent intervals. For this reason a container is needed which the worker can carry about between meal breaks. The most suitable beverage for a heavily sweating worker is tea. Compared with fresh water, tea has the great advantage of having been boiled. Workers should not be tempted to drink water of uncertain purity. Salt deficiency through heavy sweating may occur and cause cramps if the food does not contain enough salt, and it may therefore be necessary to add salt to the food and liquids taken.

3. Rest Periods and Leave

Rest Periods

As has already been pointed out, heavy physical work requires sufficient rest periods. With a continuous heavy load of work, frequent short breaks of up to half a minute may give sufficient rest to prevent a progressive increase of fatigue. If the worker himself is not able to stop his work for such short recovery periods —for instance in mechanised operations—an organised break of five minutes at the end of each hour can have a similar preventive effect.

For some jobs that are very strenuous regular relief may be necessary, as in spraying operations with portable powered machines weighing 10 to 15 lb (20 to 30 kg). Quite frequently, recovery will be possible during idle times, for instance when a worker waits for the next car to drive up after loading wood.

For an eight-hour working day longer breaks are necessary. Normally, there should be at least two breaks of half-an-hour each. During lunch-time, a longer break is preferable: a minimum of 15 minutes after eating should elapse before work is resumed; a break of three-quarters of an hour or an hour will therefore be necessary. A longer break in the middle of the day has the advantage that less time is spent on work between 1 p.m and 4 p.m. when efficiency generally reaches its lowest level. Fewer accidents will occur, too, since accident rates are highest at this time of the day, productivity also being low. Protection against weather may become important if long breaks are made.

Exceptional climatic conditions may call for different lengths and distribution of rest periods. If it is very hot at the middle of the day, it may be advisable to concentrate work in the early morning and late afternoon—leaving a midday rest of several hours—or even to restrict hours of work to the period between early morning and noon. In cold climates, on the other hand, when there is deep snow on the ground, there is a danger that body temperature may drop; it may therefore be preferable to reduce rest periods, particularly on scattered work sites without any shelter.

In contract work contractors should comply with the recommendations concerning the length and distribution of rest periods.

In developing countries workers unused to regular working hours who are recruited for forest operations often tend to neglect regular breaks. If paid at piece-work rates they may start working at dawn and continue until dusk without any proper break. Accumulated fatigue, low efficiency and high accident rates are the result. Hence the workers should be trained to keep to fixed working hours and suitably spaced regular breaks of adequate

length; these matters should be specified in the contract of employment. A working time of 48 hours per week should not be exceeded except in case of emergencies, and one day of complete rest should be provided every week, even in countries where this is not customary in rural districts.

Leave

It has been said that for some time heavy work may exceed the energy limit provided that easier work follows, or the work is stopped for a season because of bad weather, for instance. Annual leave should also have a beneficial influence similar to that of easier work, but this can only be the case if the leave is given in one period, and is really used for recovery and not for other work. Payment of leave that has not been taken is unacceptable from the medical point of view. In many cases it will be difficult for the workmen to take leave in one spell, especially if they maintain small agricultural holdings. On the other hand, the employer can help greatly if the operations are closed down for a certain period that is convenient for leave.

4. Workers Needing Special Protection

Young Workers

Young workers need other forms of medical supervision as well as examinations.

As long as a young person is not fully grown he must be kept away from heavy or dangerous operations and his physical and mental development must not be endangered in any way.

Some general provisions on the age of admission to industrial employment are contained in the Minimum Age (Industry) Convention (Revised), 1937, which fixes a general minimum age of 15 years for admission to industrial employment, but adds that

for employment on dangerous work higher age limits should be fixed by national laws or regulations. In forest work many countries have established detailed standards, varying with the worker's age, relating to maximum working hours per day or week, handling of dangerous materials, maximum weight to be carried, etc. The question of the maximum weight to be carried by one worker was considered by the International Labour Conference at its 51st (1967) Session, when it adopted the Maximum Weight Convention.

For persons under 18 years of age only light work should be permitted, preferably planting and tending operations in young stands. Lifting of heavy loads can be particularly harmful and result in permanent damage to the spine.

Young persons do not have the same sense of responsibility as older ones, and tend to be careless. They should, therefore, not be allowed to do dangerous work such as operating power-driven machinery, felling trees or handling dangerous substances. Exceptions are only permissible when young persons are under constant guidance and close supervision (e.g. during vocational training).

Even the use of simple hand tools can involve particular risks for young persons. In handling axes they suffer many more accidents through cuts than adults, who are usually more safety-minded. Safety education should take special account of such matters.

Safety requirements for young persons should not be taken lightly, nor should the special needs of individual cases be disregarded. Since physical development is slower in some people than in others, it may in certain cases be advisable to continue health and safety measures for young persons after the age of 18.

Much understanding and help, as well as close supervision, are needed to give a young person a good start in his job. Occasional changes of work and association with other workers who understand his problems will be beneficial. If he is properly cared for and well taught, he can very likely be turned into a workman who enjoys his job and does it well.

Older Workers

Older workers have quite different health and safety problems than young and middle-aged ones. Up to about 50 years of age a worker can normally be considered to be in possession of full working capacity, but from then on his physical strength will gradually decline. For a while he may make up for this by the experience acquired during his working life, but he will eventually reach a stage where he should no longer be engaged in heavy work and should be transferred to a job where physical demands are low and experience is still useful.

In tropical regions climatic stress, diseases and malnutrition may lead to a considerable reduction of working capacity before the age of 50. Under such conditions, earlier transfer to lighter jobs is called for.

The older worker will in many cases find it hard to adapt himself to new machines and working techniques, especially if he has done only manual work. It will be unwise to impose upon him a job that he will never be able to do properly or safely.

Older workers are more liable than young ones to sustain falls and to be badly hurt in them. Hence, work on rugged and steep ground and on slippery surfaces, choker setting and other hazardous or trying work should be done only by able-bodied younger workers.

After an accident or an illness the older worker needs a longer recovery period than others. He may, however, be inclined to take up work again before he has fully regained his health, and then a serious relapse may result. This must be borne in mind not only by physicians but also by employers and, of course, by the workers themselves. After a long absence from work, a physician should always decide whether an older worker is able to perform heavy work again.

In forest operations the worker can be given far more individual attention than in many other industries and the older worker

can often be helped and encouraged although there may be a rather limited choice of lighter jobs.

The aim should be to make such use of the forest worker's physical capacity throughout his working life that he reaches retirement in good health and can enjoy life for many years to come.

Women Workers

It must always be borne in mind that, on the average, women have only about 80 per cent. of the physical strength of men. The ratio is the same for the total amount of energy that can be expended during working time without injury to health. Owing to their bodily constitution, women tire more quickly if work is carried on without interruption. Working in a bent position and carrying loads are particularly tiring for them.

On the other hand, women may in certain circumstances work faster and more skilfully than men. Generally, employers should try to give women work where they can do as well as or better than men, for example planting or nursery work.

Many forest operations, however, are too heavy to be carried out by women, for instance timber felling and associated work, and carrying loads such as heavy bundles of plants. In some cases it may be necessary to provide women with lighter tools for different jobs, e.g. weeding.

Pregnant women should do only very light forest work and should never carry loads.

Besides going out to work, women quite often have a heavy burden of housework. Employers should remember this. In many cases relief can be given by adapting the working periods to suit housewives, e.g. by allowing one day off a week, reducing hours of work and providing transportation to and from the worksite to save time and energy.

5. Climate and Weather

Forest work is probably more hampered by climatic and weather conditions than any other work. Since the worksite frequently changes, it is difficult to protect the worker against the weather.

Generally speaking, industrial workplaces offer shelter against rain, snow, heat and cold, and are preferred by workers. Forestry in this respect can never compete with industry and this emphasises the need to improve conditions. A temperate climate offers more favourable working conditions than extremes of cold or heat, both of which reduce working capacity.

Cold

At very low temperatures heavy working clothes are necessary. Not only do they restrict the worker's mobility; carrying their weight of 10 to 20 lb (5 to 10 kg) consumes a certain proportion of the energy available for work. In addition, at stationary workplaces at roadsides or landings where the worker is less active, it may be necessary to provide special warming-up breaks in heated shelters if the temperature is very low.

In some countries with heavy snowfalls outdoor activities are traditionally restricted to the absolute minimum during the winter season. Here it might be desirable to use at least part of the winter for forest operations and thus provide a steadier source of employment. This, however, can be achieved only if proper working clothes are available and also suitable shelter during breaks, if necessary.

Sometimes lack of suitable clothing and shelter in winter is the only reason why work does not continue throughout the year, despite the fact that labour is short and would welcome full-time employment. Moreover, certain forest activities like timber transport can be facilitated by the snow.

Heat

Compared with protection against the cold, the possibilities of counteracting the adverse effects of excessive heat are very restricted in outdoor operations. In any kind of physical work only a small proportion of the energy expended is converted to work and most of it is converted to heat. Since the body has to maintain a certain temperature, the excess heat has to be disposed of by perspiration, exhalation of water vapour, radiation or convection. In a hot environment the evaporation of sweat is the most important factor for regulating the body's temperature. This process is, however, considerably impaired if the environment is not only hot but also humid. Such conditions are very common in tropical rain forests with a temperature of between 25 and 30°C (77 and 86°F) and a relative humidity close to 100 per cent.

When the evaporation of sweat is insufficient to dissipate the heat load produced by the job, the body temperature and cardiovascular responses such as the pulse rate rise, although the same number of calories are needed for the job as under more favourable conditions. Heat stress lowers working capacity and vigilance considerably. Whereas at about 25°C (77°F) and 100 per cent. humidity it is still possible to perform heavy work requiring about 4 kcal/mn, at 30°C (86°F) and the same humidity working capacity is decreased to only about 1.5 kcal/mn, and at 35°C (95°F) and 100 per cent. humidity the body is only able to dissipate the heat produced when not doing any work at all. If these energy expenditures are exceeded, the heat accumulates in the body; when the body temperature has risen more than 1°C (2°F) above its normal level, the worker is unable to work any more.

Thus heat stress can transform an easy job into a hard or even an impossible one. In a hot and humid environment with little air movement and limited evaporation of sweat, it is necessary to avoid excessive heat stress by providing sufficient rest periods or reducing the working hours in order to allow the body to cool down. It is of the greatest importance to facilitate the performance of heavy jobs as much as possible under such conditions.

Seasonal and Daily Changes of Weather

The seasonal and daily changes of temperature, humidity, wind and light are also important environmental factors. They can affect health and safety in many different ways. Respiratory diseases and rheumatic pains will frequently occur if proper care is not taken, and the rate of absenteeism will be high. Furthermore, during working hours, productivity can be largely reduced by climate and weather. Idle days and idle hours during the day are particularly numerous in regions with heavy precipitation.

There are different ways of controlling natural influences. The employer can help to protect his workers' health by taking account of seasonal changes of climate when changing operations. In mountainous regions, for instance, with heavy snowfall in winter, it may be advisable to fell timber at higher altitudes during the summer.

In wet weather, felling should not take place in dense young stands. In certain circumstances some operations should not be carried out at all because of high accident risk, for example skidding or climbing trees when the surface of the ground or tree is covered with ice, tree felling in stormy weather, and operation of cableways when a thunderstorm is approaching.

If motor transport from home to worksite can be provided, weather risks will be very much reduced, especially where long distances are to be covered.

Shelters

Provided that the operations are not scattered over a large area and access to the forest is adequate, setting up provisional shelters can be very helpful to protect the workers during rest periods and spells of rain. Shelters should have a stove for heating them and warming the food. Petrol-driven machines and flammable materials should be kept at sufficient distances from fireplaces, preferably in special boxes accessible only from the exterior of the shelter. The workers will very often be able to construct

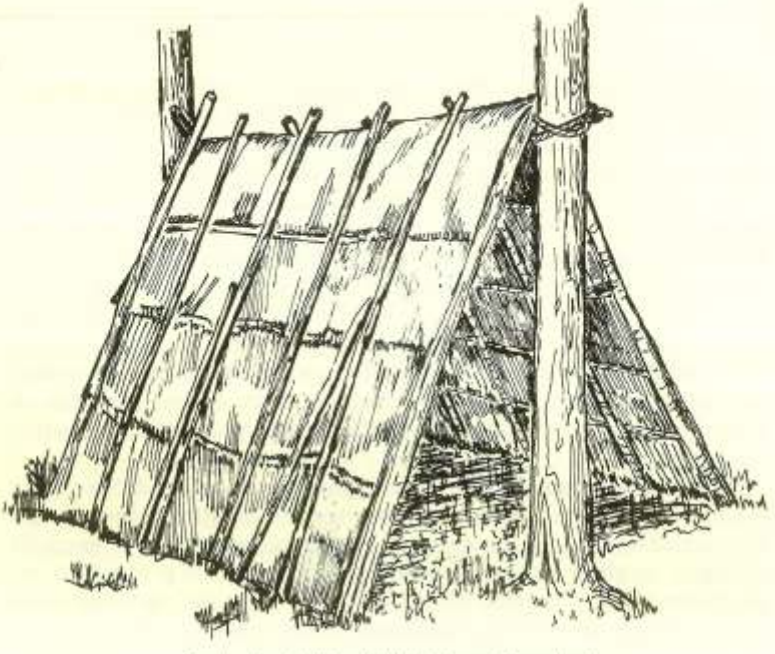

Fig. 6. A primitive shelter hut made from bark.

shelters themselves if the necessary materials are available. Mobile shelters on wheels have proved very useful (figs. 6-10).

Certain types of machinery also provide shelter for workers during operation. Tractor cabs protect drivers against rain and sun (figs. 11 and 12). Planting machines can be covered by canvas roofs and thus allow the continuation of planting in wet weather, not only affording the worker protection but permitting planting under the most favourable conditions (fig. 13). Similarly, with some resourcefulness it will be possible to shelter workers in other situations, especially when machines are used for work at roadsides.

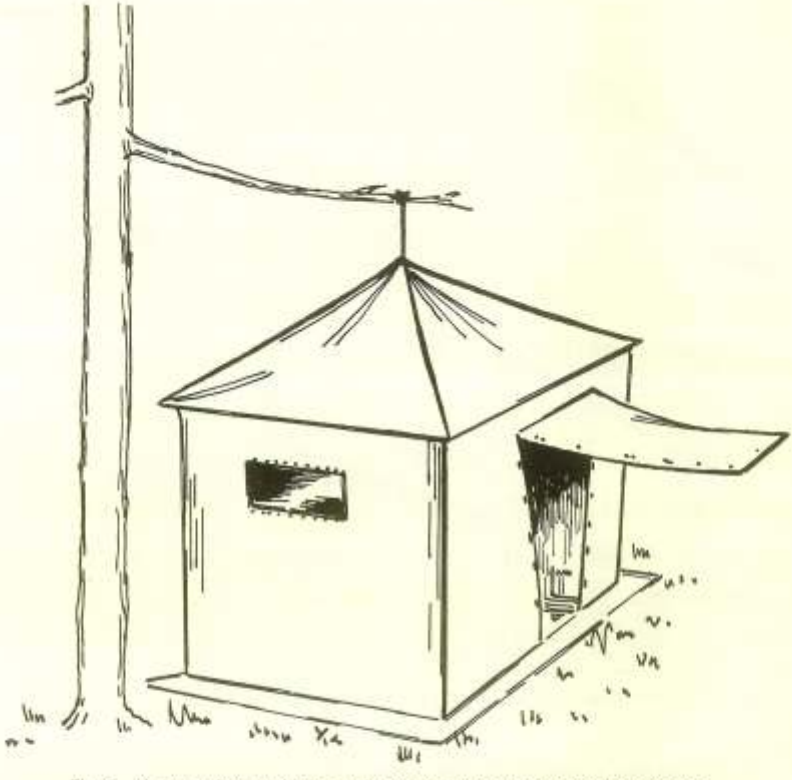

Fig. 7. A type of tent which can be easily transported on difficult terrain.

CLOTHING

The worker himself should, of course, adapt himself to weather conditions as far as he can, for instance by wearing the right kind of clothing. His employer can help him by making such clothing available. Vocational training, too, should be concerned with this point.

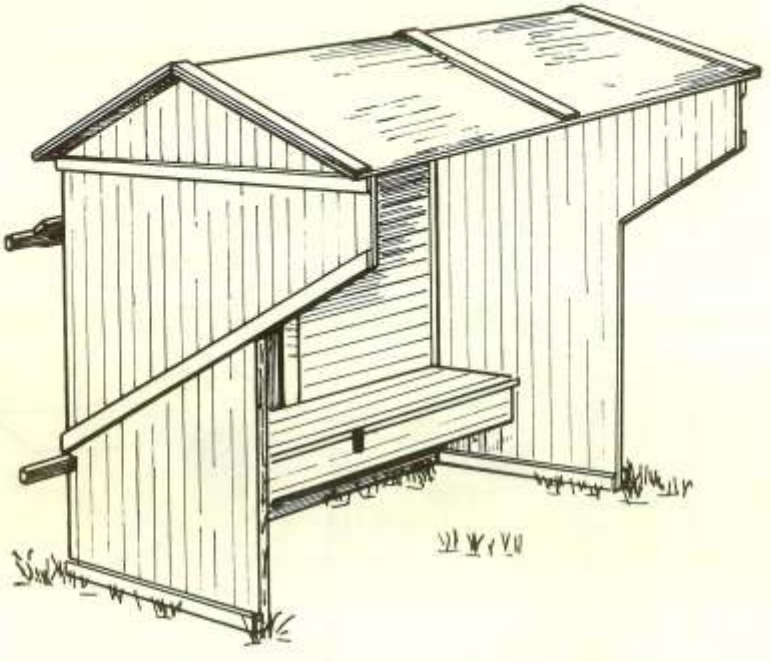

Fig. 8. Portable shelter bench to protect a small group of workers from the weather

Working clothes should serve two main functions: to keep the body sufficiently warm and dry. These two requirements are frequently difficult to combine if the worker is perspiring heavily. Sufficient ventilation will, however, allow the perspiration to evaporate, unless the humidity in the air is considerable and the temperature high. Working clothes that do not allow for sufficient ventilation because of their cut and the density of the material become wet from the inside. This must be prevented by using textiles that are sufficiently permeable, but in a rainy climate the worker may then become wet from the outside. A suitable cut,

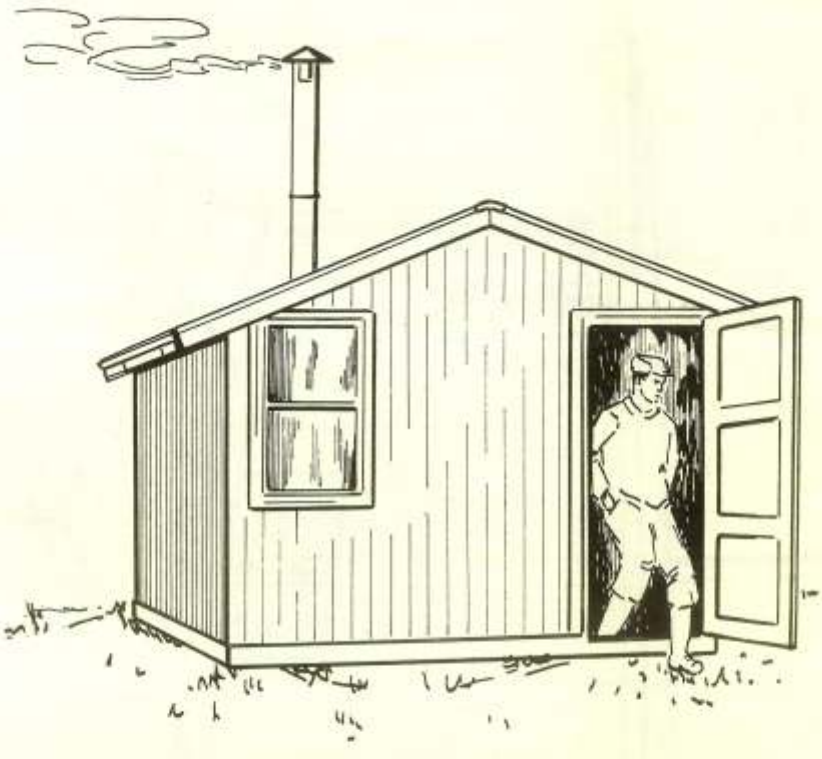

Fig. 9. A portable shelter hut.
This type of shelter is more comfortable and spacious than a bench but requires more time for moving.

leaving openings under the arms, will in such cases provide satisfactory ventilation of clothes.

The workman who performs heavy work will usually wear lighter clothes than one working under the same weather conditions but exerting less physical effort, a tractor driver for instance. In rest periods workmen may, however, need to put on additional

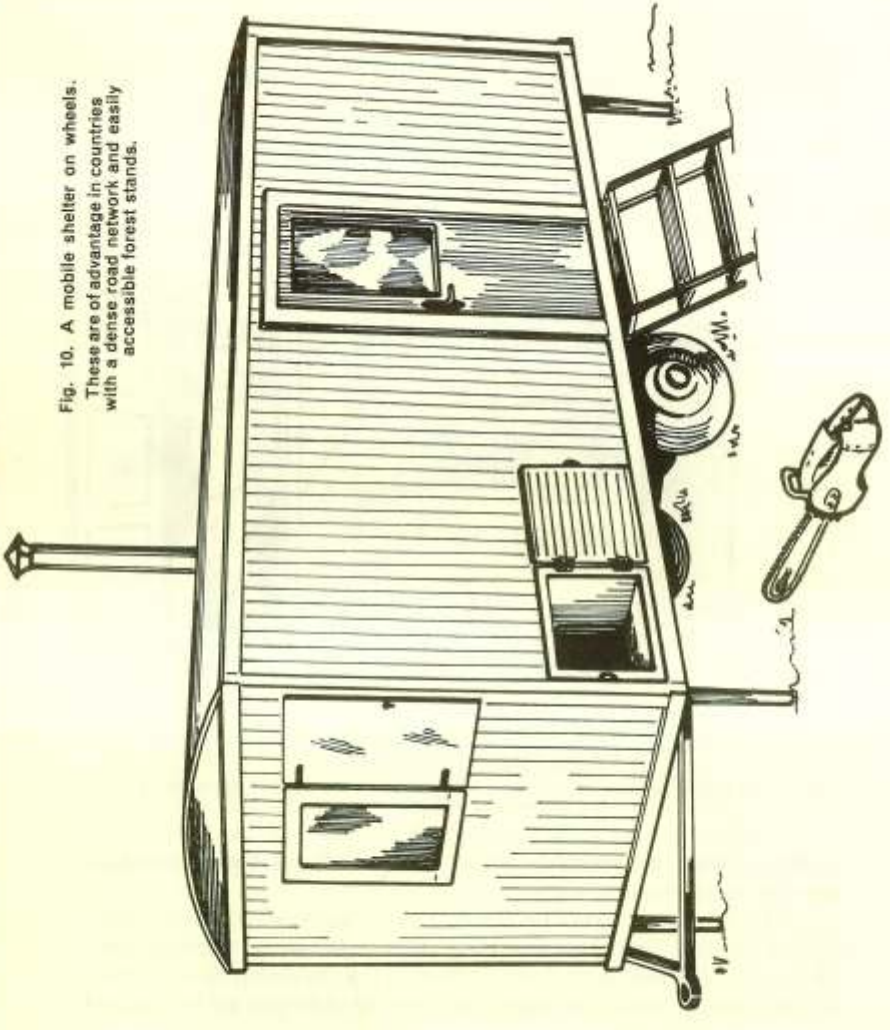

Fig. 10. A mobile shelter on wheels. These are of advantage in countries with a dense road network and easily accessible forest stands.

Fig. 11. Tractor equipped with a sturdy cab.
In addition to protecting the driver against the weather the cab resists the impact of overturning.

clothes to keep themselves warm enough. On the way from home to the worksite the clothes should be suited to the means of transport used.

The role of clothes in accident prevention is discussed in Section 20 (Part II), "Personal Protective Equipment".

In designing working clothes manufactures should not overlook the fact that, especially for women, they should be as attractive as possible. Otherwise workers may prefer to wear clothing of their own choice, which may be less suitable for the job.

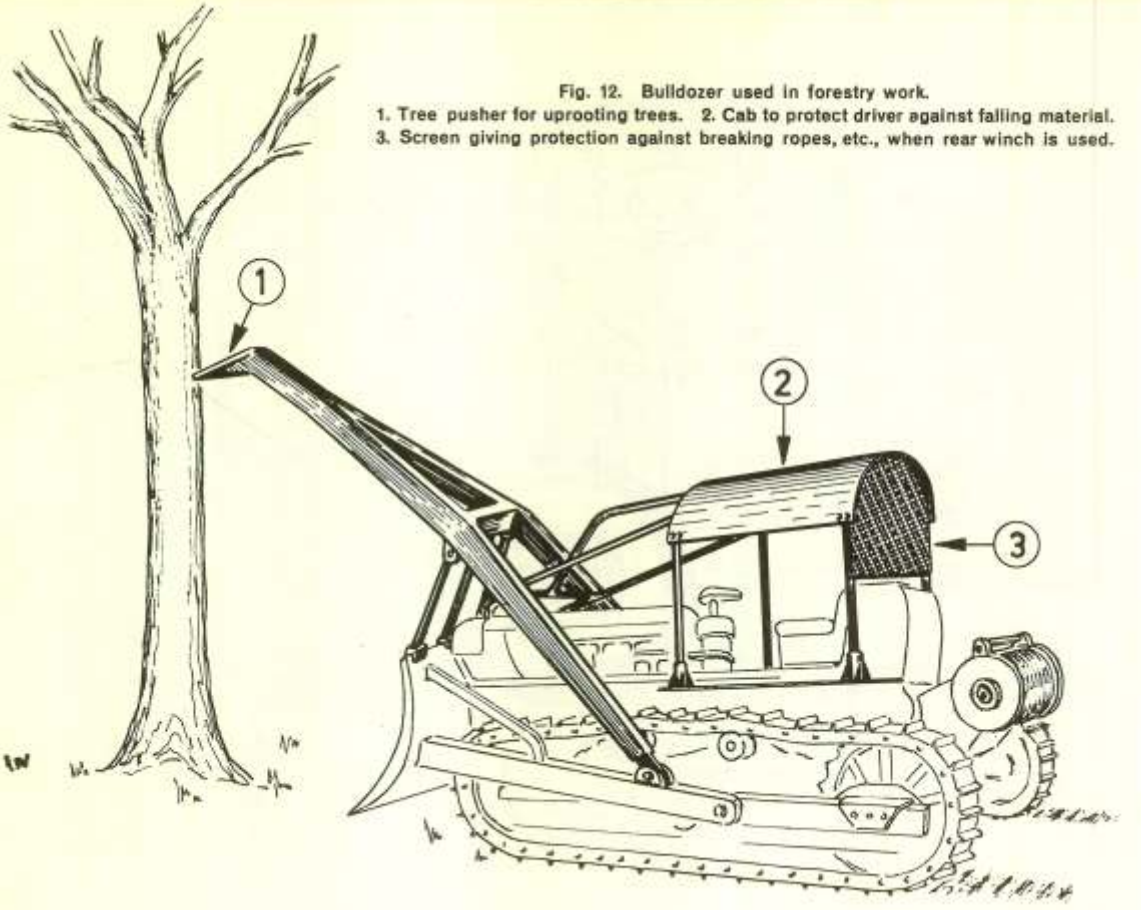

Fig. 12. Bulldozer used in forestry work.
1. Tree pusher for uprooting trees. 2. Cab to protect driver against falling material.
3. Screen giving protection against breaking ropes, etc., when rear winch is used.

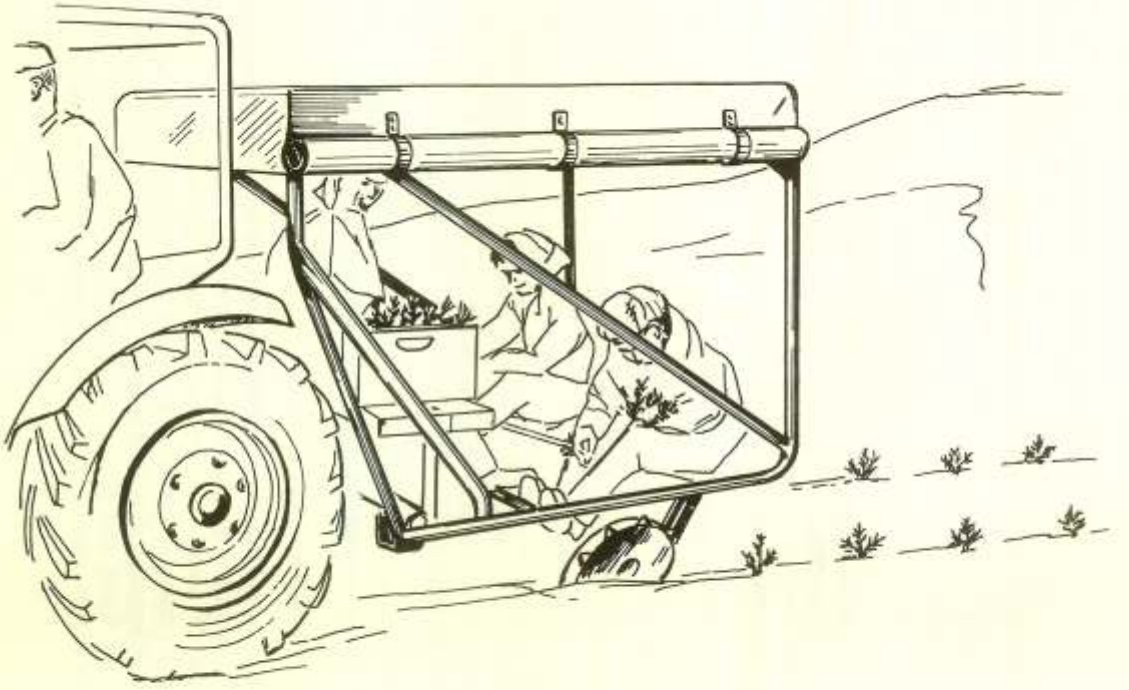

Fig. 13. Workers on a planting machine protected by a canvas roof against sun and rain.

6. Plants, Animals, Insects, Infections

Among the health and accident risks in forest operations are those caused by certain plants and animals. The risks vary greatly with the climate, vegetation, general standard of hygiene, etc. In some places there are practically no risks, while in others they are the main concern of those responsible for safety and health.

Only a few general precautions can therefore be considered here, since adaptation to local conditions is necessary. As a rule, all workers who are not thoroughly familiar with local dangerous plants, animals and insects should be well informed of their dangers and taught to recognise them. This applies especially to workers who have left towns for the country or who come from other regions.

Dangerous Plants

Puncture Wounds.

It is surprising how many injuries in forests are caused by touching or handling plants or parts of plants that break into sharp splinters, or have sharp edges, thorns, etc. Working clothes of stout material offer the best protection against injury from them. When any kind of undergrowth is cleared, gloves should be worn that give sufficient protection. First-aid kits should contain forceps for the removal of thorns and splinters.

Allergies and Poisonings.

Additional caution is needed where there are plants that cause allergic reactions or poisoning after touching or breathing. The sawdust of some tree species can have similar effects. Well-fitting clothing is essential to avoid accidental contact. Long gloves or leggings should be worn, or trouser cuffs and shirt sleeves tied over shoes and gloves. Garments that are exposed to poisonous plants should be removed without being touched by bare

hands, and are best dry cleaned. As far as possible, poisonous plants should be destroyed, though it should be remembered that when burning them toxic fumes may develop. Persons with pronounced allergic reactions should keep away from poisonous plants; if the skin is exposed to irritating plants, it should be carefully washed with soap and hot water and, if necessary, inspected by a physician.

Some mushrooms, berries, and other fruits are easily mistaken for edible ones. Where this could be a source of danger, workers should be able to distinguish dangerous plants from harmless ones.

Animals

Wild Animals.

In remote places certain large animals can sometimes be dangerous. It might be useful to equip crews working in danger zones with firearms as protection against sudden attacks from them.

Snakes.

In certain regions, where there are poisonous snakes, high boots or leggings should be worn and snakebite kits carried. Persons should always watch where they step, special care being needed in places where snakes might hide, such as in or under timber stacks. Certain poisonous snakes to be found in trees attack persons walking underneath, and hard hats should be worn as protection against them.

Normally, however, a snake will not attack unless it is touched, trodden on or cornered. Anyone who is bitten should remain calm and remember that few people die from bites of even the most poisonous snakes because the snake is seldom able to inject a full dose of venom.

The bitten limb should be immobilised, the bite washed thoroughly and a slightly constricting bandage applied. If available, an antidote should be injected as soon as possible and the sufferer hospitalised or put to bed.

Insects, Etc.

Spiders, ticks and many kinds of insects, such as flies, mosquitoes and wasps, can be a considerable nuisance and even dangerous. They should be kept in check by insecticides and repellents, especially in the vicinity of areas where workers are concentrated, such as nurseries or workshops. Logging camps have, of course, to be kept clear of any kind of vermin.

Domestic Animals.

In less mechanised countries, animals such as horses, mules, donkeys, oxen and elephants are much used for dragging or carrying loads. Some animals can be quite dangerous if not treated with care. They should be entrusted only to experienced men who know how to lead them, are patient and calm, treat the animal kindly but firmly and keep cool in dangerous situations. Nervous, anxious and ill-tempered men can easily spoil an animal's habits and so create hazards.

Animals selected for work in the forests should be well broken in and good-natured. Their feeding should be adequate for the performance of their work, and as far as necessary proper stables should be provided to keep them in good condition. It takes much experience to train them for dangerous jobs such as timber skidding on steep terrain. Animals with bad habits, like kicking and biting, should not be employed for work if it is not possible to train them to behave safely.

Animals should be approached with care particularly after lay-offs and, in the case of females, during heat, gestation and suckling. Persons should always be in a place where they cannot be pushed against a wall or other obstruction or be hurt by sudden movements of the animal's head or feet.

All bridles, harnesses, saddles, etc., should be maintained in good condition and be properly adjusted. Reins or leads should be held firmly and never be wrapped around the wrist or body.

If an animal is tethered, not too much slack should be left, since this might entangle the animal, and places where tethered

animals might come into contact with barbed wire, loose wire, fragments of glass or other objects that might hurt them should be avoided. As far as possible, animals should be kept away from insects likely to attack them.

Infections

A number of common diseases are communicated by domestic or wild animals or insects to men, for example brucellosis, tularaemia, rabies, spotted fever and malaria. Different forms of protection and treatment are required, depending on the nature of the disease and the method of infection (contact with the infectious animal, breathing infectious dust, consuming infectious food, or bites from blood-sucking flies and ticks).

Here again cleanliness is an important precaution. Diseased animals should be removed or, if possible, killed, and contaminated premises should be disinfected. In some cases immunisation by vaccination is needed. If domestic animals are spreading disease, the advice of a veterinary surgeon should be sought.

As an example of an infectious disease caused by animals rabies may be mentioned. This is present in most parts of the world and, although primarily transmitted by dogs, can be spread by many other kinds of animals which become infected, such as cats, cattle, rats, mice, martens, foxes, wolves, skunks and deer.

The causative organism of rabies, a virus, is present in the saliva of the infected animal. It enters the body of another animal or person through bites or through the exposure of cuts or sores to the saliva of the infected animal. Two to five weeks after infection the first symptoms appear. The animal becomes restless, nervous and excitable. It may change its character completely. A friendly dog, for instance, may become irritable and snappy, while a less amiable one may become friendly. During the first stages of the disease the animals may wander about widely and attack and bite persons. Later, they become exhausted, develop partial paralysis, stagger about and have difficulty in drinking. Complete paralysis follows, leading to convulsions and death.

Where the disease is present, domestic animals should be kept away from wild animals. Wild animals that approach men should never be touched but be watched carefully to avoid sudden attacks. Animals suspected of being rabid should be put in quarantine and observed, or be inoculated with rabies vaccine, or be killed and buried deeply. If possible, a veterinary surgeon should be informed of cases where rabies is thought to be the cause of an animal's death. For identification of the disease the head of the infected animal should be sent to a laboratory for examination.

Wounds caused by the bite or scratch of a rabid animal or of an animal suspected of being rabid should be immediately thoroughly washed with soap or a detergent. Persons who are bitten by a rabid animal or who touch it should be vaccinated as soon as possible.

Among the insect-borne diseases malaria may be mentioned as a second example of a fairly common infection. Malaria is still a widespread menace in tropical countries, though in many parts of the world progress has been made in controlling and eradicating it. Malaria is normally confined to regions with a mean annual temperature of over approximately 16°C (60°F). It is transmitted by certain night-flying mosquitoes by the bite of which the malaria parasite enters the human blood stream.

Malaria is still the most important rural disease in many tropical regions, and can easily lead to a higher rate of absenteeism than all the other diseases or all accidents together, if no proper preventive measures are taken.

As mentioned in Section 37 (Part IV), "Logging Camps and Housing", screening and regular spraying of insecticides are necessary in malaria-infested areas. Anti-malarial drugs are an excellent means of bringing an epidemic to an end but cannot be relied upon permanently, because drug resistance may develop in the parasite. Especially between dusk and dawn when the mosquitoes attack, long trousers and long-sleeved shirts should be worn.

In addition, insect repellents applied to exposed parts of the body reduce the risk of malaria. Furthermore, it may be advisable to spray mosquito breeding places around worksites and landings which are in use for long periods. All these methods depend largely on local conditions and on the epidemic potential of the disease. They should be adapted in accordance with the advice of local medical authorities.

PART II

TOOLS, EQUIPMENT, MACHINES, MATERIALS

7. Hand Tools

Numerous accidents in forests are caused by slipping, breaking, or improper use of hand tools. Mechanisation will undoubtedly help to reduce these accident risks, but the use of hand tools will continue to some extent, for instance for repairs where—according to accident statistics—they are still important. Hence, this aspect of accident prevention should not be neglected.

In forest operations hand tools, like all other equipment, have to be of high-quality material and sturdy construction in order to withstand heavy stresses.

Since repair shops are not normally available in the vicinity, breakage will often result in extensive delays, which must be avoided at all costs. On the other hand, tools which often have to be carried over long distances on rough terrain should not be too heavy. As far as possible, light alloys should be used for metal tools.

The following rules for preventing accidents with hand tools should be observed:

1. Always use the proper tools for the job (do not use an axe as a wedge, a knife as a screwdriver, etc.) (fig. 14).

2. Use tools in the right manner (never cut towards the body with axe or knife, keep at a sufficient distance from other workers when using a tool, etc.).

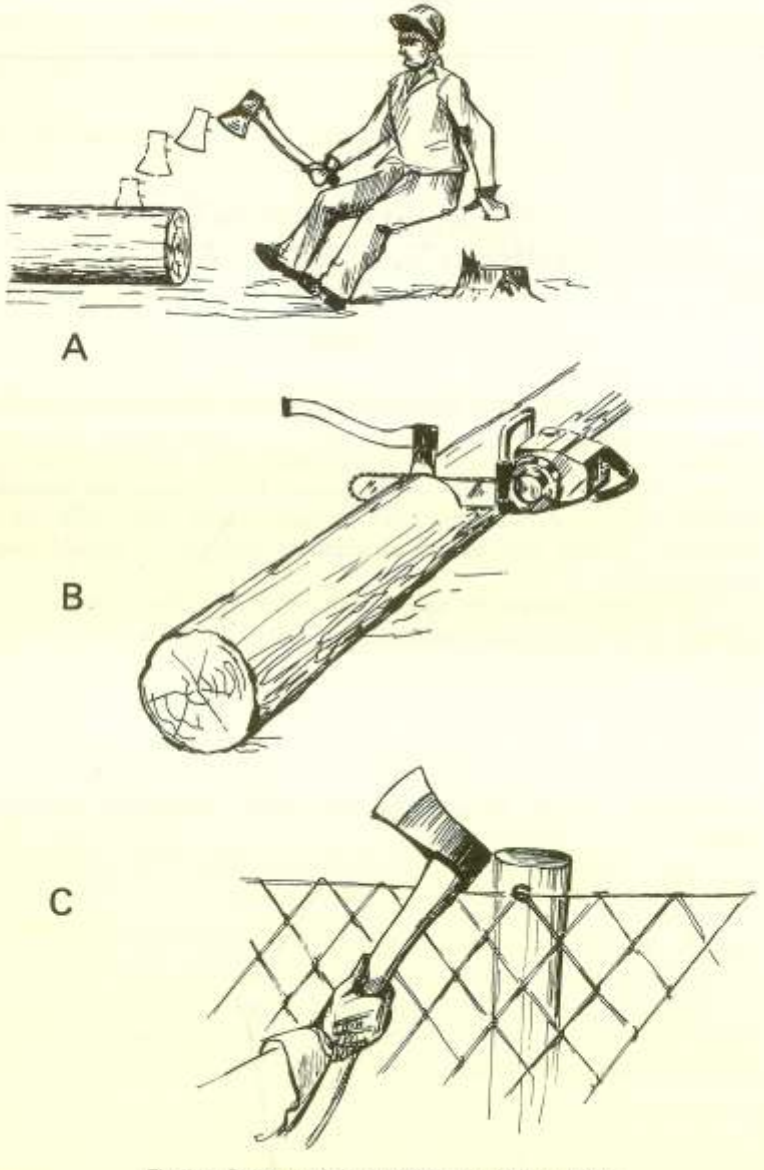

Fig. 14. Some uses of an axe that should be avoided.
A. As a hook. B. As a wedge. C. As a hammer.

3. Keep tools in good condition (replace broken handles, keep cutting tools sharp, etc.).

4. Provide proper transport and storage (guard sharp-edged or sharp-pointed tools, place tools in a safe spot where nobody will fall over them, etc.) (fig. 15).

5. Inspect tools regularly (are cutting tools sharp, heads of shock tools dressed, handles tight and unbroken, etc.?).

6. Try to replace dangerous tools with less dangerous ones or by machines.

7. Use protective equipment where this will help to decrease the accident risk (for instance, safety boots with steel caps for axe work).

In this guide it is impossible to deal with all the many hand tools used in forest operations. But the rules and examples discussed above will doubtless suggest how other tools can be used safely.

Handles

It is not uncommon for an accident to occur because the handle of a tool breaks or the head flies off or the tool is unsuitable for the workman. All handles of hand tools should therefore be fitted carefully to the tools and have the appropriate length and shape for the person who uses them.

Wooden handles of hand tools should be of hard and straight-grained wood, free from cracks and knots. Hickory or ash, for example, are very suitable for handles. Handles should fit snugly into the head of a tool such as an axe. They should be well centred and firmly wedged and from time to time be rewedged. Metal wedges can be useful for this purpose.

In many cases proper handles have been introduced once the workers have been taught how to make them themselves. This has the advantage that the worker can adapt the handle to the size of his arms and hands.

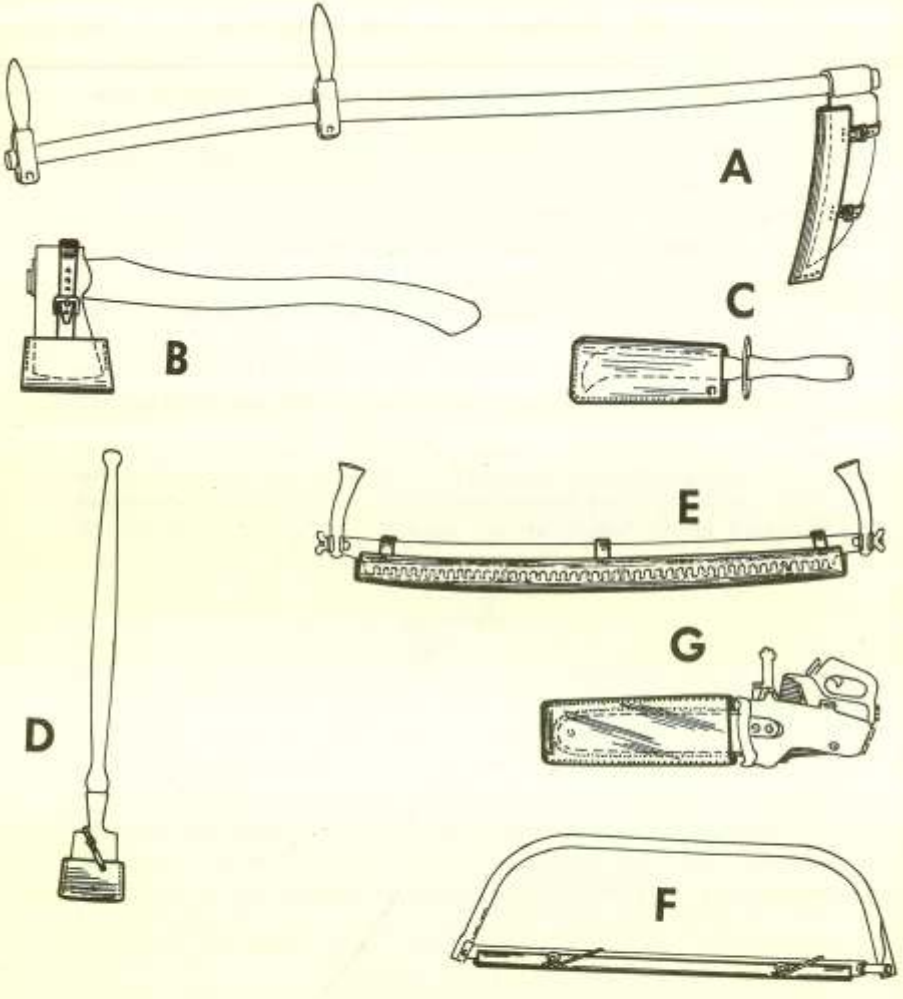

Fig. 15. Some guards for sharp tools.

A. Scythe. B. Axe. C. Billhook. D. Barking spud. E. Two-man saw. F. Bow saw. G. One-man power saw.

Cutting Tools

The most dangerous hand tools in forest operations are cutting tools such as axes, hatchets, billhooks, saws, barking spuds, scythes and sickles. All these tools should be handled with great care. Young people in particular should be reminded that cutting tools involve considerable accident risks. It is dangerous to throw these tools from person to person.

Design.

Handles of cutting tools such as billhooks should have a projection which prevents the hand from slipping on to the blade. Axe handles should end in a knob that can be gripped firmly by the lower hand and prevents the handle from slipping off when it is wet. In severe cold the blades used to be kept somewhat thicker to resist breakage, but with modern improvements in metallurgy a thinner blade can be used which will not glance off easily and will yet resist breakage.

Transport.

During transport, sharp edges should be enclosed in protective covers or sheaths as far as possible. One should be supplied with each new cutting tool. If the tools belong to the workmen they should be shown how to make protective covers themselves. This can be demonstrated very well during training courses (fig. 15). If sharp tools have to be carried without protective covers, they should be kept close to the body with their cutting edges pointing outwards.

Maintenance.

All cutting tools, as well as pointed hooks, should be kept properly sharpened, since blunt tools glance off easily and require more effort and working time to use.

Custody.

For storage in rooms, tool boxes or appropriately secured tool racks are useful. No tools and implements of any kind

should be left lying in places where persons have to work or pass, or on elevations from which they might fall on persons below. The feller should always place his tools clear of his escape route (fig. 16).

Axes.

In some countries where axes are used frequently in felling operations, up to one-third of all injuries to workmen are axe cuts, and they can lead to long periods of absence. Hence work with axes will be one of the most important items to receive attention in accident-prevention activities. Very often an axe is deflected and hits the worker's foot or leg. This can be avoided if the working space is kept clear of twigs and undergrowth, and if during branching the worker keeps the stem between himself and the branches being cut. Furthermore, safety boots with steel caps are of great advantage and should always be worn by men using axes.

Hand Saws.

Hand saw injuries are usually less serious. They occur mostly when a new cut is started and the saw jumps out of the cut and hits the hand that is guiding the saw blade or supporting the wood to be cut. Accordingly, short and light strokes, if possible with both hands holding the saw, are necessary until the cut is deep enough. Further, high-tension bow saws must be released with care. This should be done by holding the bow firmly between the legs and releasing the blade with both hands; the blade must point outwards. Saws have to be kept sharp and well set to allow smooth cutting and to prevent pinching.

Scythes, Sickles and Billhooks.

Scythes and sickles can be most dangerous tools when used carelessly. Many accidents occur if the distance between the workers is insufficient and the scythes or sickles are deflected or slip. Replacement by other mechanical or chemical means of weed control can help to reduce accidents. Where sickles cannot

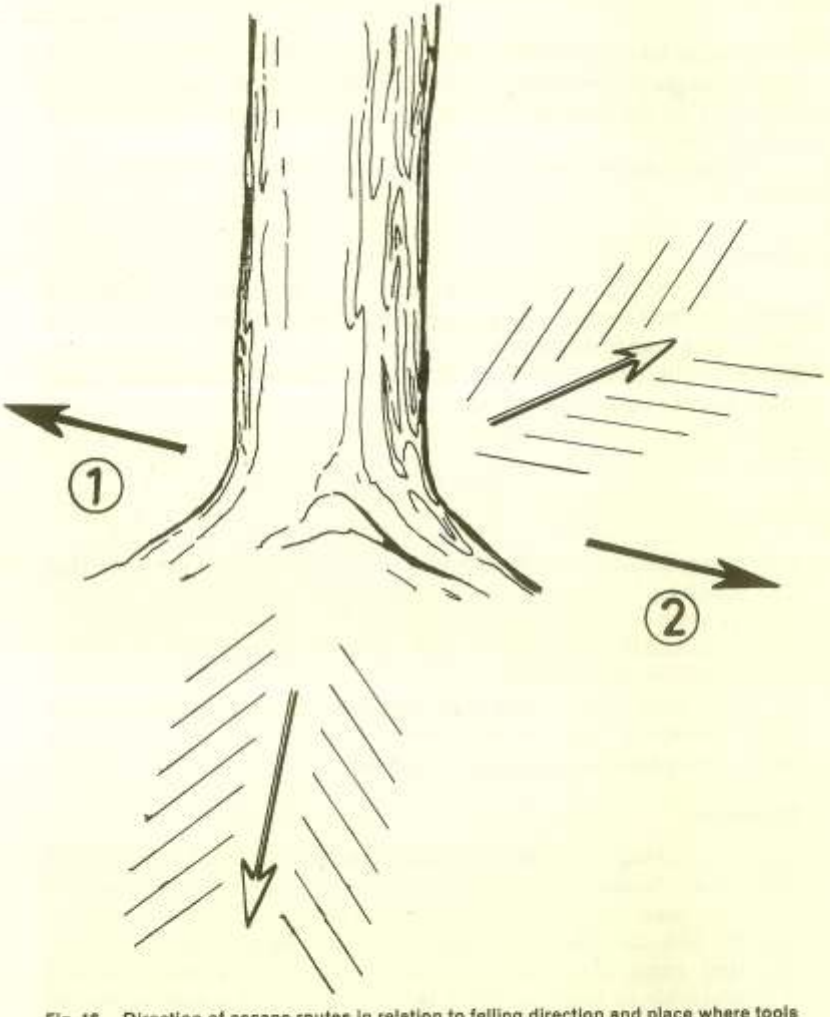

Fig. 16. Direction of escape routes in relation to felling direction and place where tools are laid.

1. Felling direction. 2. Direction in which tools should be laid. White arrows indicate escape routes.

be replaced by other means, the worker's hands should be protected by canvas gloves with strips of rubber sewn on the back; this is not necessary in the case of scythes, where both hands are out of the danger zone.

Similar protection is recommended for persons who work with billhooks.

Files.

Files used for sharpening should be kept clear of oil and grease. They should always be equipped with a handle and should be pushed smoothly along the blade to prevent their slipping off. When honing is done with an oil-stone after sharpening, the stone must always be given a circular motion (fig. 17).

Shock Tools

Many injuries are also caused by shock tools, such as wedges and riving hammers, which are used during felling, cross-cutting and splitting. Flying chips of metal can inflict severe injuries, such as severed tendons or eye injuries.

High-quality materials and proper tempering are most important for shock tools.

Like axes, shock tools may break or glance off during severe frost. Keeping them warm close to fireplaces or warming them up by a few light strokes will be helpful.

Hammers.

For driving fence posts, a heavy hammer is often used by one man while another is holding the post. If the hammer misses the post, the man helping may be badly hurt. This can be avoided and the job considerably facilitated if hand-operated or tractor-operated rams are used. If such equipment is not available it is advisable to hold the fence post by means of a wire or special long-handled tongs.

Hammers should be slightly harder than wedges or chisels.

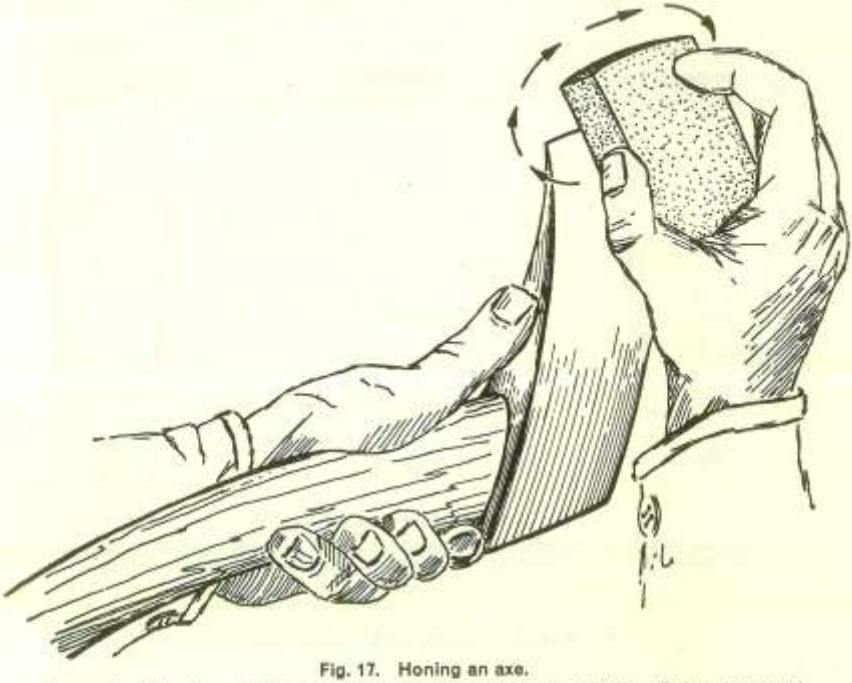

Fig. 17. Honing an axe.
Axes should be honed with a circular motion so that they do not slip off the stone and cut the worker's hands.

Wedges.

A disadvantage of metal wedges is that in the course of time their heads mushroom and crack. They must then be dressed or ground and the edges of the heads bevelled (fig. 18). Steel wedges should not be used where they can be replaced by other types.

Wooden or aluminium wedges or metal shoes with wooden heads greatly reduce the risk of injuries by shock tools. In tree-felling modern plastic wedges are particularly safe and convenient. Wedges will enter frozen wood more easily if their surface is profiled.

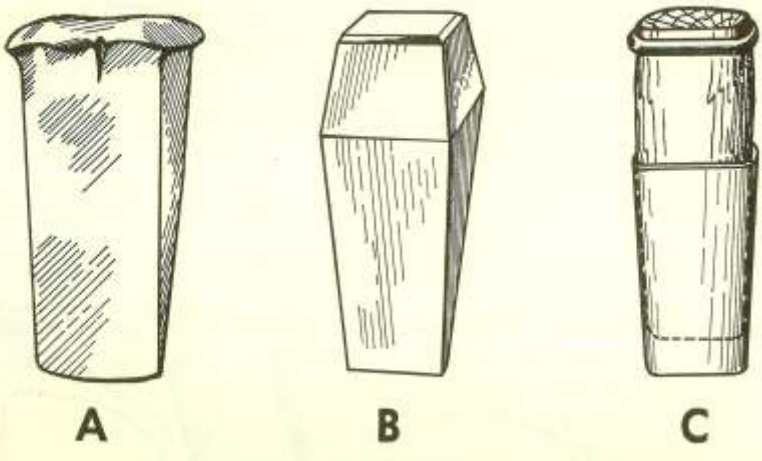

Fig. 18. Wedges used for splitting wood.
Mushroomed heads of wedges (A) should be dressed properly (B). A metal shoe with a wooden head (C) eliminates the danger of injuries from flying chips of metal.

8. Ropes, Chains and Accessories

Ropes and chains are very commonly used in forest operations, especially during timber transport. But there are many other jobs for which they are also needed, such as pulling down lodged trees or climbing trees. Ropes and chains can become a considerable accident risk if they are handled carelessly. Since it is not rare for a man's life to depend directly on their reliability, it is important to know what kinds to use and how to use them properly.

Ropes and chains, as well as slings, straps, chokers, shackles, hooks and pulleys, should be of good material and construction. They should be examined regularly. As far as possible, the maximum safe working load should be marked on them conspicuously.

Except where otherwise stated in this section, the safety factor should normally be at least five, i.e. the breaking strength should be at least five times the maximum safe working load.

Chains are frequently replaced by wire ropes. This can generally be recommended, since wire ropes are lighter, easier to handle and safer at high tensions.

Wire Ropes

Wire ropes are of the greatest importance for all skidding, loading and transportation equipment. Workers using them frequently should have a thorough knowledge of their composition and their maintenance requirements. Suitable ways of joining and attaching ropes, such as splicing and socketing, should be familiar to them. If a rope has deteriorated, they should know when to replace it.

For many jobs there exist special kinds of wire rope, meeting various requirements of strength, pliability and resistance to abrasion. The rope selected should always be appropriate for its intended use. Accidents happen frequently when broken ropes are replaced by others that are not suitable for the job.

In the course of time wire ropes can lose much of their strength if they are not handled carefully.

Since broken wires can cause dangerous injuries leading to blood poisoning, wire ropes should never be handled with bare hands. Tough leather or canvas gloves afford good protection.

Material, Construction, Fittings.

Wire ropes should conform to national standards, if any. A high-quality galvanised steel wire will stand the stresses of work far better than most other materials.

The ends of a rope should be seized to prevent the strands from becoming loose, and such fittings as clips and clamps provided in adequate number and retightened from time to time. Eye splices should be provided with thimbles (fig. 19).

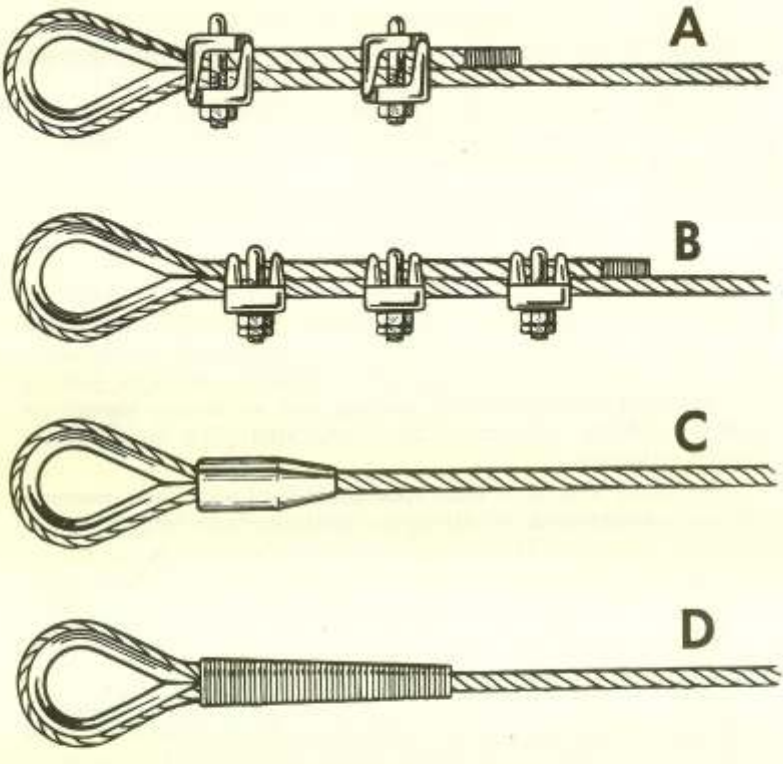

Fig. 19. Some fittings for wire ropes.
A and B. Clamps. C. Socket. D. Splice. Eye thimbles should be used in addition.

Maintenance.

Regular cleaning and lubrication of a rope will lengthen its service life and diminish corrosion. Knotting of ropes should be prevented by all means, since this weakens them considerably (by 50 per cent. or more). Abrasion, for instance by crossing ropes,

should also be avoided as far as possible. This is of special importance during skidding. Excessive bending of a wire rope will lead to fatigue.

Wire ropes which show evident signs of wear should be replaced. There are no definite scales for determining when this time has come, for many factors are involved, such as corrosion, fatigue and abrasion. As a general indication it may be said that if more than 10 per cent. of the total number of wires are broken in any length eight times the diameter of the rope it should certainly be replaced.

Wire ropes should be stored in dry places where they are not exposed to excessive heat.

Drums, Pulleys, Shackles, Etc.

Drums and pulleys should be at least 30 times the diameter of the rope, larger diameters being preferred if practicable. The size of sheave grooves should be appropriate to the rope diameter, and in any case large enough to enable the rope to run free.

Three turns of a wire rope should always be left on the drum during work with a winch.

Shackles, hooks, pulleys, slings, eye splices, sockets, anchorages, etc., used with a wire rope should have at least the same strength as the rope.

Fibre Ropes

In some places fibre ropes still play an important part in forest operations, although they are being replaced more and more by wire ropes.

A good grade of Manila rope should be used. Ropes of suitable synthetic fibres such as nylon can also be recommended for certain purposes, since they possess greater breaking strength and far superior elasticity and are more resistant to abrasion and rotting. The safety factor should be at least ten.

Fibre ropes require similar precautions to those for wire ropes, as regards rope fitting, avoidance of abrasion, kinking, excessive bending, etc.

Fibre ropes should always be kept clean and dry and should not be exposed to destructive chemicals. If they become saturated with water they should be properly dried and protected against freezing.

Regular examinations of ropes in use should be made for abrasions, broken fibres, cuts, fraying, displacement of strands, deterioration of fibres and discoloration; defective ropes should be renewed as soon as possible.

Fibre ropes should be stored, after being cleaned and dried if necessary, in dry, well-ventilated places where they are not exposed to excessive heat.

Chains

Like wire ropes and fibre ropes, chains are used for dragging, hoisting or fastening. Breakage of chains can lead to injuries if persons are hit by the load or by the chain itself if it flies off with great force.

An advantage of chains is that a qualified local blacksmith can in certain cases repair them, or even make them himself from wrought iron. Nowadays, however, electrically welded chains of alloy steel are preferred because of their greater strength and resistance to corrosion. The metals from which they are made should conform to national standards, and all new and reconditioned chains should be subjected to a tensile test before they are taken into use. Proper facilities for their repair are frequently not available locally. They should never be annealed.

Care and Maintenance.

Chains should not be crossed, twisted, kinked or knotted. Regular inspections for bent links, cracks, scores and corrosion

are necessary. If a chain is much worn, or its elongation exceeds 5 per cent. of its length, it should be discarded.

Splicing broken chains by inserting bolts, by wiring or by passing one link through another and inserting a nail to hold them together, is a dangerous practice and should be prohibited. Special links with slots are available for this purpose. Their breaking strength, however, should correspond to the chain on which they are used.

When wrought-iron chains are repaired, annealing and normalising should be done only by competent persons. Wrought-iron chains used for hoisting should be annealed periodically, say at intervals of one year.

Chains that are exposed to extremely low temperatures can lose much of their strength. This can be prevented by warming them, but since this will in most cases be impossible in forest operations, their maximum working load should be reduced.

Swivels, Shackles, Etc.

When there is a danger of torsion in chains, a swivel can help to avoid it. Swivels, shackles and hooks used with a chain should, if possible, be secured by safety bolts, have at least the same strength as the chain and be of the same material.

9. Climbing Equipment

Tree-climbing equipment is used for high rigging, pruning, cone-picking and sometimes for special operations in which standing trees are topped, branched or pulled over by ropes. Generally, it is helpful if at least one experienced climber equipped with a suitable climbing kit is available.

Ladders

Ordinary ladders are advantageous if only relatively short distances have to be climbed and it is not too difficult to transport

them. Greater heights can be reached with extension ladders or sectional ladders.

When special climbing jobs have to be done in the vicinity of towns, or at roadsides, turntable ladders of fire-brigade type may be useful.

Material, Construction.

Wooden ladders should be of sound material and of adequate strength, with their rungs free from knots and spaced at equal intervals ranging from 10 in. (25 cm) to 14 in. (35 cm). They should not be painted but oiled or treated with transparent preservatives so as not to conceal any defects. Wooden ladders or sections of extension ladders should not be longer than 17 ft (5 m). Their rigidity, and hence their stability, can be increased by placing metal tie rods at their upper and lower ends. Ladders with only one upright are dangerous and should not be used.

Fixed ladders used for fire lookouts, etc., should be interrupted by landing platforms every 30 ft (9 m), and the top platform should be protected by a drop gate.

Use.

If ladders are set up vertically, they should be fastened firmly to the tree and the climber should be secured with a safety belt.

Leaning ladders should be used in such a way that the bottom and top cannot slip or the ladder break because of excessive bending. The bottom can be secured by spikes, and the top which rests against the tree by means of a curved top rung. During climbing both hands should be used, and the climber should always face the ladder. For passing tools handlines are needed.

Work on vertical ladders can sometimes be facilitated if the climber is provided with a small platform on which he can stand at ease and where he does not tire so quickly as on a rung. The same purpose can be served if the top rung is made broader to give a better footrest.

Care, Maintenance.

Ladders should be stored in dry, well-ventilated places, and not left for long periods exposed to the weather. Regular inspection will help to discover faults.

Climbing Spikes

Climbing spikes should be used only where ladders are not practicable. They will normally be used for climbing tall trees or poles and for work on telecommunication lines. No one, other than experienced climbers who are in good physical condition, should be given such jobs, and they should never be carried out during bad weather such as storms or showers, or when the tree is covered with ice.

Climbing spikes must be kept in perfect condition and inspected daily during use. Straps must be strong and reliable. Spikes should be kept sharp so that they do not slip. When walking on stony ground with spikes fastened to the shoes, the climber should be careful not to blunt them. In tree-climbing the spikes should grip firmly before the weight is shifted from one foot to the other.

Some special equipment, e.g. the "tree bicycle", is available which allows the climber to climb trees without injuring the bark. This, too, should be kept in perfect condition and be examined daily for possible faults before use.

Safety Belts

When climbing with spikes, mounting sectional ladders or working aloft, the worker should wherever possible be secured by means of a safety belt or a tree harness and a lifeline. For tree-climbing, safety belts will not always be practicable when trees are branched. The climber should nevertheless wear one as often as possible and rely on it. If single thick branches stop the climber,

he should first attach one safety rope above the branch and then open the second one, and so be able to continue the climb without at any time being in danger of falling.

Safety belts should withstand not only the static load on them during climbing or working but also the violent shock of a sudden fall. This requires high-quality material, proper care and daily inspection during use. Waist belts can be made of leather or webbing. Webbing is rather better since it does not cut as easily and will not be affected by hot and dry storage. Leather must be oiled, but no mineral oils should be applied.

Waist belts should be securely buckled and worn tightly. Two safety ropes should be firmly attached to the waist by means such as D-rings. Simple riveting is not sufficient. Fastening and opening or lengthening and shortening of the ropes should be easy.

If lifelines are employed, Manila rope ½ in. (12 mm) thick is recommended. Lifelines can be used in connection with a special braking device which enables the climber to descend safely and which can be arrested in any position required to protect him against a sudden fall.

All ropes and belts must be kept away from sharp tools.

Ropes can be severely damaged if they are burned by excessive friction. Where cutting tools are used by the climber, safety belts with wire ropes or ropes with a steel core are preferable.

Belts and fittings, and especially rivets, should be examined at frequent intervals.

10. General Precautions with Machines

The aim of mechanisation should be not only to increase the productivity of an operation, but at the same time to relieve the workers of physical effort and reduce the accident risk. Well-conceived mechanisation can undoubtedly improve the safety of forest operations.

As accident statistics of highly mechanised forest operations show, properly operated machines are only a minor cause of

accidents, and the majority of accidents are due to human errors, falling branches, rolling logs and other non-mechanical causes.

On the other hand, in the operation of machines there are risks unknown in manual operations. The operator and the supervisor should be aware of these risks, and work should be so arranged that no machines are employed except in conformity with good and safe working practices. Detailed instructions should be issued for this purpose.

Work with machines being much faster than work with hand tools, the operator has to react much more quickly. This requires not only complete familiarity with the handling of the machines, but also more skill and concentration. For heavy machines like crawler tractors, only workers with a keen sense of responsibility should be selected as drivers.

The operation of machines is frequently accompanied by noise, vibration and the emission of carbon monoxide in exhaust gases. These aggressive agents are detrimental to the workers' health.

It is therefore highly desirable that machine manufacturers should construct machines with the lowest possible level of vibration and noise. When forestry undertakings buy new machines they should spare no expense to ensure comfort of operation. Where noise and vibration cannot be avoided, foresters or foremen should endeavour to organise the work by rota, so as to protect the workers from their harmful effects.

If the various suggestions made in this section are followed, it will often be found that a job which was formerly avoided by workmen because of its risks and discomfort has become highly attractive.

GUARDS

In machine operations the power of prime mover is transmitted to machine tools or appliances in various ways. Rotary, reciprocating or merely linear movements can be found in power transmission. Shafts, wheels, drums, pulleys, couplings, clutches,

belts, and chains are common features of all kinds of machines. If not guarded securely they can be a considerable and often underestimated accident risk. Work with an unprotected power take-off in tractor operations, for instance, has already resulted in numerous fatalities and serious injuries.

Hence it is a fundamental prerequisite that all such dangerous parts of machines should be well guarded. Precautions have also to be taken against risks like flying particles or kick-back of sawn materials.

It should be forbidden to sell any machines which do not conform to the standards laid down for their guarding in national laws and regulations, and when forest undertakings order machines they should always specify that they should be properly guarded. [1] Sometimes machines are built or altered in local workshops, and this can be a great source of danger if safety rules are neglected. The construction of machines in such places should be adequately controlled.

The guards attached to machines should combine a maximum of protection with a minimum of interference with the operation and discomfort to the worker. During repairs, they should only be taken off after complete stoppage of the machines. Preference should be given to interlocking guards which make the operation of a machine impossible when they have been taken off. Since not all parts of machines can be guarded completely (for instance power-saw chains) the operator's clothes should be tight enough to prevent any dangerous contact with moving parts.

Starting Up

When machines are started up everyone should stand clear. It may be advisable to ensure this by a signal given by the operator and answered by his fellow-workers. Cranking or starting with

[1] The Guarding of Machinery Convention, 1963, prohibits the sale, hire and transfer in any other manner of machinery of which certain dangerous specified parts are not provided with appropriate guards.

a handle should be done in such a way that the operator is not hurt by backfiring and persons standing nearby are not injured (fig. 20). Machines should be sufficiently secured against being started by unauthorised persons. Stopping devices should be easily accessible to the operator or to other persons.

Maintenance, Use

Machines must always be kept in a safe working condition. This is especially important for parts like brakes and clutches. Excessive speed should be prohibited and limited as far as possible.

Petrol-driven machinery should be stored or garaged in fire-proof places, be fuelled safely and, where the danger of starting forest fires exists, be provided with spark arresters fixed to the exhaust pipe.

Operator's Stand

Special care should be given to the operator's stand. It should be comfortable and protect him against noise, vibration, exhaust gas and bad weather. Operating handles and levers should be in a position where they can be reached and moved without effort. Where practicable, a seat with a suitable spring, a foot-rest and a handhold or similar device should be provided to lessen the stress of the job.

Noise

Noise that exceeds approximately 60 to 70 decibels may affect the nervous system. From approximately 90 db onwards the sympathetic nervous system and the hearing are affected. Depending on the frequency distribution of the sound waves, loud noise can eventually lead to hearing loss or even complete deafness.

Such a risk exists in power-saw operations where up to 105 db have been measured and levels over 90 db are common.

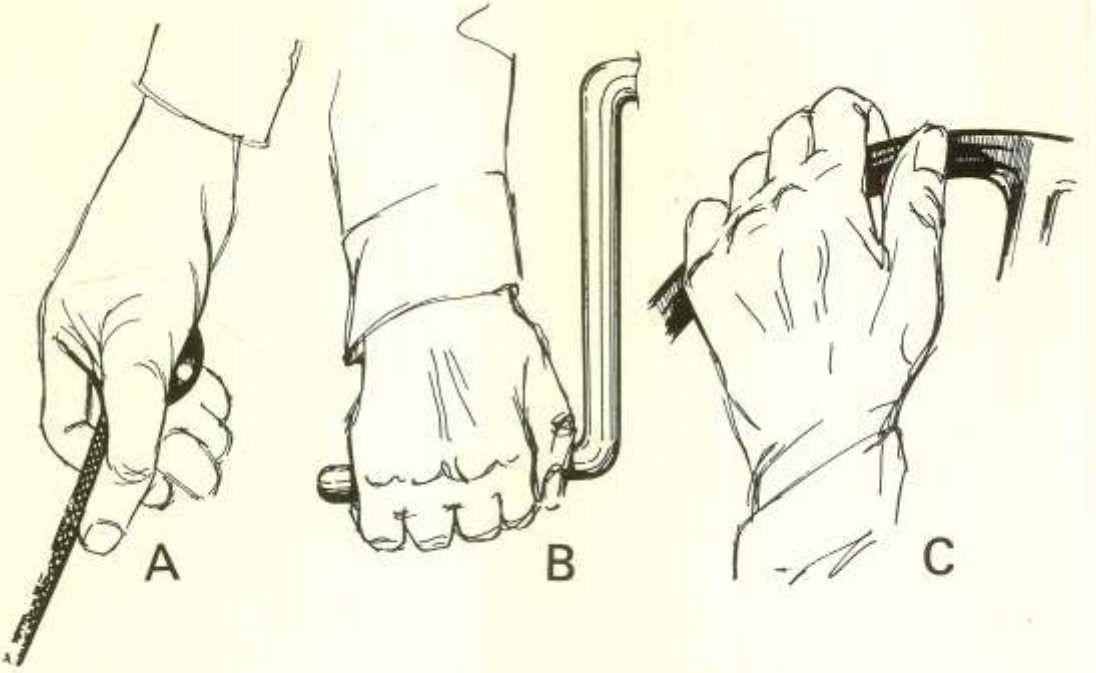

Fig. 20. Safe ways of starting an engine or holding a steering wheel.
A. Starter cord. B. Cranking handle. C. Steering wheel.

Research institutions and manufacturers are at present attempting to reduce the noise of power saws by mufflers.

Whenever the noise from power saws or any other machines exceeds tolerable limits, special precautions are necessary. Earplugs are the simplest means of protection against noise, but it has proved difficult to get men to wear them. Furthermore, they are effective only if they exactly fit the worker's ear. Ordinary cotton-wool plugs are neither hygienic nor effective as protectors. Though special glass-wool plugs which can be thrown away after use have proved to be more hygienic and effective, the best means of noise protection are ear mufflers which cover the whole ear and can be attached to hard hats. Ear mufflers can quite conveniently be worn at stationary work places or by tractor drivers, but are less convenient for power-saw operators who move about and perform heavy physical work.

When men do not use any means of ear protection, it may be necessary for them to be taken off noisy operations and replaced by other workers at intervals. In power-saw operations this is very important if the saw runs almost continuously. If, however, besides sawing, the worker performs other duties, like barking with a barking spud, branching with an axe, and measuring trees, there is enough variation in his job to prevent injury from noise. The introduction of machines for branching and barking, for example, might change the situation and demand appropriate precautions.

Persons working in the vicinity of noisy machines may also be affected, so that workers other than the machine operators should, if possible, be placed at a sufficient distance from the source of the noise or otherwise protected.

Vibrations

Vibrations of machines create much the same kind of problems as noise. They occur in moving vehicles, particularly two-wheel tractors, and on power saws and other portable machines.

Prolonged exposure to vibration fatigues the human body.

In the long run vibration can be harmful to the nervous and sympathetic nervous systems and may also cause damage to joints or arthrosis. Such harmful effects depend not only on the time during which the body is exposed to vibrations, but also on their frequency and intensity as well as on the parts of the body affected.

Portable power saws generate high-frequency vibrations which are concentrated on the hands and arms. If these vibrations are very intense, numbness occurs, pains are felt in the fingers and hands, and the fingertips become white, particularly at low temperatures. Workmen are increasingly being forced to give up power-saw operations owing to such symptoms (though unfavourable working conditions combined with individual sensitivity may have been partly responsible in some cases). From workers who operate pneumatic tools like rock drills we know that after a few years arthrosis of the joints of hands; elbows and shoulders can develop. Handling of power saws with intense vibrations has similar results.

Recent observations indicate that the symptoms described above are more pronounced if both vibration and noise are present, as in power-saw operations.

When driving vehicles like tractors, the whole body is exposed to vibrations, which usually have a low frequency. These can affect the spine and the digestive system.

Vibration can be reduced by various means. In vehicles such as tractors, for instance, vibration can be greatly reduced by providing a seat with suitable springs. Machine designers can also contribute considerably towards reducing vibration, for instance by placing handles in the best position or by providing a counter-piston to counterbalance the load of single-piston engines. Power-saw manufacturers have achieved promising results with specially designed handles. Rubber elements placed between handle and saw absorb much of the vibration, so that there is hope that this will cease to be a problem. At present, however, as with noise, a frequent change of work is necessary. This applies to all machines where vibrations are obviously harmful.

Carbon Monoxide

A third harmful feature of work with petrol-driven machines is the generation of exhaust gases, which contain a certain amount of carbon monoxide. However, research has shown that in forest operations this normally causes no danger as the wind rapidly disperses the gases. Nevertheless, the exhaust pipe, on a tractor for instance, should discharge so that the gases are carried away from the operator's face. In special circumstances, for instance in a hollow where the air is still and exhaust gases can accumulate, precautions are needed. Similar risks can occur when deep snow has been cleared away around a tree, and also on sites with dense vegetation, especially if a power saw is used for felling, branching and cross-cutting consecutively. In rooms, of course, petrol-driven machines must not run unless suitable exhaust ventilation is provided.

11. Sawing Machines

Power Chain Saws

Power chain saws are in many ways more dangerous than hand saws. The rotating chain can cause severe cuts; the noise impedes aural communication. Higher cutting speeds and greater difficulty of cutting accurately can create further risks. On the other hand, the one-man power saw greatly reduces the danger involved in cutting tensioned wood by its ability to cut more easily through the tree.

When the motor is started by pulling a cord, bruises can be caused if the cord kicks back or breaks (fig. 20). The saw should be firmly supported by hands and feet. It should be placed on even ground and the chain must be clear of the ground so that no obstacles are caught. Saws should never be started at places where a petrol tank has been refilled. Serious injuries can occur if the motor is started when the saw blade and sprocket are dismantled.

When the saw is idling, the chain should stop, and the idling screw must be adjusted accordingly. When cutting, the operator should always have a safe foothold and carefully watch any wood that might get loose. Very many accidents with power saws are caused through falls into the running chain. No onlookers should be permitted in the vicinity of operating saws; serious accidents can result if the saw is suddenly pulled or thrown backwards and hits the onlooker's legs.

When a cut is started, the movement of the saw chain should be watched, since it can push the saw away from the cut or draw it towards the cut. Cutting with the tip of the saw blade is especially dangerous because the saw can be thrown up or down during cross-cutting, or sideways during felling. In cutting into a tree the cut should not be started with the tip of the blade at right angles to the tree trunk but with the blade held obliquely while the tip is guided gently into the wood (fig. 21).

The hand holding the front handle is frequently hurt if the saw kicks back during cutting. A special guard on the handle largely reduces this danger.

No iron or steel wedges are permitted when a power saw is in operation. Wedges made of wood, magnesium, aluminium or synthetic materials may be used. If the saw hits the wedge it can kick back or throw the wedge out of the cut. When big trees are felled it is safer to take the saw out of the cut after completion of back-cutting, and to use a wedge for finally pushing the tree into the felling direction.

Sawdust and wood splinters frequently hamper the operator, especially in windy weather during branching, and when cuts are made high above the ground. An adjustable face shield attached to a hard hat or goggles can effectively protect the eyes and the face from flying particles.

Noise, vibration and exhaust gases demand special precautions in power-saw operations. Frequent interruptions of the operations or a relay of operators will prevent harmful consequences.

Tight clothes, a hard hat, ear plugs and gloves are necessary precautions against cuts, vibrations and noise.

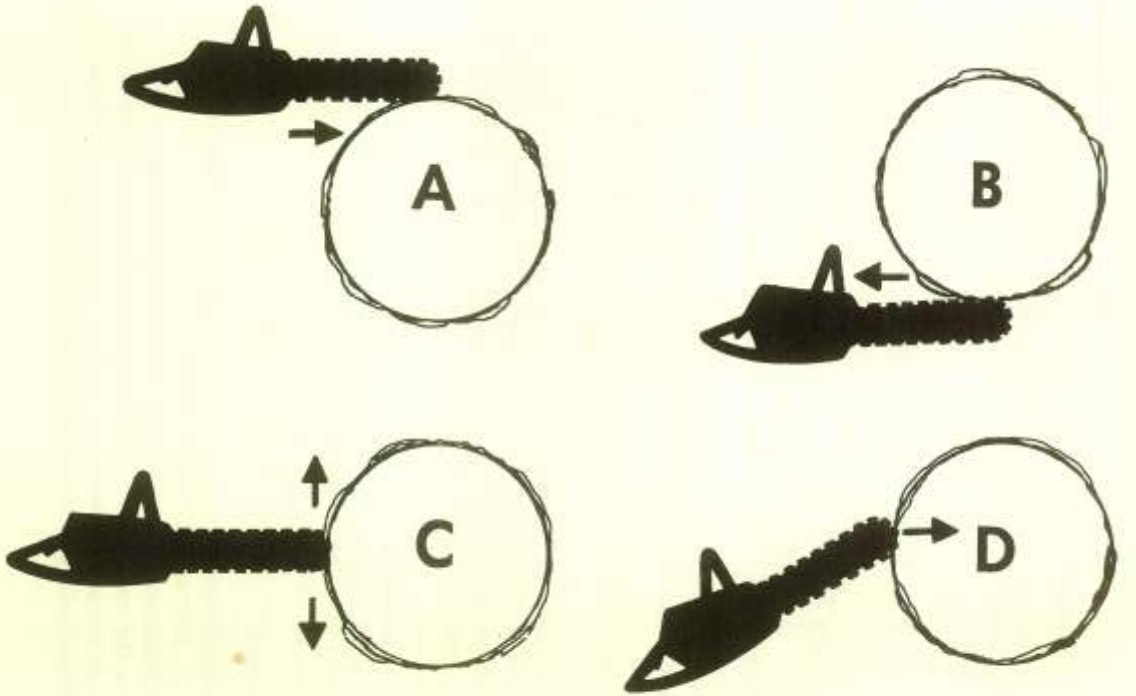

Fig. 21. How to start a cut with a chain saw.
The chain can drag the saw towards the cut (A), push it backwards (B) or throw the tip up or down (C). The correct way to start a cut is to hold the tip of the blade obliquely to the tree trunk (D).

Care and Maintenance.

A power saw should not be serviced in the vicinity of open fires, and smoking should not be allowed during servicing. A power saw should never be stored close to fireplaces.

The saw chain must be kept in good condition and be sharpened properly so that it runs smoothly and does not kick back or break.

Transport and Storage.

When the saw is being transported the motor should be stopped, except for short distances from cut to cut, e.g. during branching or cross-cutting.

During storage and transport over longer distances the saw blade and chain should be protected by a sheath.

Circular Saws

In forestry operations circular saws are sometimes used for cross-cutting pit-props, pointing fence posts, ripping fence rails or woodworking during repair or building work, and are often used for cutting short lengths of firewood.

Circular saws are among the most dangerous machines. If they are inadequately guarded, contact with a running saw blade can result in serious injuries in the event of kick-back of sawn material or breakage of the saw blade. Both the operator and his helper are exposed to these risks.

Construction.

Circular saws should be mounted on solid tables and be set up in safe places kept clear of waste.

A maximum of protection should be provided by properly guarding the saw blade. A solid hood should cover the part of the saw blade projecting above the material that is cut, and should be adjusted according to the thickness of the material. Such a hood

will prevent chunks or splinters of wood from being thrown off as well as preventing contact with the blade.

When the saw is not in use the hood should cover the blade above the table. The saw blade must be completely guarded beneath the table, in a manner that allows the safe removal of sawdust.

An adjustable riving knife mounted behind the saw blade is necessary to prevent kick-back during ripping. It should extend above the table to a height of 3/32 to 3/16 in. (2-5 mm) less than the height of the saw. The clearance between saw blade and riving knife should not exceed 1/8 in. (3 mm).

For cross-cutting short lengths of fuel wood a sliding feed table or a rocking or swinging frame should be used for pushing the wood against the saw. In addition, devices by which the wood can be pushed without exposing the hand to the saw blade are recommended.

Saw blades should be suitable for the specific job, be properly sharpened, well centred and run at the proper speed. If they show signs of cracking they should be discarded at once. For cross-cutting the blades should be different from those used for ripping. If both jobs have to be done on a combined cross-cutting and ripping saw, a general-purpose blade should be used.

Use.

The operator should stand slightly to one side and not directly in line with the blade. A hard hat and a leather apron will give him additional protection. A face shield of wire mesh will provide adequate protection against flying materials. Circular saws should be operated only if the daylight or artificial light is sufficient.

Big pieces of round wood have to be split before sawing. Special attention is necessary if the wood contains cracks and splinters or if it is wet and slippery.

When small pieces of wood are to be cut a push stick is an excellent means of preventing contact with the saw blade.

Quite often manual-feed circular saws impose a heavy strain on workers who feed the material to the saw or take it off. This

job can be largely facilitated by employing trestles with feed rollers and by arranging the work so that as little lifting and carrying as possible are done.

If circular saws are installed at permanent landings the accident risk can be reduced by means of automatic feeding and remote control.

Brush-Cutting Saws

For cutting brush or small trees up to a diameter of approximately 1 in. (2 cm) portable brush-cutting saws are available with a motor and a circular blade or a short chain blade attached to a transmission shaft. They are carried on the worker's back. Their operation is rather strenuous and requires workers in good physical condition who work in turns.

The straps used for carrying the machine should be padded and adjusted to balance the machine; furthermore, they should permit rapid removal of the machine from the body in emergencies (fig. 2, p. 9).

While brush-cutting tools are being used other persons should keep at a distance of at least 16 ft (5 m) since they will be in great danger if the machine suddenly swings round. The operator must be careful not to clean the saw while it is running, and beware of material that might hit his feet after he completes a cut. He should wear safety shoes with steel caps.

In addition, the precautions applicable to the operation of circular saws or chain saws should be followed, subject to the necessary modifications.

12. Machines for Branching, Barking, Wood Splitting and Wood Chipping

The machines discussed in this section can only be dealt with briefly, since there is a great variety of them and they are still undergoing rapid technical development. Many different mech-

anical principles have been tried out. Mention will be made only of those machines that are widely used.

In some countries having flat terrain, large clear-cut areas and rather small trees, experiments have been made for a number of years with combined timber-harvesting machines. They consist usually of a tractor on which are mounted a power saw and loading, branching and barking devices in different combinations. From the safety point of view these machines have the considerable advantage that they can be operated by only one man, as against several in conventional operations, and the man can be fairly well protected in a cab.

As far as individual tools are concerned, the usual precautions have to be taken. Little can be said about the risks of these new machines until they have been used on a larger scale.

Branching (Limbing)

Branching or limbing is often done by power chain saws or by special petrol-driven portable circular saws similar to the brush-cutting saws described above. In such cases the safety rules mentioned for these latter tools should be followed. A good foothold for the worker and safe support for the machine during the cut are essential. The power saw should rest as much as possible on the log. In addition, rollers attached under the saw have been found to ease the operation. When branching with a power saw, the operator should protect his eyes with a face shield or goggles.

Little information is available on fixed branching machines installed at landings. An important point seems to be to provide a safe working space and protection against the swinging tree and material that is cut or sheared off.

Barking

For the mechanical barking of small trees, the machines mostly used consist of cylinders with rotary knives through which the tree,

pole or billet is passed. Most accidents happen in feeding the machine, when the wood slips, falls down or swings to the side. Twisted and bent material can be very dangerous and should be discarded if its shape is too irregular. A steel bow fixed in front of the feeders can greatly help to prevent billets from swinging in a wide circle. Hydraulic lifting appliances should not be lowered until the feeding rollers are holding the material firmly. Feeding rollers should be fenced, as far as practicable, and any contact with them should be avoided. If the machine has a high speed of operation, care must be taken that enough men are available for feeding and that rest pauses are made at appropriate intervals.

Barking machines in which the billets rotate can be very dangerous if the operator's clothes are caught, particularly if billets of an irregular shape are passing through the machine. Hence it is most important that the operator should wear tight clothes.

Splitting

For wood splitting, different models of machines are available with wedges moving up and down, either at regular intervals or when set in motion by an operating handle. The latter system has advantages if the wood is twisted and difficult to split and has to be placed very carefully under the wedge. Pieces that are too difficult to handle have to be broken down to the proper size by other means before they can be put under the machine. Non-slip supports at a height appropriate for the operator can facilitate the operation greatly.

Another splitting machine used for short lengths of fuel wood consists of a conical screw which can be driven from the power shaft of a circular saw. In such a case both the saw blade and the shaft have to be covered completely. The rotating cone can become quite dangerous if it catches a glove or sleeve. Rotating pieces of wood that are thrown off are another source of accidents, but these can be prevented by two sharp wedges mounted at the front end close to the cone. The wood should be held at the top

end, and the operator prevented from coming too close to the dangerous parts of the machine by a guard mounted on the working table.

Chipping

Wood-chipping machines require solid guards which enclose the feeding table or feed opening at least 20 in. (50 cm) from the feed rollers. The knives must also be fenced in order to prevent any contact during operation, and securely fixed pipes should be provided for evacuating the chips in the desired direction. Workers feeding the machine should not stand on the side of the feed table but at the far end to avoid being caught and drawn towards the machine.

If the material becomes entangled, the machine should be shut off before any clearing work begins. A worker should never try to remove the feed enclosure and pull the entangled material off while the machine is still running. Loss of limbs or even fatal accidents occur in this way. This is particularly the case with undergrowth and small, twisted material. On the other hand, when thicker poles are chipped, the risk of injury from the swinging tail end is greater.

Care must be taken that no one is hurt by the chipped material, which sometimes flies off with great force, especially if the chipping lengths are great. The danger zone should not be entered and, if necessary, should be fenced off.

13. Tractors

Because of their mobility, tractors are a power source of almost universal application in forest operations. They are often used for skidding, loading and transport of trees, road construction, cultivation of planting sites, and driving motor sprayers, circular saws, wood chippers, barking machines and other machines. In the forest a large number of different makes and shapes of tractors

are used, such as wheeled and crawler types and both ordinary agricultural and special forest types. However different these types of tractor may be, a number of precautions should be observed in the case of all of them.

Driver

Possibly even more than the operator of other machines, the tractor driver requires skill, intelligence and a sense of responsibility to cope with his job. This is particularly true as regards heavy tractors like high-powered crawlers, and operations in which other workers besides the driver are engaged.

A good physical capacity is needed in order to withstand the frequently rough working conditions, the bouncing, the noise and the dust. A new driver should first undergo a medical examination and proper practical training before being allowed to operate the tractor himself.

Construction of Equipment

Means of Access.

Numerous tractor accidents occur during mounting and dismounting. As far as possible, handholds, access ladders and slip-resistant foot-rests and platforms should be provided to make access easy and safe.

Cab.

In recent years it has been clearly demonstrated that the best means of protection for the tractor driver is a solid cab or frame which resists the impact of overturning (fig. 22). At the same time it can protect him against other objects such as falling branches or trees, and also against the weather. The cab should be spacious and comfortable and have easy access from both sides. It should have a windscreen and windows of transparent non-splinterable

Fig. 22. Robust frame mounted on a tractor to protect the driver if it overturns.
The roof gives additional protection against falling material during skidding operations, etc.

material and a power-driven screen-wiper. If the tractor is used to travel over frozen lakes or streams the cab should have an additional top outlet which should be opened. The arrangement of the seat and the control levers should afford a maximum of comfort and convenience.

Wheels.

The stability of a wheeled tractor can be increased if the tracks are adjusted so that they are as wide as possible, if twin rear wheels are used and if additional weight is put on the front axle. The wheels should not be too high since this raises the centre of gravity. The back wheels should be equipped with mudguards that protect the driver from contact with them. The seat can be sprung or suspended and be provided with a back rest.

Power Take-off

Power take-off shafts, belt pulleys and belts must be effectively guarded to prevent anyone coming into contact with them. Shaft guards must be of robust construction, and must be properly fitted over the full length of the shaft. Shaft ends must be secured by caps (fig. 23). Their danger is often overlooked, but like long shafts they can easily pick up a person by his clothing and whirl him around or crush him so severely that he is badly injured or even killed.

Fire Extinguishers.

It is good practice to equip each tractor with one portable fire extinguisher.

Exhaust Pipe.

The exhaust pipe should be so placed that the driver is clear of the exhaust gases; it should be equipped with a spark arrester.

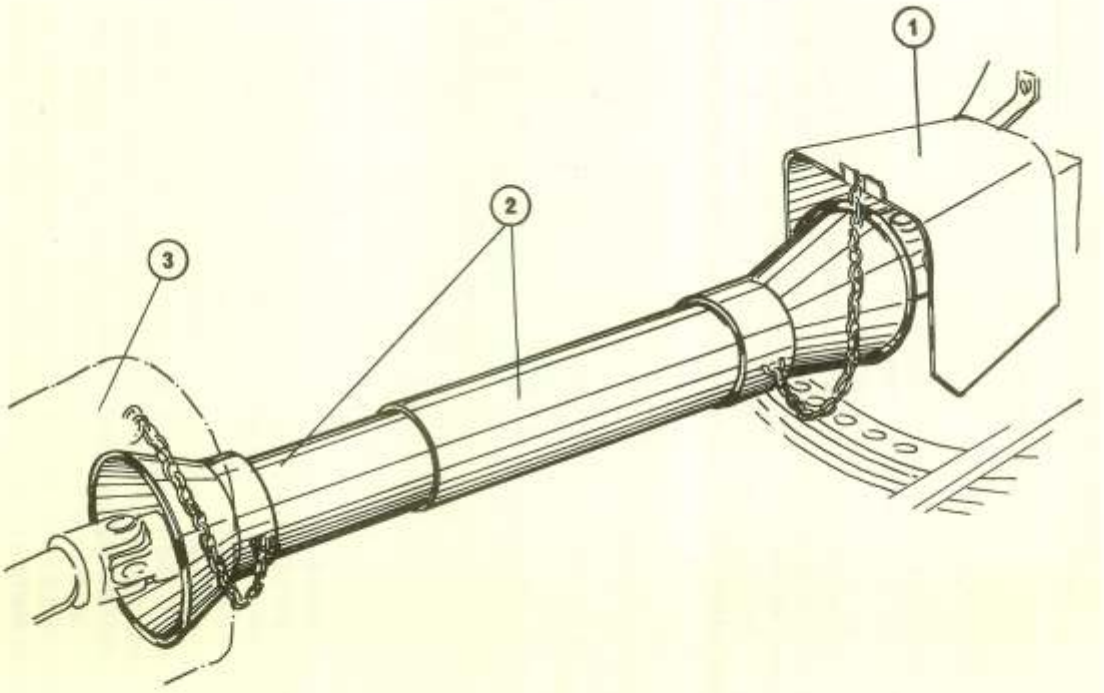

Fig. 23. Robust guards protecting power take-off shafts.
1. Guard on tractor end. 2. Sliding cylindrical shaft guard. 3. Guard on end to which implement is hitched.

Operation

Starting and Stopping.

Injury to persons or damage to property frequently occurs when a tractor is started carelessly. Before starting a machine it is wise to go around it once and look out for persons or obstacles that might be run over. Starting the motor can lead to accidents if the tractor is in gear. An interlocking device is of advantage because it makes starting impossible unless the gear lever is in neutral. In cranking by hand the thumb should be placed alongside the other fingers and pressure should be exerted upwards (fig. 20 B, p. 64).

Hitching of Implements.

If trailers, sulkies, arches or similar implements are coupled to the tractor, no one should stand between the tractor and the implement, and the hitch should be guided with a pole or a bar. The equipment to be hitched to the tractor should be blocked. Similarly, if equipment is manoeuvred by pushing it backwards, a push bar should be firmly attached between equipment and tractor, while helpers stand in a safe place.

When fixed or mobile equipment that is operated by power take-off, such as a rotary hoe or a barking machine, is started the operator should not engage the clutch without giving a warning signal to persons standing dangerously close. If necessary, his fellow-workers can give him appropriate signals, as described in Section 22 (Part III).

The operator should not leave his seat without shutting off the power and putting the gear in neutral. Equipment that is lifted hydraulically should be lowered during stops. On slopes the tractor should be parked sideways and be firmly braked. When leaving the tractor the operator should always take the ignition key with him to prevent children or other unauthorised persons from starting it up.

Overturning Backwards or Sideways.

Of all fatal accidents in tractor operations probably the largest number are caused by the tractor overturning. The risk is especially pronounced with wheeled tractors on steep and rough terrain, but it also exists with crawler tractors and in flat country.

Overturning backwards can be a matter of a few seconds if the back wheels of a tractor are blocked and the front end consequently rears. When the back wheels get stuck in a hole or in a ditch the driver should never attempt to jerk the tractor out by increasing the speed of the motor and suddenly engaging the clutch. It is much safer to back or tow the tractor out. In the event of rearing, the clutch should be released immediately.

Another cause of rearing is the high hitching of implements. If, for instance, a ditched vehicle or a stump has to be pulled out by a tractor, and a rope or chain is attached above the centre of the tractor's rear axle, it will act as a lever, and the tractor can be pulled over very quickly if the vehicle or stump does not come free (fig. 24). Loads should therefore always be hitched as low as possible.

Similarly, if a load is pulled by a winch mounted on the rear of a tractor and the load gets caught suddenly, the pull of the winch may overturn the tractor backwards unless the load is released at once.

Special attention is required on steep slopes. On uphill journeys, loads resting on the rear axle—for instance the weight of a two-wheel trailer—will increase the tendency to rear. Going downhill requires first of all reliable brakes; the motor should be in gear, the load should not be excessive and slippery patches should be avoided. On a loose surface a lowered bulldozer blade may be useful for controlling the speed of descent. The tractor should be snubbed only if safe anchorage is available. Sound stumps are much more reliable than standing trees, which might be pulled over.

Overturning sideways occurs if a tractor is driven too close to ditches and banks. During soil cultivation sufficient headland

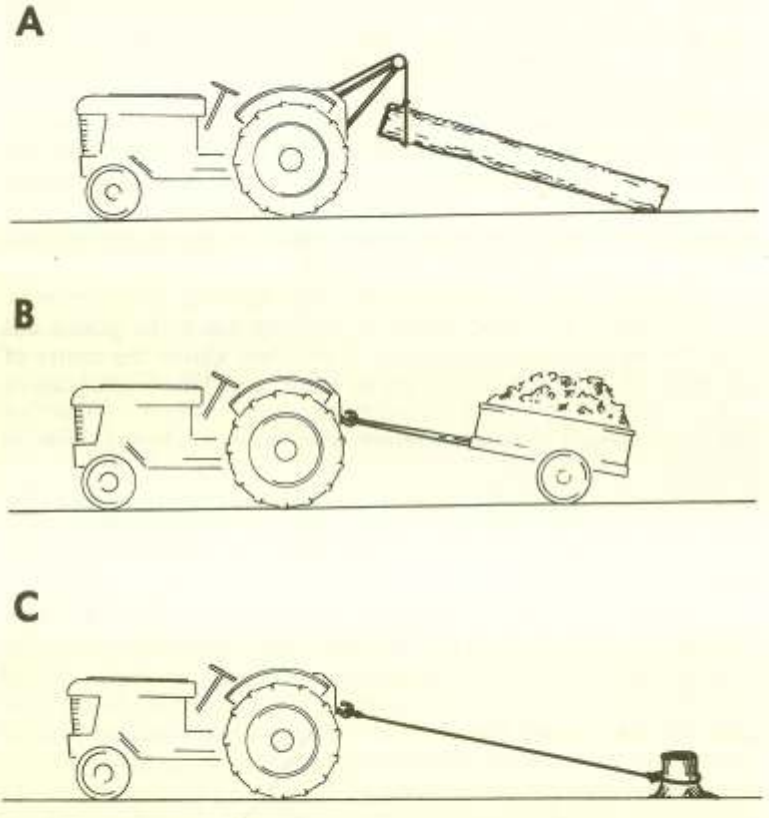

Fig. 24. High hitching of loads increasing the danger of rearing.
A. Hauling a tree trunk. B. Drawing a trailer. C. Uprooting a tree stump.

must be left to avoid such a risk. Turning and reversing on hillsides should be done slowly and in a wide circle. If loads are transported downhill they should be braked sufficiently, since they may push the tractor over. Danger exists too when implements like loaders are operated and the centre of gravity is shifted.

Other Precautions.

Taking passengers on the tractor is permissible only if proper seats with foot-rests and back-rests or hand-holds are available. Standing on drawbars is a very dangerous habit, and has caused many serious accidents, especially when the tractor draws a trailer.

Getting on or off a moving tractor should be strictly prohibited.

The tractor driver should be taught to adopt safe driving practices and in particular to drive slowly if surface conditions are dangerous. He should know that the force of overturning is increased fourfold when speed is doubled. When a tractor with a safety cab or framework overturns, the driver should grip the steering wheel firmly and stay in the cab.

Care, Maintenance

Tractors have to be checked daily before use. This check should include oil and coolant levels, lubrication, tracks and wheels, all controls and all indicators. Safe operation is possible only if the following equipment is available and properly maintained: front and rear lights, reflectors, horn, direction indicators, windscreen wipers and rear-view mirrors.

Brakes are of paramount importance; they should be properly adjusted and kept in perfect order. Worn linings must be replaced, and the ratchets of parking brakes kept well toothed. Steering brakes consisting of individual pedals placed side by side should be locked if not needed. The clutch should be so arranged that it can be engaged or disengaged smoothly; steering should respond smoothly too. The differential must be locked only if necessary,

since the tractor cannot otherwise be steered properly. Tires or gripping plates on crawler tractors must be in such a condition that a good grip on the ground is ensured.

It is surprising how many serious accidents occur during repair and maintenance of tractors. In principle, no repairs or adjustments should be done while the tractor is running. Cleaning the hoes of a rotary cultivator or the knives of a wheeled mower can, for instance, easily result in the loss of a limb if the clutch is disengaged by the foot and the operator's foot slips off the clutch pedal.

Repairs or adjustments of implements that are controlled hydraulically should be done only when they are lowered to the ground or blocked safely. If jacks are used for lifting the tractor, they should be secured against slipping.

If the motor is overheated, the radiator lid must not be removed, since this can easily lead to bad burns. The fire hazard must always be borne in mind during fuelling.

14. Winches

Winches are commonly employed in all stages of timber transportation for loading heavy materials, for pulling down lodged trees, for ramming posts and for other purposes. They are usually fitted to tractors, but some independently powered units and smaller hand-operated winches are also used.

Construction

All winches should be of solid metal construction and have a safety factor of not less than five. The maximum load must be stamped on a plate affixed to the winch in a conspicuous place. Relatively light winches mounted on tractors with high horsepower rating should be suitably protected against overloading. If the operator is exposed to injury by broken lines, hooks or

pulleys, he must be shielded by strong screens or other adequate means.

There should be a fastening point for the rope at both sides of the drum. The rope should run on to the winch at right angles to its axis.

Hand-operated Winches

Hand-operated winches can kill if the operator is struck with great force by a handle which reverses or flies off the machine. Ratchet wheels on the drum shafts, locking pawls, self-locking devices and similar means have to be provided to prevent this danger.

For lowering loads effective brakes are needed, and the handles must be so constructed that they do not move. Detachable crank handles should be secured against accidental removal. The maximum effort applicable on a handle should not exceed approximately 22 lb (10 kg) if it is operated by one worker, or 33 lb (15 kg) if it is operated by two workers. Handles of winches should be easy to operate from a safe place.

Installation, Operation

Winches have to be securely anchored. On tractors it is best to use hydraulically operated supports for anchorage. If winches are hauling loads uphill they should be so set up that they are drawn uphill by pulleys in the event of their breaking loose from their anchorage under the shock of a load suddenly rolling downwards.

Winches used for pulling down large trees have to be anchored at places where they will not be endangered by the falling tree.

Pulling long hauling lines uphill can be a very strenuous job if done manually. In this case especially the cable drum should run as easily as possible and be kept clean. Double drum winches with a haul-back line are of advantage under such difficult conditions. When a helper follows a log being pulled by a winch, the speed of the winch should not exceed 16-20 in./sec (0.4-0.5 m/s).

Manual guiding of the rope is permissible only by means of a stick and should never be done by a worker standing in the bight of the line. During unspooling the rope should be secured at one end since it is apt to fly back after coming off the drum because of its coil. Winches need effective brakes by which the rope can be stopped at once in any position.

Electrically operated winches with extension cables and, to an even greater extent, radio-operated winches have the advantage that the operator can observe the operation from a safe place and the winch responds more quickly than one with mechanically operated controls.

During the operation of winches moving lines have to be watched carefully, and, if necessary, signals must be given to keep the operation under control. (Signalling is dealt with in Part III, Section 22.)

15. Temporary Hoisting and Haulage Installations

For the loading, unloading and hauling of logs a great variety of techniques are used depending on surface conditions, gradient, size of logs and availability of special machinery and other equipment. Frequently, temporary hoisting and haulage installations are constructed in the forests for the transportation of logs from the felling site to landings if the site is only accessible with difficulty. Different systems of cable transportation, operating by power winches or by gravity or both, are in use by which loads can be brought uphill or downhill, or be shifted sideways on flat terrain. During transportation loads can be lifted completely off the ground or lifted at the front end only or skidded. For the loading and unloading of trucks much the same temporary constructions are used as for hauling. Sometimes they are erected independently, but they are more often directly combined with haulage installations.

Even when these precautions are observed manual guiding remains a difficult and dangerous job. Automatic guiding is preferable and should therefore always be fitted on new winches.

It is beyond the scope of this guide to give detailed descriptions of the different varieties of hauling and hoisting devices. Many common features can be observed, such as the setting up of rigging on elevated places like spar trees, or the arrangement of main lines, haul-back lines, and skylines. Similarly, there exist a number of common safety precautions that will be summarised here.

At all places where rigging is attached to wood, the bark has to be removed. Rigging should be prohibited in bad weather like fog or heavy rainfall. Only experienced workers should be engaged on rigging.

For all hoisting and hauling materials, such as wire ropes, chains, chokers, pulleys, etc., the safety factor should be not less than five. Before any installation is used a thorough check is necessary, and a test should be made with a load exceeding the maximum working load by 30 per cent.

Landings

All hoisting and haulage installations should be laid out methodically with a view not only to efficiency but also to safety. For landings, level places should be selected which leave sufficient space for all constructions, for setting up winches, for parking log trucks, etc. Landings should be cleared of all obstacles and always kept free from litter.

Special attention is needed when landings are situated on roads used by other traffic. Signposts should be put up marking danger zones, which should be closed during operations.

Spar Trees

Spar trees should be strong, sound and green, and should be properly branched. Spar trees should be securely guyed by taut guy lines. Spars require at least four guy lines of a length one-and-a-half times their height. They should be topped not

more than 12 ft (3.5 m) above the top guys. Very tall trees need intermediate (buckle) guys as well as top guys if they are used for skidding.

Derricks and Sheer Legs

Derricks and sheer legs should be made of sound, straight-grained timber and be of adequate strength for the loads that they will be required to move.

Derricks should be vertical or raked slightly towards the load. To prevent overturning and displacement they require at least three guy lines twice as long as the height of the derrick. If necessary, additional intermediate guys should be used.

Sheer legs should not be inclined more than 45°.

Guy Lines and Anchorages

Guy lines should be made of good-quality steel or equivalent material.

Guys should be fastened to sound stumps not less than 10 in. (25 cm) in diameter. If they have to carry a heavy load, bigger stumps are required. The stumps should be notched and have three turns of the rope fastened round them; the rope should be properly secured by staples and cable clamps and never by spikes driven through it.

Running Lines

Running lines must be installed in such a manner that they are securely anchored and no friction against other lines occurs, and the workers are not in danger from the bight or suspended loads. Where work in the bight is inevitable, blocks must be secured by additional straps or by stakes. Trails used by workers should be at a safe distance from running lines. This distance should give sufficient protection against long logs, swinging, bouncing, or rolling to the side.

In the vicinity of power lines the sudden slackening or the break of a cable could be most dangerous. There should be a distance of at least 30 ft (10 m) between a power line and any guy line or moving line.

For skylines longer distances are needed, depending on the length and height of the skylines.

Long skylines require protection against lightning by conductor cables which are attached at both ends of the skyline, lead straight to the earth and are buried at least 10 in. (25 cm) deep. In special cases earthing of winches can be advisable too. If a thunderstorm comes closer than 2 mi (3 km) work on skylines should stop, and the workers should keep at least 100 ft (30 m) away.

Shelter huts should consequently not be placed closer than this to skylines or landings.

Timber Chutes (Rollways)

In mountainous regions timber chutes are sometimes a relatively easy means of transporting logs downhill by gravity. Skilled workers, however, are required to construct the chutes so that they are safe. There are few operations that can be more dangerous than lowering timber in chutes if these are not constructed and operated with the utmost care, since the great momentum of sliding logs can be disastrous to workers.

Chutes should be so constructed that logs cannot be flung out of their path. Great experience of surface conditions and size of logs is needed to build chutes that satisfy this requirement. Curves have to be widened and banked at the outside. Chutes passing over streams or trails must be constructed with high side rails. Crossings should be provided with bridges at a safe height above the chute and should have proper railings. If there is any danger to traffic underneath, above or alongside the chutes, the traffic should be stopped. Outside the danger zone a footpath should be built for men walking from the bottom to the top of the

chute. At the feeding end devices should be provided to block all logs collected there and prevent them from sliding downwards accidentally.

16. Roads and Vehicles

Increasing use is being made of truck roads and trucks for transporting wood from the forest to permanent landings, to collecting points for floating, to railway stations, or directly to the consumer. Tractor-drawn vehicles are used on poorer roads or where no trucks are available. Animal-drawn carriages are found where mechanisation is less advanced. Narrow-gauge forest railways are of local importance in some countries. Nowadays forest railways are built only in exceptional circumstances, and existing ones are frequently replaced by truck roads. The means of transportation that are available for wood are very commonly employed for other materials, and personnel too.

This section will discuss some general safety aspects that have a bearing on different forms of transportation. Because of their increasing importance, trucks are dealt with more specifically.

Roads

Truck roads as well as railroads should be so constructed and maintained that safe traffic is possible with the vehicles used. Gradients depend on the power of the vehicles, on the strength of brakes and on the weight of the load. Curves should be appropriate for the length of the loads, the speed of the traffic and the road width. Narrow curves should be kept clear on their inner bank to provide sufficient visibility of traffic approaching from the opposite direction. If narrow two-way roads are used, wider passages should be provided at suitable intervals and places to enable vehicles to pass each other. On such roads loaded equipment should always have the right of way. Dead-end roads should have turning space at the end. Speed limits should be

marked clearly. When game paths cross a road, warning signals are useful. If tree felling is done in the vicinity of roads, appropriate safety measures must be taken by posting signalmen or by setting up warnings. Road surfaces must be kept clear. Stacks of wood along roadsides should never hamper the traffic. During winter it is advisable to remove snow and to strew sand or ashes on slippery surfaces. On bridges and alongside precipices, ravines, etc., adequate guard rails should be constructed.

Frozen Waterways

Crossing frozen waterways is permissible only if the crossing is cleared of snow to a width of at least 65 ft (20 m). The relation between the weight of the loaded vehicle and the thickness of clear blue lake ice should be as follows:

up to 10 tons	—	at least	18 in. (45 cm)
„ „ 20 „	—	„ „	24 in. (60 cm)
„ „ 30 „	—	„ „	30 in. (75 cm)

Depending on the quality of the ice, these values must be reduced by up to 50 per cent (for slush ice).

Only one-way traffic is allowed. The minimum distance between different crossings should be 165 yd (150 m) and between vehicles following each other 45 yd (40 m). Continuous use of the same crossing will fatigue ice and cause it to give way. Crossings should therefore be displaced frequently, and the ice reinforced by spraying water, if necessary. Doors of drivers' cabs should always be kept open when driving across frozen waterways.

Vehicles and Trailers

Vehicles travelling on public roads should comply with official regulations, for example as regards brakes, signals and lights. All vehicles should be provided with effective brakes. Trailers and especially their braking and coupling systems should be adequate for the means of traction. It is most dangerous to use a trailer constructed for animal traction at the much higher speed of motor

traction. Permissible loads and speeds should be conspicuously indicated. All vehicles should be checked regularly.

Drivers' Cabs.

Comfortable seats with safe and easy access to them should be provided for drivers and helpers. In addition, it may be advisable to install safety belts in the cabs. If heavy loads are transported the back of the cab should be solid enough to give protection against displaced loads, or a special safety bulkhead should be fitted behind it. Steered trailers should have an adequate seat or platform for the steerer.

Transportation of Logs.

Motor trucks and trailers used for the transportation of logs should be equipped with pivoting bunks, stakes or chock blocks and binder ropes or chains. They should be so constructed and installed that they can be safely released from the ground on the side opposite the direction of load fall (fig. 25). Inclined skids and stakes used for loading should be sufficiently strong and should be placed securely to prevent slipping.

The number of binder chains required depends on the load: while two chains may be sufficient for smaller loads, up to four may be necessary for bigger ones, a load tied with three or more chains being less dangerous if one of the chains breaks. Effective devices, such as track sticks, should be provided to tighten binder chains. Loose ends must be fastened properly. Tail flags or lamps should be attached to long loads.

Cranes and Winches.

Cranes and winches mounted on vehicles should be of solid construction, and the operating handles should not endanger the operator when loading is in progress. Cranes should not be mounted on vehicles that do not afford sufficient lateral stability. On the vehicle special supports that can be lowered to the ground may be needed to prevent it from sagging under a heavy load. Such supports can be very conveniently operated hydraulically.

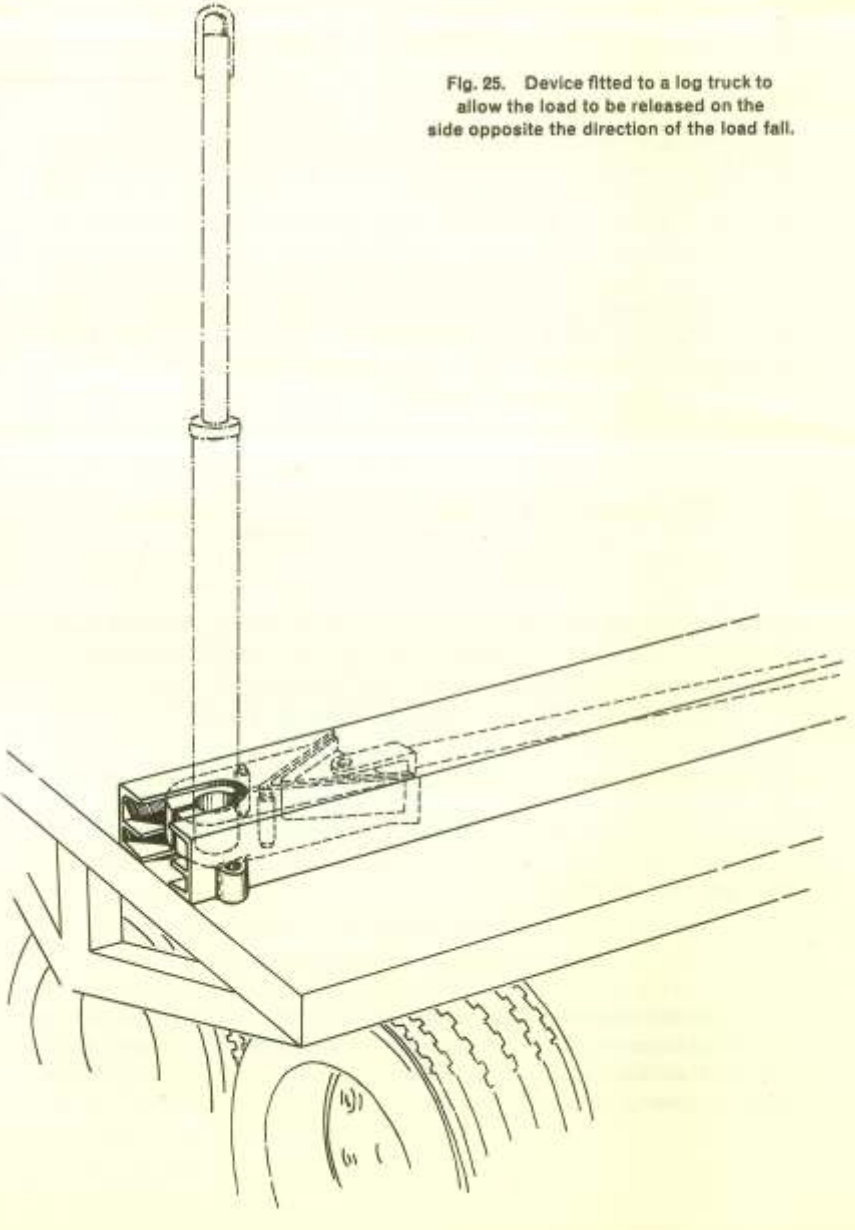

Fig. 25. Device fitted to a log truck to allow the load to be released on the side opposite the direction of the load fall.

Passenger Vehicles.

If vehicles are regularly used for passenger travel, fixed seats, a ladder or steps, and a roof for weather protection are necessary. Tools and materials transported at the same time must be fastened securely. Flammable materials and explosives should never be transported with passengers. Some effective means of signalling are needed between the driver and passengers. If, for some urgent or exceptional reason, passengers are transported for whom no seats are provided, they should sit on the floor of the vehicle. Riding on loads should always be strictly prohibited.

All vehicles should be equipped with a first-aid kit and flares for emergencies.

17. Machines and Equipment for Road Construction, Afforestation and Forest Protection

Although many different types of machines are used for road construction, afforestation and forest protection, they exhibit many similarities from the standpoint of safety, and most accidents involving them can be classified in a few characteristic groups.

Generally speaking, equipment used in forestry conditions needs to be far more sturdy and solid than for agriculture. Shallow and stony soils, roots and undergrowth often impede mechanical operations and cause breakage of agricultural machines like ploughs, harrows, and cultivators. Breakdown and repair of machines, however, not only lead to production losses, but also increase the accident risk.

Tractor-operated Equipment

Tractors are frequently employed as a means of traction. It can be dangerous to use a tractor with implements intended for animal traction, for they are often hitched too high on the tractor, thus increasing the danger of rearing.

Loading, unloading, mounting, hitching and coupling of implements are sources of many accidents. Mobile machinery must be braked properly during loading, hitching or coupling. Mechanical loading devices operated by winch or by hydraulic systems can prevent injuries due to slipping or falling loads and strains caused by heavy manual lifting. Ramps and stakes, if used with care, can be of advantage too. When implements are hitched, lifted or lowered, all persons should be at a safe distance. Hydraulically operated loading appliances should be placed on the ground or on supports when the machine is not in operation.

Transmission shafts and other dangerous parts must be guarded properly.

Cleaning of clogged power-operated tools is a hazardous job if the machine and the tools are not stopped and braked properly. This also applies to adjustments. During operation adjustments are permissible only if proper operation handles are provided that can be controlled safely.

Operators and helpers should be seated as comfortably and safely as possible and be protected against weather, dust, dirt, exhaust gases and other unfavourable influences. If there is a danger of flying objects, hard hats may be necessary to protect the head.

During road transport, equipment projecting beyond the tread of the vehicle should be marked with red flags, and during darkness with lights.

Rotary Cultivators, Etc.

Rotary cultivators, rotary brush and weed choppers and rotary ditchers are particularly dangerous. They require a solid guard that should cover as much of the tool as possible and give sufficient protection against stones, sticks and other objects that are thrown off with great force. Onlookers should keep at a safe distance from such machines, since, despite guarding, objects may be thrown 65 ft (20 m) or even more.

Single-axle tractors fitted with rotary cultivators need guide bars long enough to enable the operator to work safely. The guide bar should be fitted with a coupling device for the wheel drive and for the rotary cultivators. Sliding clutches (torque-limiting clutches) fitted on rotary cultivators should not be adjusted too tightly, since this increases the danger of knives breaking and objects being thrown off with great force.

If the clutches of rotary cultivators are not disengaged during halts they are liable to push the machine forward, thus causing accidents.

Loaders, Etc.

As already stated, the centre of gravity of a tractor may be changed by attaching equipment to the vehicle. In this respect special care is needed in the use of equipment like front-end loaders, shovel loaders and grapple forks, especially when they are used on slopes. Counterweights might be necessary to reduce the danger of overturning.

Harrows.

When operating in difficult conditions, spring-tooth harrows need a device that will release them if they strike against an obstacle. While they are working there is a risk of flying objects. No one should ever stand on an implement such as a disk harrow or an earth-moving blade in order to weight it; special weights should be used for this purpose.

Ploughs.

Tractor-mounted ploughs require a device to release the plough when an obstruction like a rock or root is hit.

Mowers.

Cutting bars of mowers should be covered during transport and storage.

Bulldozers

Bulldozers used for uprooting trees require a solid cab to protect the operator against falling branches. In addition, they should be fitted with a special tree pusher that consists of a hydraulically operated boom acting as a lever and allowing the tractor to operate farther away from the tree base (fig. 12, p. 34).

Pressure Sprayers

With pressure sprayers operated by hand pumps a very specific danger exists, namely explosion of containers due to corrosion of material. Containers should be of material like copper or steel which are more resistant than brass. A safety valve, a pressure gauge and a release valve should be provided. If a container is not fitted with a release valve the compressed air should be released by the spray gun and the container be turned upside-down before it is opened.

Before a compressed-air sprayer is put into use for the season the container should be tested hydraulically by a competent person and the safety equipment checked. The test can be performed as follows:

1. Remove the pump.
2. Fill the container completely with water: no air should remain in it.
3. Replace the pump and fill it with water; press the piston downwards until the maximum permitted pressure is reached; check the safety valve and the pressure gauge.
4. Release the pressure, remove the safety valve and plug with a tube-end plug.
5. Press the piston downwards until a pressure of one-and-a-half times the maximum permitted pressure is reached; higher pressure may damage the container; no air should remain in the container or in the pump.

6. Let the pressure remain for ten minutes and inspect the container.

7. If any leaks or permanent deformations are observed, the container should not be used.

8. If there is no defect replace the safety valve.

If the container is supplied with a combined safety valve and pressure gauge, this must be removed and a special gauge inserted for the test.

After use containers should be cleaned thoroughly and always be stored upside-down with the pump removed.

18. Garages and Workshops

When machines are employed on a large scale, garages and special workshops are necessary. It is most important that they should be constructed and equipped safely, especially if they are set up in old buildings originally used for other purposes.

Arrangement of Workshops

Moist, cold, poorly lighted and poorly ventilated, insufficiently equipped and badly kept workshops are very likely to cause long delays during repairs and frequent absences due to illness or accident. Workshops can be the most critical part of the whole undertaking and can severely interfere with all operations if not properly organised.

Such troubles will seldom occur if workshops are well arranged, properly equipped and run by sufficiently qualified persons. Tools should be kept in good condition and stored in practical racks and tool boxes. Work benches should be suitably lighted and of the proper height. Good order and maintenance of workshops can often be guaranteed only by strictly prohibiting their use by persons who are not regularly working in them.

If forest undertakings keep stores, tools and equipment used for fire fighting should be kept apart. But it will often be of

advantage to put the personnel responsible for repairs in charge of them in order to make the equipment accessible at any time.

Fire Risks

A considerable fire risk is encountered in garaging and servicing internal-combustion machines and in the operation of equipment like welding apparatus and abrasive grinding wheels.

At dangerous places smoking and the use of open fire should be forbidden and notices to this effect posted in conspicuous positions. Buildings and their surroundings should at regular intervals be cleared of combustible waste and materials blocking access ways. Larger buildings or rooms should have two access ways.

Heating Installations.

Heating installations in garages and other rooms where internal-combustion engines are housed should have no open flames or incandescent parts.

Stoves, fireplaces, stove-pipes and chimneys can easily cause fires if they are not installed and maintained safely. Between stoves and combustible walls or materials there should be a minimum of 1 ft (30 cm) if special insulation shielding is provided and 2 ft (60 cm) if not.

Highly Combustible Materials.

Sparks falling on highly combustible material such as rags soaked in oil can have disastrous results. Fire-resistant construction, therefore, is the first prerequisite for the premises. Combustible material should never be stored in them. Diesel oil must be stored only in sealed containers, in quantities not exceeding 40 gal (200 l). Oily and greasy waste should be kept in self-closing metal receptacles. It is a most dangerous habit to use petrol or other highly inflammable liquids for cleaning machines, clothes or hands. As far as possible non-combustible solvents

should be employed for such purposes. If this is not possible, the precautions mentioned in Section 19 of this part should be observed in the storage and handling of flammable liquids.

Fire-Fighting.

If a fire starts in a building all occupants have to be got out and electricity or gas shut off immediately. In entering or leaving a room draughts should be prevented. Hot doors should not be opened. In heavy smoke, breathing is facilitated by covering the mouth and nose with a wet cloth. If a building is completely in flames, fire-fighters should keep at a safe distance as protection against falling debris or collapsing walls.

All persons working or stationed in a building should be made acquainted with the fire-alarm and escape system at regular intervals.

Fire-extinguishers, sand containers, water buckets and ladders should be kept in good order and stored at accessible places, especially in or near dangerous places like garages or repair shops.

Water should only be used for extinguishing once the electricity main has been turned off. Water is not suitable for extinguishing burning petrol or oil. For this reason chemical extinguishers must be available at accessible places close to the entrance. Buckets filled with sand or soil can be useful as well. Chemical fire extinguishers should be inspected once a year by a qualified technician. Sand must be kept dry.

ELECTRICITY

The use of electricity in forest operations is usually confined to garages, workshops and logging camps. Only in rather exceptional cases is electrical equipment needed in the forest.

Careless handling of electric installations and equipment can cause severe shocks, burns, and, quite frequently, fatalities. The danger is especially pronounced in damp places or where work is done with wet hands and clothes.

Conductors.

Electric wiring should be done only by qualified electricians. All wiring should be of suitable cable with earthing wire. There should not be any unearthed circuits, so that there will be no reason for cutting off the earth on power tools. Extension cables and cables of portable tools should be of a high quality, be inspected frequently and be stored in dry and cool places. Wall sockets should be provided at suitable places so that trailing cables are as short as possible. Cables must be protected very carefully against abrasions and cuts.

Electric cables for portable or mobile circular saws should be attached to supports about 7 ft (2 m) high.

Portable Tools.

Portable electric tools with protective earthing must be provided with three-pin plugs, the third pin being connected to a proper earthing system. Earthing is of utmost importance in wet or damp localities for protecting against possible electric shocks. Other protective systems, such as double insulation of the tool, can also be used.

Lighting.

Proper electric lighting should be provided in workshops. It is both unsafe and uneconomic to try to save money by providing poor lighting.

Battery Charging.

When batteries are recharged hydrogen is generated, and it may explode if exposed to an open light. Recharging should therefore be done in sufficiently ventilated and fireproof places. Since hydrogen is much lighter than air, it is important that the upper part of these places should be especially well ventilated.

Inspection Pits and Hoisting Equipment

For servicing and repairs, inspection pits and different kinds of hoisting equipment are used, ranging from simple home-made devices to expensive hydraulic lifts. Whatever their degree of technical perfection there is always a considerable accident risk when heavy machinery or other heavy equipment is lifted or moved.

Inspection pits should have safe means of access, such as steps, and be sufficiently spacious to afford the worker easy movement. They should be so constructed that vehicles can be parked and braked properly above them. When not in use they should be secured by means of a close-fitting cover.

Pits are hazardous if motor fuel is spilt, and they should therefore be sufficiently ventilated to get rid of the fumes.

Jacks.

All jacks should be so constructed that the load remains supported in any position and cannot be lowered inadvertently. They should have a solid footing and the load should be centred to prevent it from tipping and sliding. Electric jacks should be provided with automatic limit switches at the top and bottom limits of travel. Hydraulic and pneumatic jacks should be fitted with devices that will prevent the load from falling suddenly if the air or liquid cylinder is damaged. Loads should always be securely blocked before a worker goes under them.

Other Lifting Appliances.

Winches, wire ropes and chains used for hoisting have been dealt with elsewhere (Sections 8 and 14 of this part).

Other Precautions.

Internal-combustion engines should never be left running in rooms unless exhaust pipes are extended outside. When vehicles are started garage doors should be opened. Unauthorised persons, especially children, should not be allowed in garages, engine-rooms and workshops.

Abrasive Grinding Wheels and Grindstones

Abrasive grinding wheels and grindstones are often used for sharpening tools or for metalworking. A considerable accident risk is involved in their operation, especially if they are power-driven.

Abrasive wheels can cause injuries if the worker touches them during operation or if he is hurt by sparks. Fatal accidents can occur if the grinding wheel shatters while it rotates and projections may hit with great force.

To avoid such risks, wheels should be guarded, and the operator should always wear safety goggles, or transparent screens should be mounted on the machine. The material being worked should rest on an adjustable tool-rest and be pressed gently against the grinding wheel. Defective grinding wheels must be replaced at once.

New ones should be tested by tapping them lightly with a screwdriver; they should give off a clear ringing sound. The grinding wheel should be held firmly but not too tightly by a spindle, nuts and flanges of the proper size. After mounting, a test run of one minute should be made. Excessive speed and vibrations should be prevented and the type of grinding wheel should always correspond to the available machine. No unmarked wheel should be used.

If a grinding wheel is struck or falls it should not be used, as it may have developed an invisible crack and may break while rotating.

Natural sandstone wheels are commonly used as grindstones. They should not be run much faster than the speed obtainable by hand operation. Grindstones should be properly centred and balanced and be kept in circular shape. It is bad practice to leave them partly standing in water. They should be mounted on firm supports that are strong enough to support their weight and are in no danger of breaking down or tipping over during operation.

Drills and Lathes

Workers operating drills and lathes should wear tight clothes. Revolving shafts, face-plates, etc., should be shielded as far as practicable.

Borers should be kept sharp, and drilled material clamped properly so that it does not rotate. Coiled chips on lathes should be removed by a hooked rod provided with hand protection. Small chips can be brushed off. Goggles should be used when the material is brittle and there is a danger of chips flying off.

Forges

Forges should be provided with an exhaust hood and chimney. No combustible material should be kept in their vicinity, and fires should never be left without supervision.

Welding

Welding should be done only by competent persons, and considerable precautions should be taken against the high fire risk. The torch flame can easily ignite material, and sparks may fly more than 60 ft (20 m). When combustible material is around, screens should be used, or the welding done outside buildings.

Welders and their helpers must protect their eyes and faces with special face shields. This is particularly important in arc-welding. If other workers might be exposed to the radiation, welding should be done behind a screen. While the welding job is being cleaned, clear goggles should be worn.

Where brass or material covered with a zinc coating or with paints containing lead is welded, toxic fumes are generated. Adequate ventilation or respiratory masks are necessary in such cases.

Welding containers for petrol, oil pitch, etc., is most dangerous. They should be thoroughly flushed, drained, dried and filled with water up to about 1-1.5 in. (2-4 cm) from the welding place, otherwise there will be an extremely serious danger of explosion.

Another means of preventing explosion is to blow the container out thoroughly with steam under pressure before welding.

Arc-welding machines should be properly earthed, and the cables inspected frequently.

Cylinders used for oxy-acetylene welding must be handled with great care. Overheating and sudden falls can cause explosions. Special cylinder trucks should be used. Valves should be protected by a cap. Cylinder fittings should never be greased since this increases the explosion risk.

Hoses should be tested in soapy water for leakage, and never be left under pressure when work is not in progress.

Woodworking Machinery

The woodworking machines most used in workshops are circular saws, which have been dealt with in Section 11 of this part. Planers and faced saws are only to be found in larger woodworking workshops. The proper guarding of their transmission shafts, cutter heads and saw blades is the most important precaution to be taken, though the fire risk of wood shavings, sawdust and other combustible waste has to be kept in mind.

19. Dangerous Materials

Toxic, flammable and explosive substances are commonly used in forest operations in many countries. Chemical control of insects, fungi, or weeds, preservation of wood, blasting during road construction, and the utilisation of internal-combustion engines in all kinds of operations are typical examples of activities that involve the use of dangerous substances. A considerable risk to life and health exists where these substances are not handled and stored with adequate care. Only reliable persons who have been thoroughly instructed should be entrusted with their use. If possible, harmless or less dangerous substances should be substituted for dangerous ones.

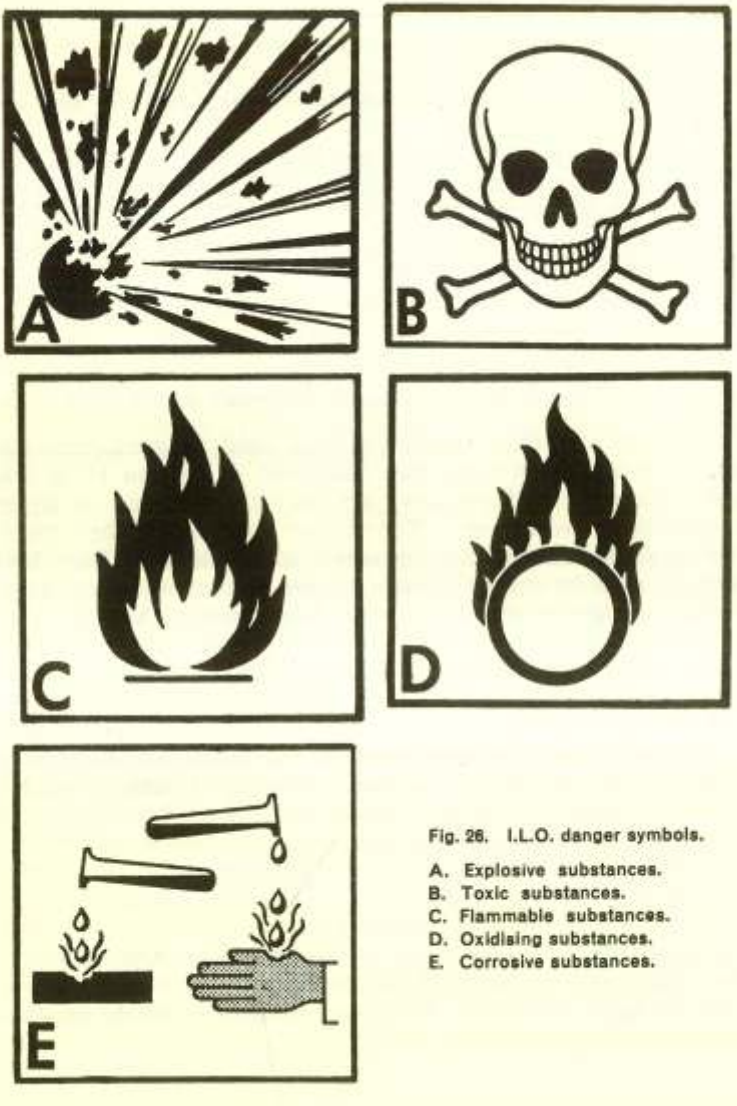

Fig. 26. I.L.O. danger symbols.

A. Explosive substances.
B. Toxic substances.
C. Flammable substances.
D. Oxidising substances.
E. Corrosive substances.

As a general precaution, dangerous substances should only be handled in their original containers bearing a conspicuous indication of the dangerous nature of the contents. Various symbols may be employed for indicating toxic, corrosive, flammable and explosive substances (fig. 26).

Toxic Substances

Toxic substances and containers used for the preparation of mixtures, solutions, etc., and also personal protective equipment, should always be stored in locked boxes or cupboards in enclosed rooms. No food, domestic crockery, clothing or other personal belongings should ever be kept in the same room.

Containers of toxic substances should have a label indicating clearly the nature of the contents, the safety precautions to be taken, the nature of early symptons of poisoning and the immediate first aid to be given in case of need.

Toxic substances may penetrate into the body by way of the mouth (ingestion), the unbroken skin (cutaneous absorption) or the respiratory tract (inhalation). Consequently, these three routes of entry need attention. Personal cleanliness is the most important precaution. Water and soap should be provided in sufficient quantities for thorough cleaning before any food is taken and after finishing work. Impermeable clothing which fits close to the neck, wrists and feet may be necessary. Rubber boots and gloves can be very suitable means of protection. During the use of certain chemicals it may further be necessary to wear goggles or face shields and respirators or dust masks. All protective clothing and equipment should be cleaned at appropriate intervals, and be kept in good condition. Before eating, drinking or smoking, protective equipment, with the exception of overalls or rubber boots, has to be removed.

Vessels used for the preparation of toxic substances should be large enough and should be unbreakable; they should never be used for other purposes. Permissible concentrations and doses of such substances should never be exceeded, and the workers should be properly instructed and supervised in this respect. The amount

of toxic substance needed for an operation should be calculated in advance to make sure that no excess is ordered, stored or prepared.

Unwanted remains of toxic substances and empty containers should be buried deep in the earth away from springs and water supplies. If they are burned, toxic fumes may develop and precautions should therefore be taken to ensure that no one is endangered by the smoke. Warning signs should be put up to keep the public out of areas treated with toxic substances as long as these may be harmful.

Equipment used for distributing toxic substances must be kept in good order. Where practicable, toxic substances should be sprayed as liquids by mechanical means. Tools for repairing and cleaning spray nozzles should be provided so that no worker is tempted to blow out blocked spray pipes by mouth. Spraying and spreading of toxic substances should never be done in a high wind or against a wind. Equipment used for spraying and spreading should operate in such a way that substances are not spilled but distributed as accurately as possible and only in the intended places. Pressure sprayers have been dealt with in the preceding section.

Flammable Substances

Special precautions are necessary when handling flammable liquids with a flash point below 90°C (200°F). The following table shows the approximate flash point of the flammable liquids that are most frequently used in forest operations:

Substance	Degrees C	Degrees F
Petrol (gasoline)	−40	−40
Diesel oil	+40	+105
Kerosene	+40 to +45	+105 to +115
Fuel oil	+40 to +90	+105 to +195
Creosote oil	+75	+165
Lubricating oil	+150	+300

Flammable liquids can create a serious danger of fire or explosion if not handled and stored with care. Mixtures of flammable liquids with low and high flash points like kerosene and lubricating oil have to be treated as liquids with a low flash point.

Flammable liquids should be stored outdoors in steel drums or tanks at a safe distance from buildings. Underground tanks are generally preferable for large quantities. Above-ground storage tanks should be placed at least 80 ft (25 m) from any building, and should not be surrounded by any combustible material. Only small quantities may be kept inside buildings; they should be stored in closed metal cans at a safe distance from any open fire. Sufficient ventilation must be provided. In the open air, containers should not be left exposed to the sun. They should never be left lying around whether filled or empty. It is important not to fill containers up to the top, but to leave some air space to allow expansion with rising temperatures.

As far as possible, highly flammable liquids should only be transferred by pumps and in the open air. If even small quantities are transferred from a metallic container, there should be an electrical bond to avoid the danger from sparks caused by static electricity. A safe distance from any running machine, open fires or open lights has to be maintained during the transfer of any highly flammable liquid, and appropriate warning notices should be set up where practicable.

Chemical fire extinguishers should be kept ready for use where flammable liquids are stored or handled regularly.

Oxidising Agents

Some chemicals used as fertilisers are flammable or are oxidising agents, potassium nitrate for instance. Oxidising agents generate oxygen when heated, thereby increasing the intensity of any fire in their vicinity; they can also cause a fire when in contact with an organic (combustible) substance. Sacks or other containers of such substances should clearly indicate their

dangerous nature and should be stored away from combustible material. Calcium oxide (quicklime) reacts vigorously when exposed to water, producing enough heat to ignite combustible material. It should therefore be kept in dry and fire-resistant places.

Explosives

Explosives, fuses, detonators, wiring and other blasting equipment should be transported, stored and handled only by persons holding a special competency certificate and possessing a thorough knowledge of the safety regulations. Vehicles used for the transport of explosives should be kept in good condition, and should be clearly marked to indicate the nature of their load.

Packages of explosives should be protected from any contact with sparking metal, effectively separated from detonators carried on the same vehicle, and securely tied and protected against rain and dampness.

Transportation of flammable substances with explosives, or the presence of unauthorised persons on vehicles carrying explosives, should be forbidden.

Magazines for explosives should be constructed at a safe distance from buildings, be kept dry and well ventilated and be firmly locked so that they cannot be broken into. Smoking, using open lights and handling sparking tools in the vicinity of explosives must never be allowed.

In no case should explosives be left accessible to unauthorised persons at any time. Where no magazines are available, unused detonators and explosives have to be destroyed by firing or burning carried out by competent persons and with special precautions. Burning should take place only in the open air, and attendants should keep at a distance of at least 100 ft (30 m). Burning cannot, of course, be allowed where it might cause a forest fire.

All equipment needed for blasting, such as cap-crimpers, tamping bars of non-sparking material, electric wiring, apparatus for testing of circuit and electric firing and signal horns should be kept available and in good order.

Bulk quantities of ammonium nitrate have to be treated as explosives.

20. Personal Protective Equipment

Personal protective equipment consists of garments and appliances that protect the wearer against certain injuries, and can be of considerable help in accident prevention. It should, however, be borne in mind that any kind of mechanical means like a machine guard is more reliable than protective measures that depend on the workers' acceptance. All other means of reducing the accident risk should be thoroughly applied before the use of personal protective equipment is considered. On the other hand, particularly in the forests, there are many operations where the degree of collective protection is bound to be rather limited. For this reason personal protective equipment plays an important role in forestry.

All personal protective equipment should fulfil certain fundamental requirements in order to be readily accepted by the workers. Besides accomplishing the appropriate safety functions it should be as comfortable and attractive as possible.

Safety rules should clearly state when certain kinds of personal equipment have to be worn or otherwise used. Naturally, they can be followed only if the suggested equipment is available to the workmen. It is one of the principal safety tasks of management to see that it is. Many employers subsidise the purchase of, or themselves provide, certain or all items of personal protective equipment that the workmen are required to use. Sometimes the equipment is kept in central stores and sold to the men on request.

Accident statistics will show in which operations the wearing of personal protective equipment seems to be important if they furnish information on the nature and location of injury in relation

to working operations, etc. Similarly, after some time has elapsed it can be established to what extent certain injuries become less frequent because of the use of protective equipment. Such information can stimulate its use. Interest is often lacking not only because the equipment is not available, but also because workers are reluctant to use it when it is. Exhibitions of pieces of equipment that have saved workmen from serious injuries or even death, and similar means of propaganda, serve to show the necessity of introducing personal protective equipment. After an accident it will be much easier to convince workmen of the advantage of using personal protective equipment that might have prevented it.

Provision has to be made for personal protective equipment to be cleaned at suitable intervals, especially when pesticides are handled or when the equipment is shared by different persons. Washing, sterilisation, greasing of leather, etc., should be carried out according to the manufacturer's recommendations. Proper storage and regular inspection are other means of keeping personal protective equipment in order.

Respirators should have their protective features clearly marked.

Hard Hats

Many fatal and other serious accidents in forestry involve head injuries. Falling branches in felling operations are a well-known source of such injuries. Similar risks can exist in tree skidding, in uprooting standing trees, in quarrying operations and in blasting.

The appropriate protection against falling or flying objects that might injure the head is provided by a hard hat or helmet. It consists of a hard shell supported by a detachable hammock or cradle. The headband of the hammock has to be adjusted to the size of the worker's head. Chin straps are usually unnecessary because the headband can be fitted tightly enough around the back of the head and thus the hat can be worn far more conveniently.

Between the top of the shell and the hammock there must be an airspace of 1 in. (2.5 cm), to allow damping in the event of a heavy impact. Suitable ventilation should be provided by holes close to the centre of the hat, made during manufacture in such a way as not to reduce its strength. Workmen should not make holes themselves since this would weaken the hats. Winter lining can be worn under the hat in cold weather. The most suitable materials for hard hats are light, strong, non-combustible, water-resistant plastics.

Hats with a brim offer protection to the shoulders as well, but hats without brims are usually preferred, since they are worn with greater ease and are no obstacle when objects have to be carried on the shoulder. Hats with a small outer groove stop the rain from dripping on to the worker's neck and further decrease the force of blows from the side (fig. 27). Such blows can frequently occur when the tension of twigs is released during branching, or if the cant hook is pushed back when turning trees.

Hard hats can normally be considered to be the most important item of personal protective equipment for forest operations. Their introduction should be rigidly enforced when working conditions require their use.

The introduction of hard hats is sometimes opposed by the workers, who complain that they get headaches when working with them, especially in hot weather. Experience has demonstrated, however, that the workers will not complain once they have got used to them. Even under tropical conditions hard hats have been successfully introduced by progressive logging undertakings soon after becoming available.

Eye Protection

Eyes are frequently injured by flying objects or particles such as chips of wood, metal or stone splinters and dust. Though most injuries are light, in severe cases the loss of an eye can result. To prevent such injuries, eye protection should be applied in all operations where a danger for the eyes exists.

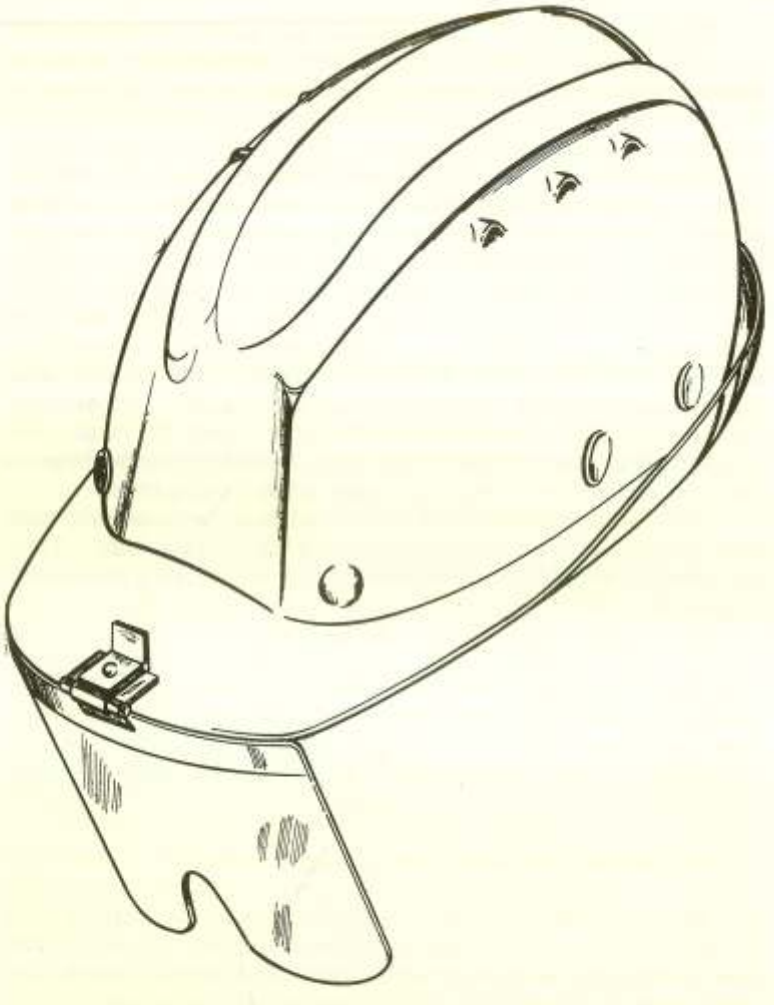

Fig. 27. Hard hat with ventilation openings close to the centre, outer groove and adjustable face shield.

The following jobs require eye protection: pruning trees above the head, splitting stones, sharpening tools on grinding stones and welding. Furthermore, eye protection may be advisable if circular saws, wood-splitting machines and portable power saws and similar machines are operated.

There are a variety of means of eye protection, depending on the nature of the work. For splitting stones by machine or by hand, wire mesh goggles are used; for grinding, a spectacle-type eye protection with safety glass or plastic lenses. Welders and their helpers should protect their eyes with face shields against harmful radiations in the visible spectrum and ultra-violet and infra-red radiations, high light intensity and sparks. For pruning, a simple kind of face shield is frequently used. A face shield that is attached to a hard hat and can be raised or lowered protects the operator against any sawdust liable to blow into his face while cutting. This is particularly important during branching. Plastic netting attached to the hard hat can also be useful protection for the power-saw operator. Drivers of fast-moving open vehicles should wear box-type goggles against insects, dust and other flying objects or particles.

Safety Gloves

Gloves protect the worker against the numerous cuts, scratches, splinters and thorns that are found in all sorts of forest work, as well as against poisonous plants and harmful chemicals. In addition, they can considerably reduce the vibration effect of machines. Wearing gloves should consequently be encouraged, not only during the cold season but throughout the year.

Gloves are necessary in all felling and skidding operations, handling wire ropes, clearing of planting sites, cutting weeds, tending young forest stands, pruning trees and spraying fertilisers or pesticides. In fact, there are few jobs where gloves do not give protection to the hands, apart from keeping them clean. It is, however, often difficult to persuade workers to wear gloves when they are not used to them, requiring much patience to do so.

The type of gloves to be used depends on the job. Soft leather mitts with seamless palms and a separate index finger are usually preferred for handling power saws. Cotton gloves with pads on the back made of hard, thick rubber or ballistic nylon could serve as a protection against cutting tools. For handling chemicals rubber gloves are recommended.

Protection of Legs and Feet

Safety boots are another essential item in the forest worker's protective wear. Their main functions are to prevent slips and falls and to give protection against rough surfaces, sharp tools and falling objects. For this purpose they need stout non-slip impermeable soles and, if necessary, toe caps reinforced against impacts and cuts. Safety boots should not, of course, be too heavy, but should keep the feet sufficiently warm and dry and be comfortable to wear.

Different materials are used, such as leather, rubber or leather coated with rubber. Generally, a sturdy make is required, and preference is given to leather for dry conditions, while rubber or rubber coating is more suitable for wearing in the wet. Toe caps are required if axes and similar cutting tools or power saws are used, because it has been found that many cuts in the toes occur during the use of these tools. Another activity requiring toe protection is skidding logs or pulpwood, which might drop or roll onto the feet.

Safety boots with a special lining of nylon have recently become available; this protects the front of the foot against cuts and punctures (fig. 28).

When workmen are required to walk on fallen trees, as in felling operations in old virgin stands, calked boots are an excellent means of securing a foothold. A similar result can be obtained with detachable calked soles, or spikes which can be tied to the soles. Such footwear is recommended in mountainous regions, especially during winter when the ground may be made slippery by frost and ice.

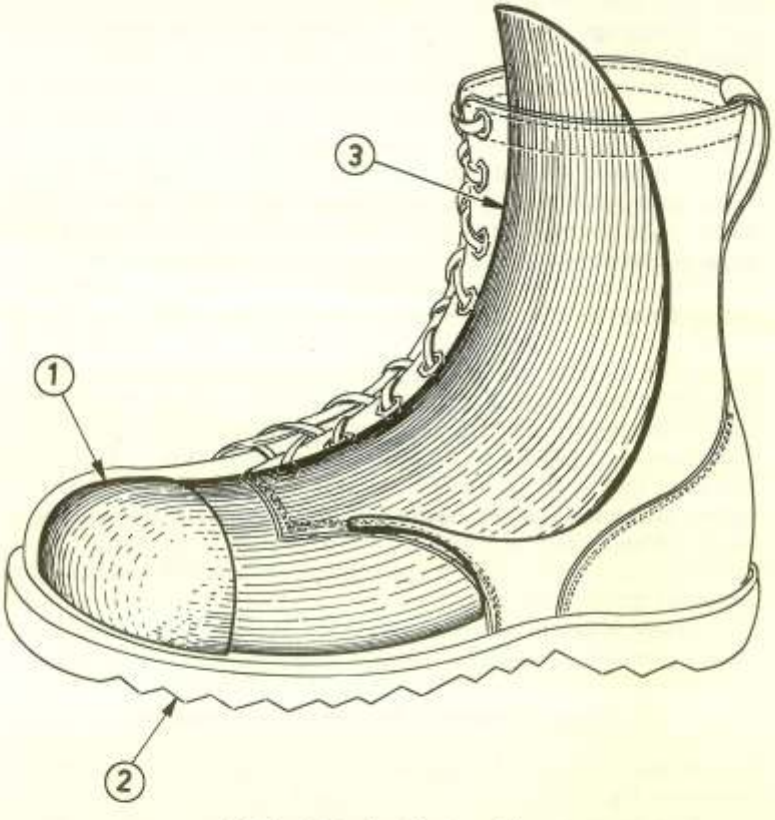

Fig. 28. Safety boots for tree felling.
1. Steel cap. 2. Non-slip impermeable soles. 3. Impact-resistant nylon lining.

The shin is frequently injured, too, but it is more difficult to protect it without hindering the worker. Though desirable when cutting tools are used, shin protection has for practical reasons to be restricted to special jobs such as climbing trees with

spikes or work in snake-infested country. Leather or reinforced canvas leggings are suitable in the former case and special aluminium leggings in the latter.

When workers frequently kneel down during their work, as in certain hand-saw operations, knee protectors are useful. At the same time they protect the knee against blows and cuts. To a certain extent this can be achieved by flexible pads of impact-resistant nylon attached to the front of the working trousers at the knee. The use of these protective pads by chain-saw operators has rapidly become popular in certain parts of North America.

Spécial mention must be made of the situation in some developing countries where footwear is not yet normally used by the population. In forest operations, however, this should by no means be tolerated and every effort should be made to supply suitable boots if they are not available, even though the workers may at the beginning be reluctant to wear them. As in the case of hard hats, they will get used to them after a short time. If no boots are worn the proportion of foot injuries is unusually high and even minor injuries will easily become infected and need a long time to heal. Where there is a danger of infection by hookworms, which occur in many parts of the tropics, boots are also the best means of personal protection.

Many logging undertakings have realised this and strictly forbid work in the forests without proper footwear.

Other Personal Protective Equipment

When no hard hat is required for work in the hot sun a broad-brimmed hat of light material and light colour should be worn.

Fire-fighters can be supplied with garments made of flame- and heat-resistant materials such as asbestos or aluminised fabric. In addition, a face shield of such materials with a wire screen for the eyes that can be clamped to the fire-fighter's helmet will give further protection.

When dangerous chemicals are handled an appropriate cover that can easily be cleaned may be necessary for the skin. Rubber

aprons can be useful here. Respirators may be required for the spraying of certain chemicals.

Finally, buoyant life-jackets and coats should be provided for certain jobs in floating operations or in timber transport by water.

There are too many different jobs in forestry for this list to be complete. It may, nevertheless, show that there are numerous ways in which the use of suitable personal protective equipment can prevent injuries or lessen the risk of serious injuries. Much depends, however, on the adaptability and the attitude of the workman.

PART III

ORGANISATION AND TECHNIQUES OF MAIN ACTIVITIES

21. General Considerations

Proper selection, guarding, handling and maintenance of machines, equipment and materials are not the only measures that are required from the viewpoint of safety and health. In addition, the organisation and conduct of all the operations should conform to safety principles.

As a rule, as few men as possible should be engaged on a job. They should possess the necessary experience and qualifications, receive clear instructions and be under competent supervision. For each regular job a standard job description, including safety precautions, should be drawn up and followed by foremen and workers.

Operations have to be planned well in advance to prevent haste and ensure proper guidance and control. This is especially important where preparations have to be made, such as planning and layout of skidding roads or prelogging of dead trees. The organisation must be flexible enough to cope with unexpected difficulties—for instance breakdown of machinery with no help available, or sudden deterioration of weather conditions.

During all operations the worksite should be kept as clear as possible, and ample space should be provided for machine operators to retreat safely in an emergency.

During bad weather certain forest operations should be avoided. In stormy weather, for instance, trees should not be felled because the direction of fall cannot be controlled and there

is an acute danger of dry branches breaking and falling. In regions with a marked tendency to forest fires it might be advisable to suspend forest operations when the risk of starting a forest fire is too great because of extended periods of dry and hot weather.

During thunderstorms workers should keep away from wire fences, wire cables, metal tools, rock outcrops, hilltops, single trees and large trees within forest stands. In open areas they should lie down or stay in motor cars if there are any. Hollows and young stands of trees of uniform age offer relatively safe shelter. Localities where danger of lightning exists should be avoided when shelter huts are set up.

Special care is required when work is performed on slopes. If the gradient requires, space should be provided for men working below others to protect them from rolling logs or stones, etc. As a rule, felling, skidding and other operations that involve such dangers should be so planned as to prevent workers from being exposed to rolling and sliding material. In many cases workers should not be allowed to work downhill from other workers.

No onlookers such as children playing or passers-by should be allowed in the vicinity of men working. This is particularly important where timber is felled or transported and where heavy machinery is used. Should it be difficult to patrol the worksite, appropriate signs or posters should be used, in addition to taking the special care needed on the job.

22. Signalling

Besides warning third parties of risks connected with forest operations, it is naturally important to warn forest workers themselves. While strangers can usually only be warned by shouting, signposts or, in some cases, special watchmen, the forest workers will frequently be able to use a uniform code of distinctive signals. Such signals can be a valuable means of communication where co-operation between two or more men is hindered by the distance or bad visibility between them. Consequently, sound signals or

signals by motion of arms and hands are frequently used in timber transportation, for instance. They will, however, fulfil their purpose only if they are simple and easily understood.

As an example, the following signals can be recommended for tractor or cable skidding (fig. 29):

Phase of operation	Motion of arms	Sound signal
Main line stop	Keep one arm horizontal	.
Main line ahead	Raise one arm	..
Main line slack	Keep one arm horizontal and move hand up and down	...
Tractor stop	Keep both arms horizontal	–
Tractor ahead	Put one hand on head	– –
Tractor back	Put one hand on hip	– – –

These signals will be given by the helper or the chokermen, or in certain circumstances by special signalmen. The signals can be supplemented as long as they do not become too complicated. Sound signals can be given by whistle or horn or, in long-distance cable operations, instructions can be given by telephone.

These signals will allow the workers to get out of the danger zone before a new phase of the operation begins. Their utility depends, however, on their being understood and obeyed. Naturally, the men giving the signals should stand clear themselves. Where a winch can be operated by remote control—for instance by ultrasonic waves—there may be no necessity for signalling, and then conditions are safer.

Another operation where signals are necessary is loading, where at least one signal is required for lifting and one for lowering. This is necessary even when a load like a pole is carried on the shoulder by several men. Shouts given by one man for lifting and lowering will be sufficient.

Where timber is transported downhill in chutes, and the bottom cannot be seen by the feeder at the top, a sound signal should be given at the top and answered from the bottom before

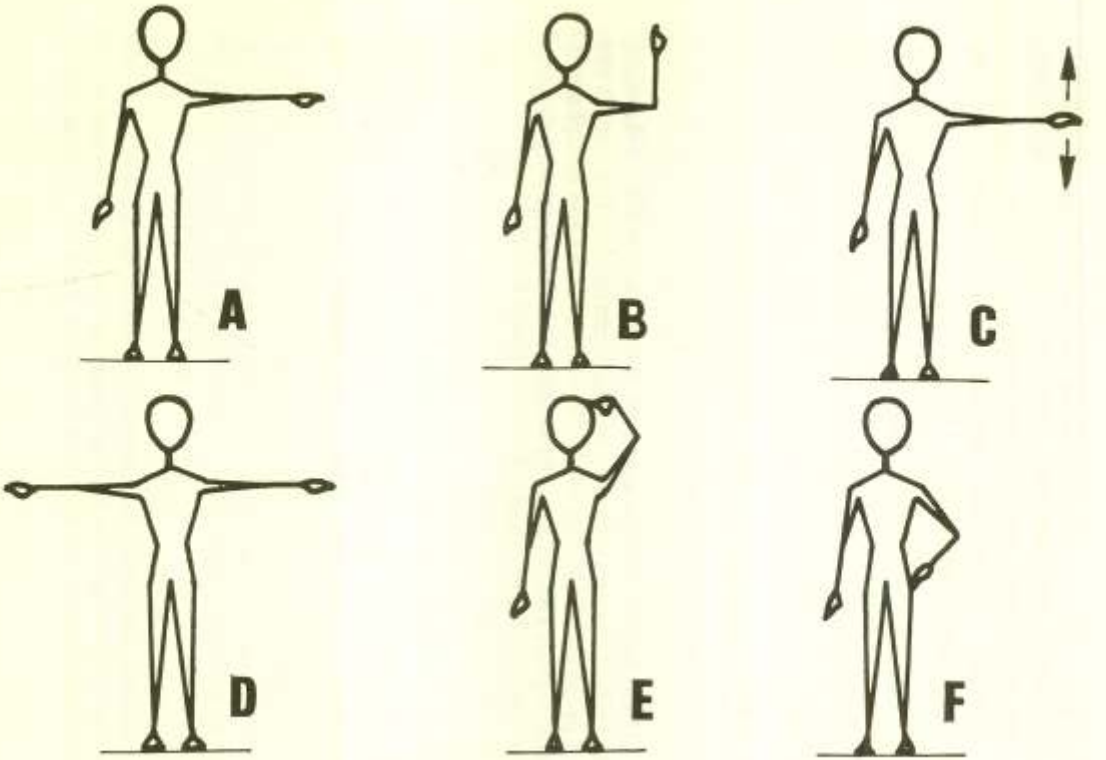

Fig. 29. Signals for tractor or cable skidding.
A. Main line stop. B. Main line ahead. C. Main line slack. D. Tractor stop. E. Tractor ahead. F. Tractor back.

a log is fed into the chute, to make sure that only one log passes through the chute at a time.

Blasting requires three different sound signals: one sound for the workmen to take cover; two sounds immediately before the shot; and three sounds when all is clear.

Simple warning signals in the form of shouts or whistles are necessary in felling operations shortly before a tree falls.

Similarly, before a tractor is started or the power take-off is engaged, a warning signal should be given and, if necessary, answered.

Fire-alarm signals may also be mentioned. Workers in buildings such as logging camps, or in regions with a serious fire danger, should be familiar with them, and they should be loud enough to be heard over a long distance.

This list of examples is by no means complete. In many instances machinery or working operations call for the development of special systems of signalling in order to facilitate the job and to protect workmen against risks. The employer should take adequate steps to ensure that such signals are familiar to the workmen.

23. Climbing Tall Trees

Climbing tall trees is a particularly hazardous operation and only properly qualified men should engage in it. They should always wear suitable equipment—climbing irons or spikes, a safety belt and a rope. This equipment should meet the requirements described in Section 9 (Part II). They should also be provided with hand lines for raising and lowering tools and material.

Clothes should be tight and boots sturdy. Gaiters will protect the legs from being injured by spikes and at the same time prevent the trousers from being caught by obstacles. Similarly, wrist protection is advisable.

Tools should be securely fastened to the climber's belt or person. While a man is in the tree a second climber and a second set of climbing equipment should be readily available, and a signaller should stand by. Other persons should stand clear so as to avoid the risk of being struck by falling objects. Isolated spar trees should never be topped unless a second man is in sight of the climber. No running lines attached to a tree in which a climber is working should be moved except on a signal from the climber, and no work should be done on any other tree connected by a line with the climber's tree. Spar trees should not be topped in a high wind, or when visibility is poor.

For picking small cones from the outer part of a broad crown of a standing tree, strong pieces of netting covering part of the crown can be a means of increasing safety and accessibility. When practicable, the use of tractor-mounted extension ladders for climbing trees and of lifelines and special braking devices for work in the tree crown and for the descent is both efficient and safe for a group of cone-pickers.

24. Felling, Cross-Cutting and Branching of Trees

Felling

Felling trees is one of the most dangerous jobs in forest operations, and requires much skill and experience. If a worker is caught by a falling tree or a moving log, or hit on the head by a falling branch, serious or even fatal injuries may be the result. The highest rate of accident severity in forestry is found in this job. Consequently, safety training and propaganda should concentrate on it.

No persons other than the fellers should be present during felling operations. Special precautions are necessary when there are public roads, electric power lines and buildings on the forest edge. The workers should work far apart so that they do not endanger each other when the trees fall, and there should be a

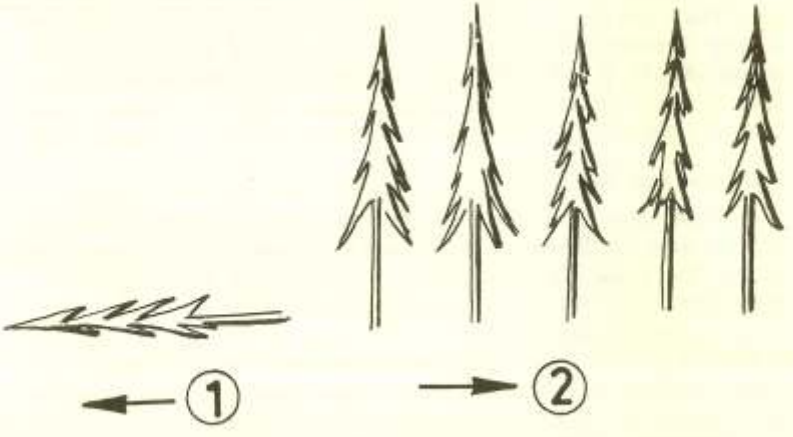

Fig. 30. How to organise felling work.
1. Felling direction. 2. General direction of working progress. Subsequent work, such as branching, cross-cutting and skidding, should be facilitated by the felling order.

minimum distance of three tree lengths between the teams. If felling is done by one man he should preferably work by himself with no other person around who might be hurt by the falling tree. The helper for a one-man power-saw operator, for instance, should be present only in the more difficult situations (felling of particularly heavy timber). Fellers should always, however, work within earshot of each other, so that help is always readily available in case of injury. Felling should not be allowed during stormy weather, since the direction of fall cannot be controlled.

When a tree is approached for felling the workman should at first decide the direction of fall before he lays down his tools. Usually a certain felling order has to be observed, so that the felled trees do not lie crosswise but more or less parallel to facilitate skidding or hauling (fig. 30). The heavy lean of a tree, a decayed tree base or considerable undergrowth may call for a felling direction that differs from the general direction.

The tools should be laid down behind the tree opposite to the felling direction, and the escape routes cleared diagonally backwards (fig. 16, p. 49). Before any work on the tree begins its base has to be freed from twigs and stones, and the working space cleared from all branches that might catch and divert cutting tools.

Undercut and Back Cut.

Small trees with a base diameter of up to 4 in. (10 cm) can be cut by axes, with one or more cuts from one or both sides. The larger the trees the more difficult it becomes to control their direction of fall when only axes are used for felling. Furthermore, much effort is needed, and a considerable amount of wood is wasted (figs. 31 and 32). Saws have the advantage of cutting larger trees with less effort and less loss of wood, and the direction of fall can also be controlled much more accurately.

For trees of up to 8 in. (20 cm) in diameter at the base, one or two preliminary cuts on the side on which the tree is supposed to fall, or one or several blows with the axe, will be sufficient to guide the tree in the desired direction and prevent splitting. When high-tension bow saws are used, small trees of up to about 6 in. (15 cm) in diameter can even be cut without a counter cut, and when power saws are used this can be achieved if the felling cut slopes downwards slightly so that the tree will slip off the stump (fig. 33).

All trees with a base diameter of 8 in. (20 cm) or more, however, should be felled with a proper undercut and back cut (fig. 34). If the tree stands straight and the wood is sound, so that no special precautions are necessary, the undercut should have a depth of about one-fifth of the tree's base diameter. For big trees a deeper undercut—of about one-third of the tree's base diameter—is needed to control the felling direction. The base of the back cut must be level and slightly higher than that of the undercut. The two cuts must not meet, since a sufficiently strong hinge of wood must be left to hold the tree and control its fall.

Felling the tree requires accurate work by the sawyer. With poor felling, where the undercut or the back cut has been carried

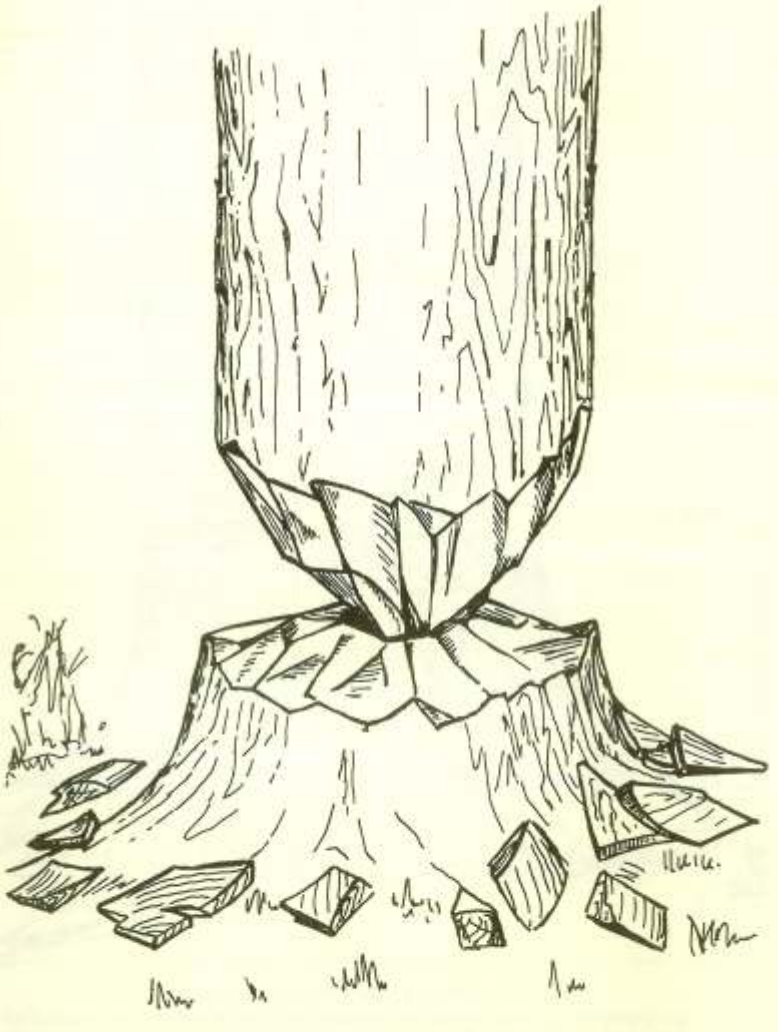

Fig. 31. Felling by axe without an undercut.
If large straight standing trees are felled by axe without an undercut it is impossible to foresee the direction in which the tree will fall.

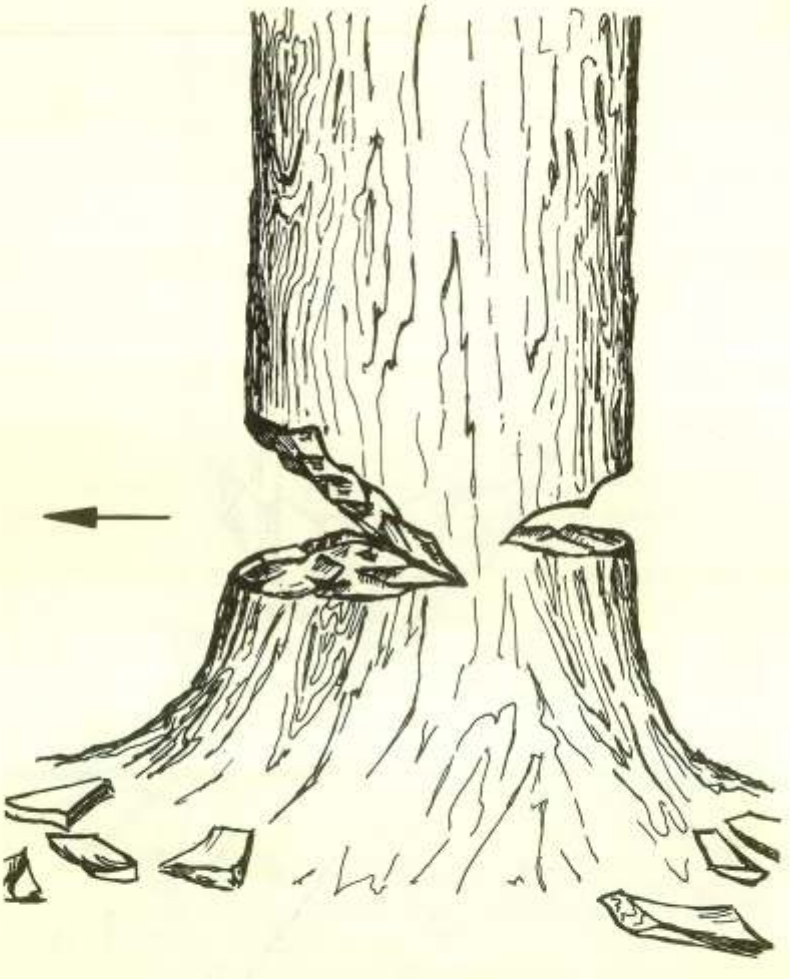

Fig. 32. Felling by axe with an undercut.

Even if an undercut is made the felling direction (arrow) is difficult to control if an axe is used, and considerable quantities of wood are lost. Axe work is especially strenuous, particularly in the case of trees with large diameters or hard cores. In such cases the undercut and backcut should be of approximately the same depth in order to avoid wood losses and save energy.

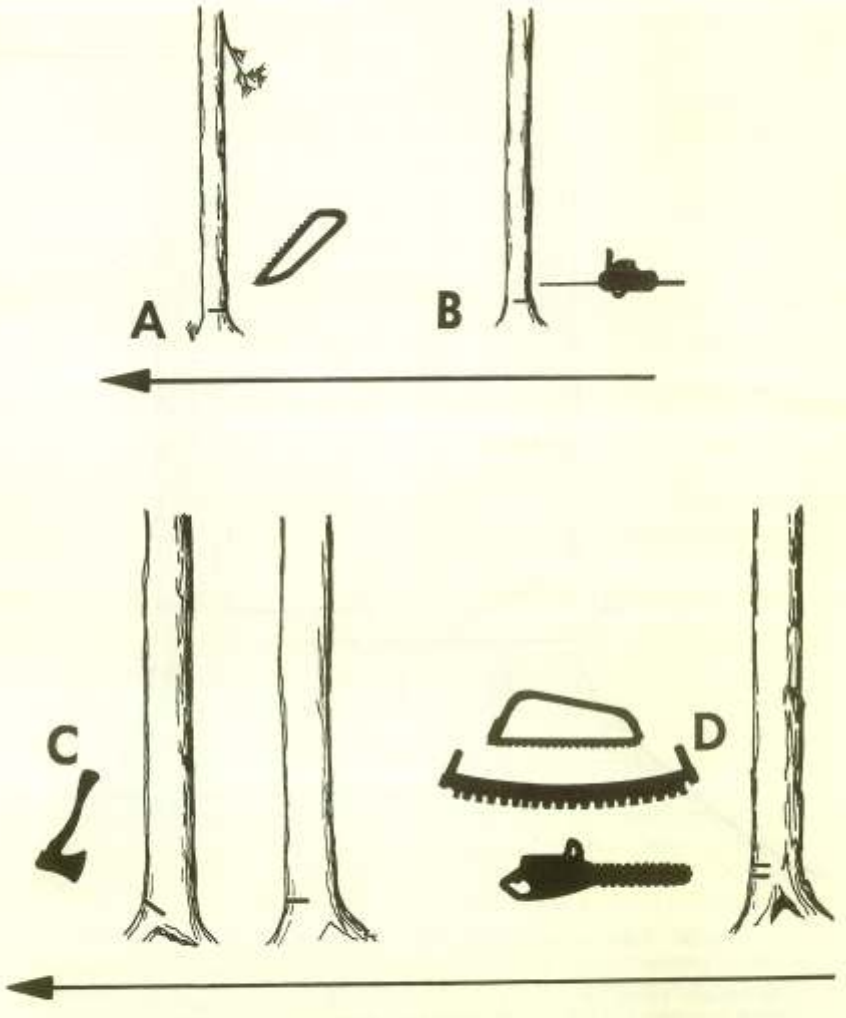

Fig. 33. Tree-felling methods.
Trees with base diameters of up to 6 in. (15 cm) can be felled by one cut of a high-tension bow saw (A) or power saw (B) in the felling direction (arrow). For base diameters of up to 8 in. (20 cm) one or two counter-cuts made with axes (C) or saws (D) are necessary.

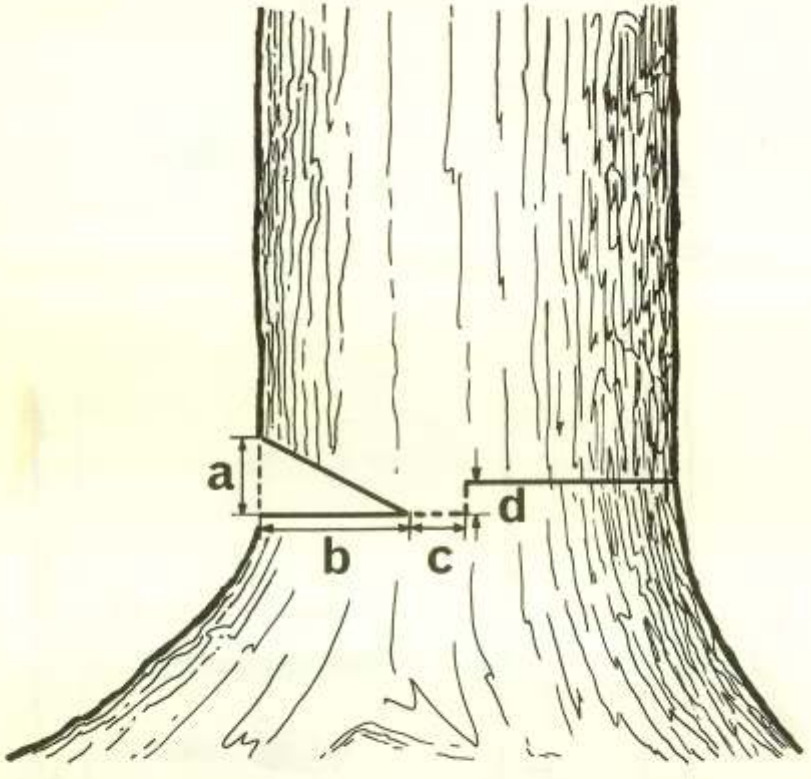

Fig. 34. Felling a tree with a base diameter of more than 8 in. (20 cm).
A proper undercut should be made, the measurements being within the following limits: a = $^1/_4$-$^1/_5$ of diameter; b : a = 2 : 1; c = $^1/_{20}$-$^1/_{10}$ of diameter; d — in hard wood = $^1/_{20}$ of diameter (minimum 1 in. (2.5 cm); maximum 2 in. (5 cm)), in soft wood = $^1/_{14}$ of diameter (minimum 1 in. (2.5 cm); maximum 4 in. (10 cm)); very large trees, e.g. in tropical forests = approx. 8 in. (20 cm).

on too far, a gentle breeze can push the tree in any direction, trapping the worker or smashing his equipment (fig. 35); after the completion of the undercut the feller should in any case examine it to see whether it points in the planned direction of fall. If necessary, adjustments should be made.

If large buttresses are removed with power saws before the undercut and back cut are made, the vertical cut should be made first and the horizontal cut should follow. Otherwise there is here, too, a danger that the horizontal cut might go too far and reduce the area of the back cut so as to prevent exact control of the tree's fall.

When using power saws before the back cut is started, and when using hand saws before it is completed, the feller should once again make sure that no one can be endangered by the falling tree, and shout a loud warning. Wedging will frequently become necessary to prevent pinching. When the tree starts falling the feller should move away from the tree base and look upwards to see whether any branches are falling down.

Leaning Trees.

Trees with a heavy lean require a somewhat different felling technique (fig. 36). If the direction of lean and the planned felling direction are the same, the bole can split for several yards once the back cut is started and hurt the worker if the undercut is made in the same way as for a straight tree.

Felling with a hand saw accordingly requires a deep undercut. In addition, both sides of the tree have to be cornered before the back cut is started. It may also be helpful to use pressure ropes in order to prevent the tree base from splitting.

When a one-man power saw is used, only a small undercut is necessary if the tree can be cut through behind the hinge and the felling cut carried out backwards leaving enough anchorage wood to hold the tree. The final cut is an oblique one from the outside.

Sometimes trees have to be felled against the lean. In this case felling begins with the back cut. Wedges are necessary to lift the tree and finally push it into the direction of fall. The one-

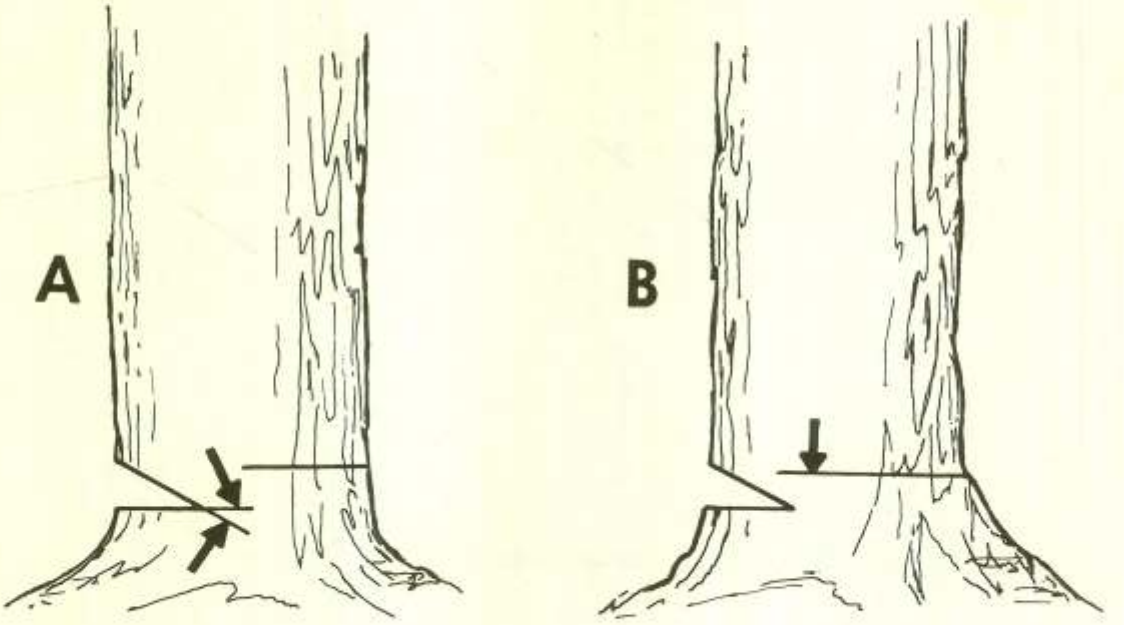

Fig. 35. Leaving a hinge on a tree during felling.
Undercut (A) and back cut (B) should never be carried on too far, for without a proper hinge the tree may fall in any direction.

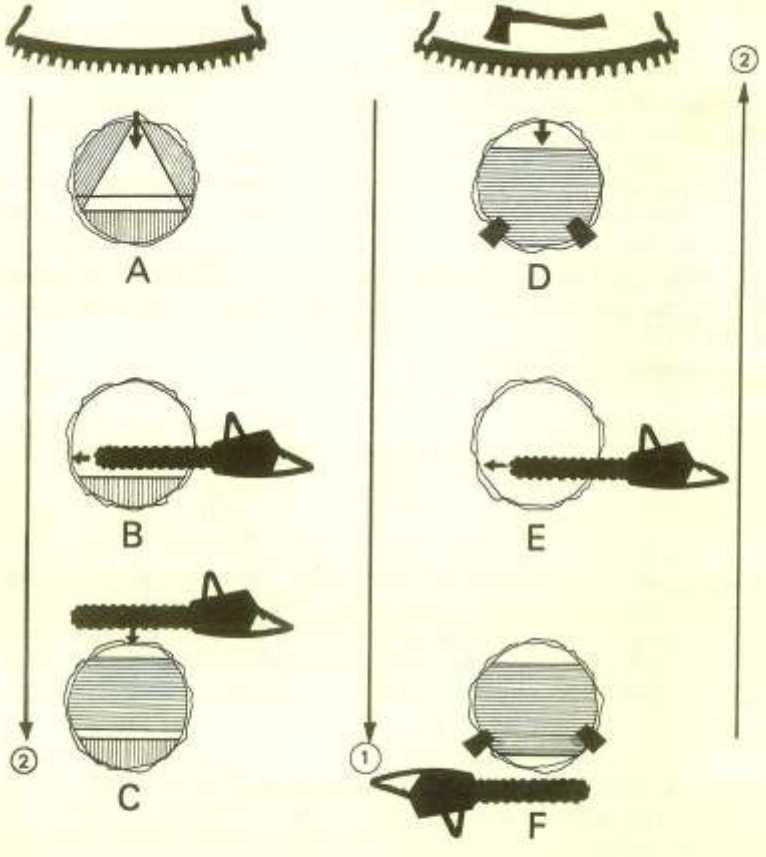

Fig. 36. Techniques for felling leaning trees.

1. Direction of lean. 2. Planned felling direction.

Left: When a tree is felled in the direction of lean the undercut must first be made. If a hand saw is used both sides of the tree must be cornered before the back cut is started (A). If a one-man power saw is used, the back cut is started by boring through the tree behind the hinge (B), the anchorage wood then being removed by an oblique cut from the outside (C).

Right: When a tree is felled against the lean with a hand saw or axe felling starts with a back cut and wedging (D). With a power saw the feller first makes the back cut by boring through the tree so as to avoid pinching (E), leaving some wood which can be cut when the wedges are inserted (F).

man power saw has the advantage that pinching can be prevented by means of boring through the tree, leaving some wood—preferably at buttresses—which is cut later when the back cut is finished and sufficiently secured by wedges. The undercut only needs to be small, and will be cut at the end of the felling procedure. If the lean is very heavy, a manual or powered winch or a horse may be necessary to pull the tree over (fig. 37).

With trees leaning towards one side, the felling direction can be safeguarded by performing the back cut in such a way that more wood is left on the hinge opposite to the lean. Wedges set on the side towards which the tree is leaning can give additional help.

In the same way, for a straight tree the original felling direction can be slightly adjusted during the back cut by leaving more wood as hinge on the side on which the tree is desired to fall (fig. 38).

Lodged Trees.

There is a serious accident risk in bringing down lodged trees. Lodging occurs in densely stocked forests if the direction of felling is not carefully planned. Every effort should be made to prevent the lodging of trees by making the felling cut with extreme care. This is particularly important when one-man power saws are used, for with them it is more difficult to cut accurately. This is another point on which training should be focused.

Lodged trees—except very small ones—should never be left standing, but an attempt should at once be made to take them down. A push pole may be of help with smaller trees if they cannot be dragged away easily. Cant hooks and peavies should next be used. It may be possible to loosen the tree by shaking it. If this does not help, the hinge, which may still connect the tree to the stump, has to be cut. Here again, cant hooks or sappis should be used to turn the tree and pull it from the stump, dragging its base backwards and sliding it on pieces of wood so as to prevent it from boring into the ground (figs. 39 and 40). Here forest workers have to be very careful not to get caught by the tree or the shaft of the cant hook if the tree suddenly moves.

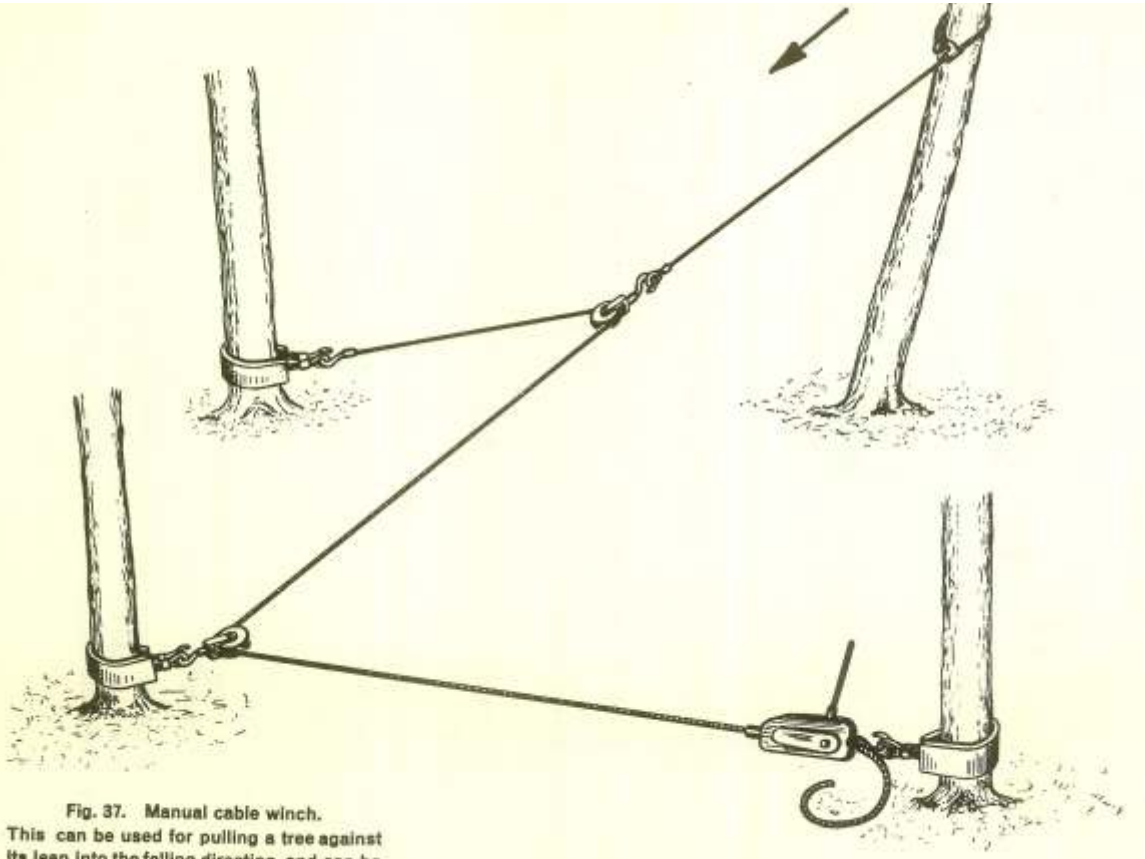

Fig. 37. Manual cable winch.
This can be used for pulling a tree against its lean into the felling direction, and can be set up at a safe place if a pulley is used.

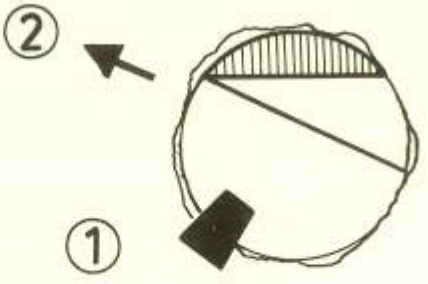

Fig. 38. Felling a tree at an angle to the lean.
1. Wedged back cut. 2. Direction of lean.
The undercut points into the desired felling direction, and on the side of the tree opposite the wedge a stronger hinge is left to correct the tree's fall.

If none of these measures is effective, a manual or powered cable winch or a horse is necessary to pull the tree down. In most cases lateral traction is more effective than traction straight backwards.

Fatal accidents may occur as a result of the following bad practices:

(i) climbing the lodged tree and loosening its crown;

(ii) felling the tree in which the lodged tree is caught;

(iii) felling one or more trees upon the lodged tree.

These practices should never be permitted except with very small trees. Other practices are dangerous too, such as cutting pieces of wood from the base of the lodged tree. They should be allowed only in exceptional cases.

If highly dangerous felling jobs have to be carried out, the supervisor should be on the worksite watching the operations, and only the most highly skilled workers should perform them.

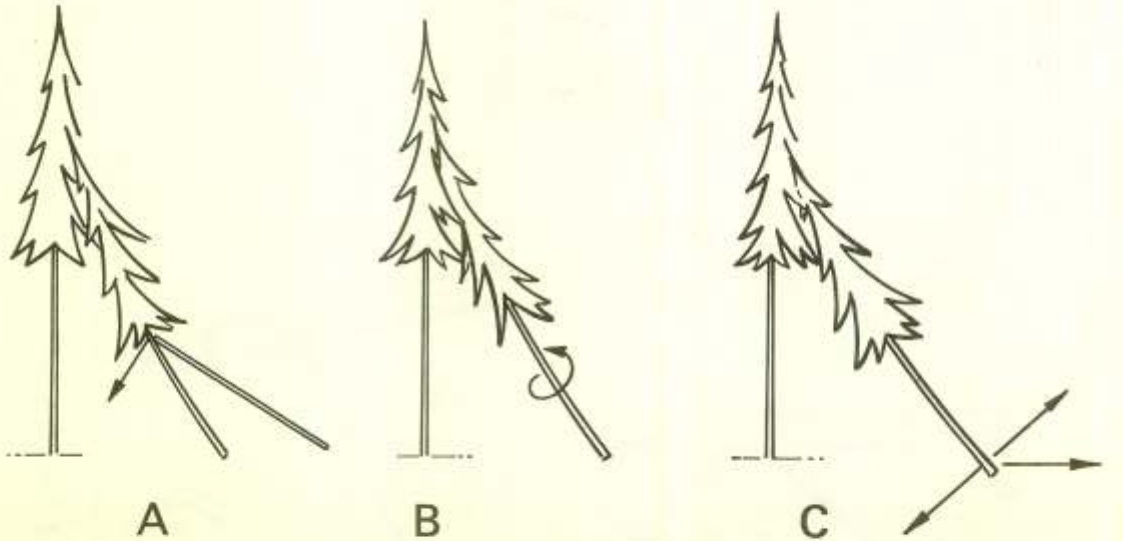

Fig. 39. Bringing down lodged trees.
A. With a push pole from one side. B. By rotating the trunk with a cant hook or cable C. By pulling them backwards or sideways.

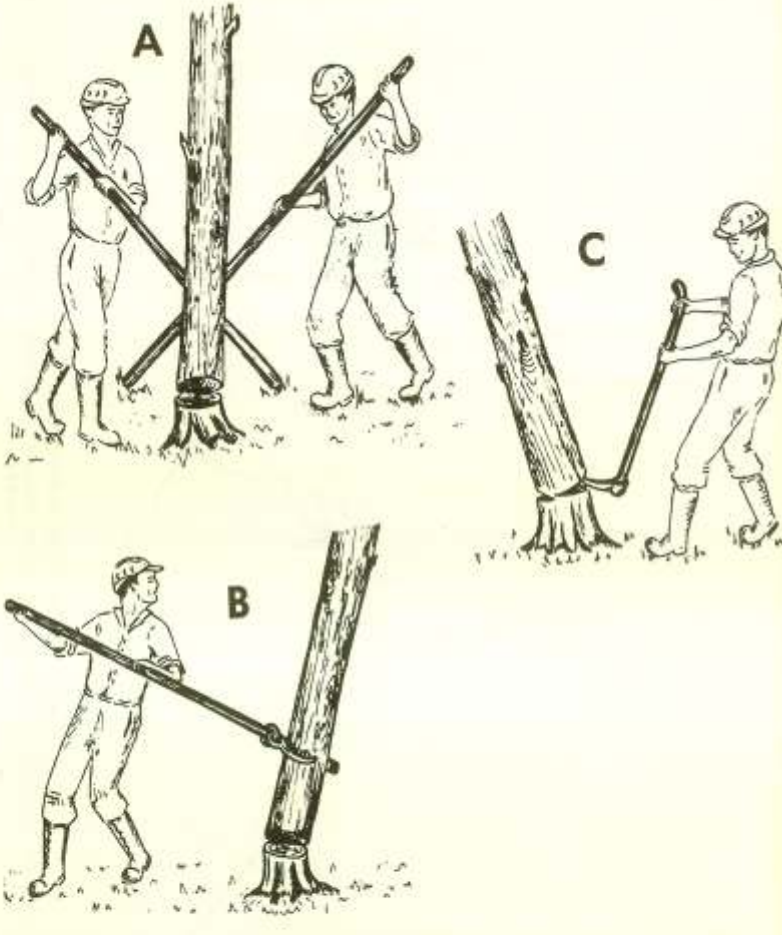

Fig. 40. Loosening a tree.
A. With booms. B. With a cant hook. C. With a peavy.

Large Tropical Trees.

In tropical rain forests where large trees are to be felled, the accident risk is particularly high for several reasons. The tree crowns are usually hidden in a dense canopy, and assessment of a tree's lean is therefore frequently difficult. Climbing plants and adventitious roots often entangle the tree's base, and impede the workers' access and retreat and the free movement of tools and equipment. Dead trees and branches, especially when linked up with a falling tree by climbing plants, are another important accident source.

Extremely large plank buttresses are quite common in many tree species once they have grown up to a large size. The butt end of stems supported by such buttresses tapers like a cone, the biggest stem diameter being not at ground level but somewhat above (see fig. 41). The felling of these trees requires much caution if timber losses as well as injuries are to be avoided.

The traditional way of felling trees with plank buttresses consists in constructing a platform of small poles and fibres around the base in order to be able to perform the felling cut with axes above the buttresses. This technique involves many disadvantages. The construction of platforms costs time and energy. Standing and working on them often for hours in a more or less twisted position is very tiring. Time is lost when withdrawing from the platform while the tree starts falling.

Accident statistics of such operations reveal that many workers are injured in slipping off the platform or while the platform collapses. In addition, severe timber losses occur because the elevated position of the cut increases the tendency of the stem to split and crack.

As already stated above, axe work does not allow proper control of the felling direction. This is a special disadvantage in tropical forests, where the worker's retreat is normally hampered by dense undergrowth. Furthermore, it requires much more energy than sawing, energy which should be saved as much as possible under the heavy strain of the hot and humid environment.

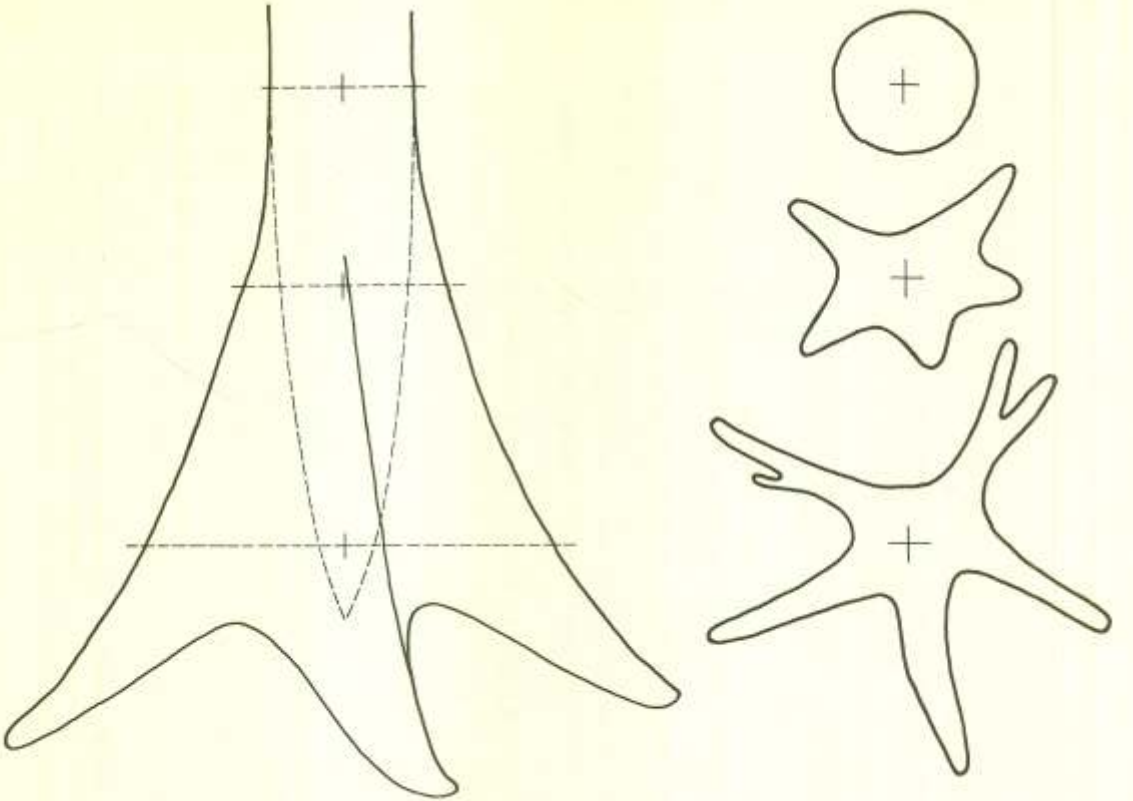

Fig. 41. Plank buttresses at the base of a tree.
Trees with large plank buttresses require a special felling technique because the butt end of their stem tapers.
Right: cross-sections at different levels.

An effort should therefore be made to restrict the use of platforms to exceptional cases (extremely large trees, steep terrain), and to replace axes by hand saws or power saws. The felling cut should be made not above the buttresses, but through them, while the worker stands on the ground. Because of the tapering butt end of the stem, the cut should be made at a certain height in order not to reduce the tree's stability too much after the buttresses are removed.

To judge the lean of the tree it can be desirable first to saw into the buttress from the outside and watch whether the saw cut closes or opens.

In dense tropical forests where trees selected for felling are usually scattered over wide areas it is essential that the working areas of the felling teams should be clearly separated. They should have knowledge of the terrain and the distribution of trees. Where several felling teams are engaged their work should be co-ordinated by a foreman. No persons other than those belonging to the felling team should be allowed within a circle with a radius of three times the tree's height.

Clearance of escape routes is of the greatest importance. Escape routes should lead diagonally backwards (fig. 16, p. 49). In dense tropical forests they should allow the workers to retreat over a minimum distance of 80 to 100 ft (25-30 m) without obstruction. In addition, it is advisable to connect the two escape routes at a distance from the tree's base corresponding to the reach of its crown (fig. 42). Escape routes about 32 in. (80 cm) wide should be cleared with a billhook, and climbers on the tree selected for felling should also be cut.

Trees with large plank buttresses are felled at a height of about 32 in. (80 cm) from the ground. At first the undercut is made in one or more plank buttresses depending on the tree's lean and shape (fig. 43). The hinge should be close to the tree's centre. The back cut is then made horizontally through the remaining plank buttresses, which are cut individually, or two at a time, leaving sufficient wood in the tree's centre as hinge. The back cut should be about 8 in. (20 cm) higher than the undercut.

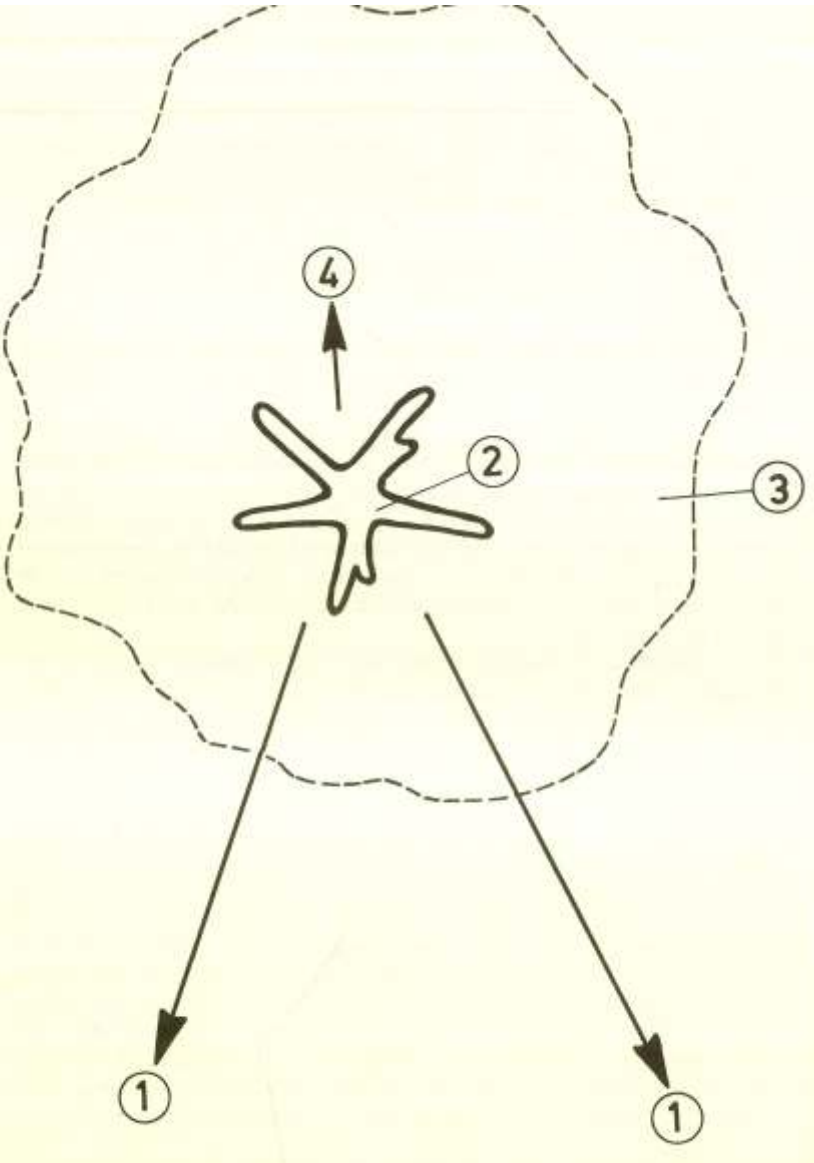

Fig. 42. Recommended escape routes in the felling of a large tropical tree.
1. Escape routes. 2. Tree base. 3. Reach of crown. 4. Direction of lean.

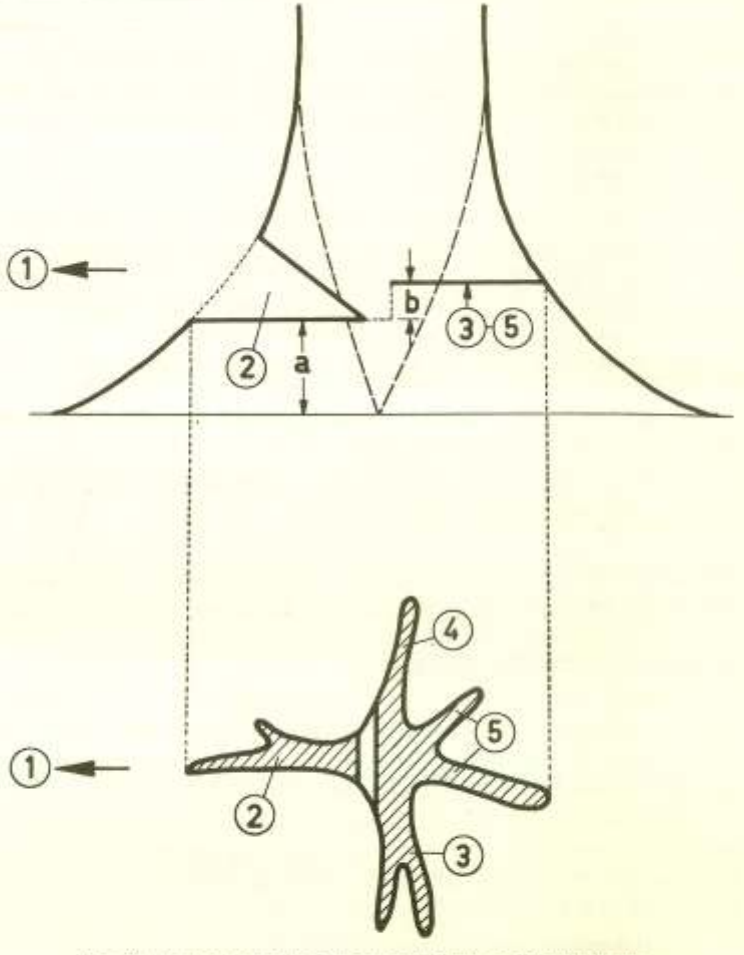

Fig. 43. Felling technique for a tree with large plank buttresses.
a = 30 in. (80 cm). b = 8 in. (20 cm). 1. Direction of fall. 2. Undercut on the buttress (or buttresses) on the side of fall. 3, 4 and 5. Back cut. Remaining buttresses must be cut in the sequence indicated so that the last buttress removed is opposite the direction of fall.

In most cases large tropical trees will have to be felled according to their lean. Deviations of about 30° to either side of the lean are possible if a hinge is left on the side opposite the lean (fig. 38, p. 138). This may, however, be difficult in trees having large plank buttresses and a small centre if the plank buttresses do not extend in the direction where a stronger hinge is desired.

If work is done with one-man power saws, trees leaning heavily into the desired direction of fall can be secured by anchorage wood, as has been explained on page 133. After the undercut is completed the plank buttresses are bored through by a horizontal cut, leaving about 8 to 16 in. (20-40 cm) anchorage wood at their outer side and the desired hinge at the inner side. The final operation is to remove the anchorage wood with oblique cuts from the outer side. In dangerous cases this should be done by axe (see fig. 44).

Felling against the lean is in most cases not possible because of the heavy weight of tree and crown.

If hand saws are used a felling team will normally consist of two men. Where it is economic, owing to scarcity of labour or high wage levels, to use power saws, it is advisable to form felling teams of three men. While the sawyer prepares the saw, his two companions clear the tree's base.

During sawing one of them guides him and watches whether the saw cut opens or closes, and wedges if necessary, while the other clears the escape routes. Before the back cut is completed the saw should be shut off and a loud warning given.

The two helpers should retreat from the base of the tree and watch the crown and other trees entangled with it by climbers. As soon as the tree starts falling the feller must retreat. In critical situations the saw should be left at the tree's base.

To the extent that the cross-cutting of the tree needs to be done at the felling site, it should preferably be carried out by the felling team, in order to reduce both the walking time and the accident risk.

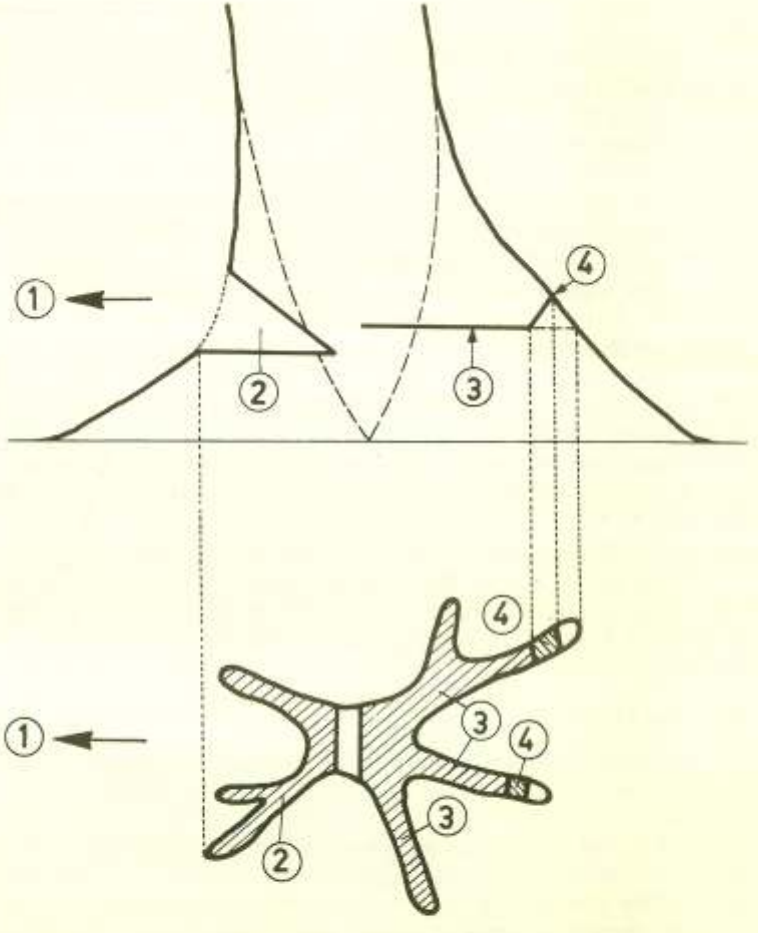

Fig. 44. Felling technique for a tree leaning heavily into the direction of fall and having large plank buttresses.

A tree leaning heavily into the direction of fall (1) is secured by anchorage wood on the opposite buttresses. After the undercut (2) and the back cut (3) have been made the anchorage wood is removed by oblique cuts from the outside (4).

Snags.

Special care is necessary when snag trees are felled because of the great danger of loose material falling from the tree. It may be necessary to post watchmen at a distance to warn the feller in time. Loose material can again be dangerous for the driver of a crawler tractor used for uprooting standing trees with a clearing blade or a tree-pushing boom. On such jobs the crawler tractor should be equipped with a solid roof and force applied gently and not in a single violent thrust (fig. 12, p. 34).

It can also be dangerous to fell trees with decayed centres, especially if the trees are tall. A hollow sound when the tree is struck, or discoloured sawdust, can often be taken as an indication of a rotten core. In such cases enough sound wood should be left to support the tree during the felling cut in order to prevent it from falling to the wrong side or even collapsing. Buttresses should therefore not be removed before the felling cut of a decayed tree is started, particularly if they are needed for wedging. In specially dangerous situations it may even be necessary to use the pull of a rope in order to control the felling direction.

If the decayed zone seems to be restricted to the base of the tree, it can be an advantage to perform the felling cut at a height of about 3 ft (1 m), where the tree can be expected to be sound (fig. 45).

Work on Slopes.

On sloping ground, uphill felling will usually be preferred if the gradient is gentle, while on steeper slopes downhill felling is the rule. Loose material can be dangerous not only for the man on the job, but also for persons working below. One wood cutter should therefore never work below another on a hill. If trees have to be felled downhill, it may in some cases be necessary to secure them by means of ropes or chains tied to the stump. Similarly, all trees that might get loose and slide or roll downhill should be blocked by pegs, rocks, and so on (fig. 46). If the ground is icy it will be necessary to suspend felling operations on steep ground.

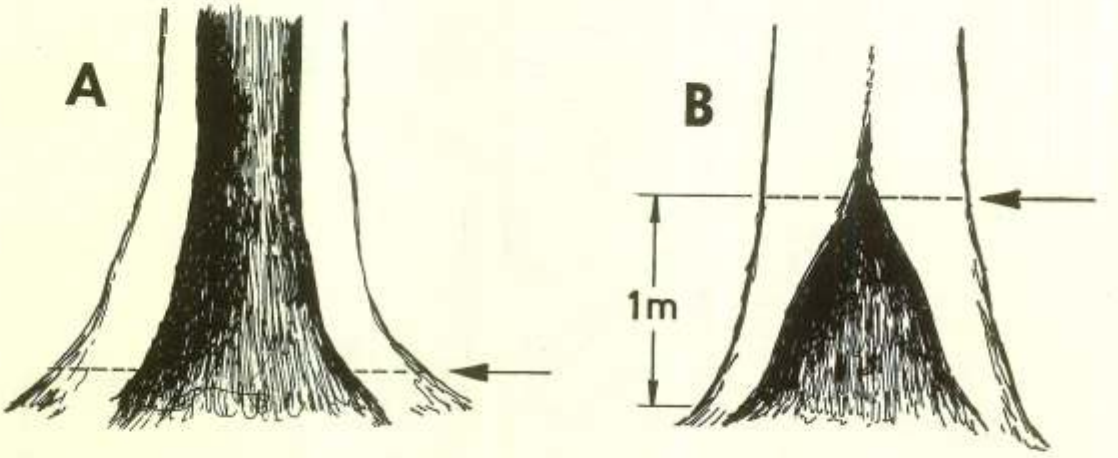

Fig. 45. Felling a tree whose centre is decayed.
Buttresses should not be removed before felling (A). If the decayed zone is normally restricted to the tree's base it may be preferable to cut the tree about 3 ft above the base (B).

Fig. 46. Securing logs on steep terrain to prevent them from rolling or sliding downhill.

Wind-blown Trees.

Where areas of wind-blown forest stands or snow breakages have to be cleared, further accident risks are to be found. When an uprooted stump is cut off it may fall back or overturn and bury either the cutter or the person standing behind the stump. The cutter should be protected by supporting the stump against the ground with beams, by pulling it away with a rope or by putting stones or other materials under the overturned tree (fig. 47). Apart from the persons who are engaged in cutting, nobody should be in the vicinity of the stump. For that reason one-man saws have a definite advantage.

Quite frequently, wood will be under high tension and there is a danger of logs splitting and swinging. Trees should always be approached from the safe side where the sawyer is not trapped by other trees or stumps. With one-man power saws it is possible to prevent splitting by cutting first through those zones of wood that are under pressure, using a boring cut if necessary. If the trees are very liable to split, pressure ropes can be useful if tied firmly close to the cut (fig. 48).

If many trees lie crosswise on each other it makes matters easier if they can be pulled away to a clear working place as soon as they are freed.

Branching (Limbing)

Branching is a job where injuries are not as serious as in felling but are far more numerous. In fact, most cuts from sharp tools occur here. A good foothold and clear working space are essential. The workman should always try to stand on the side of the tree opposite the branch that he is cutting, or direct the cut away from his body (fig. 49). When using an axe he should make certain that it is not deflected during hewing. Power saws may slip off the branch if they are not supported firmly. Branches under tension can hit a worker if they are cut loose. Furthermore, the whole tree can move and turn when supporting branches

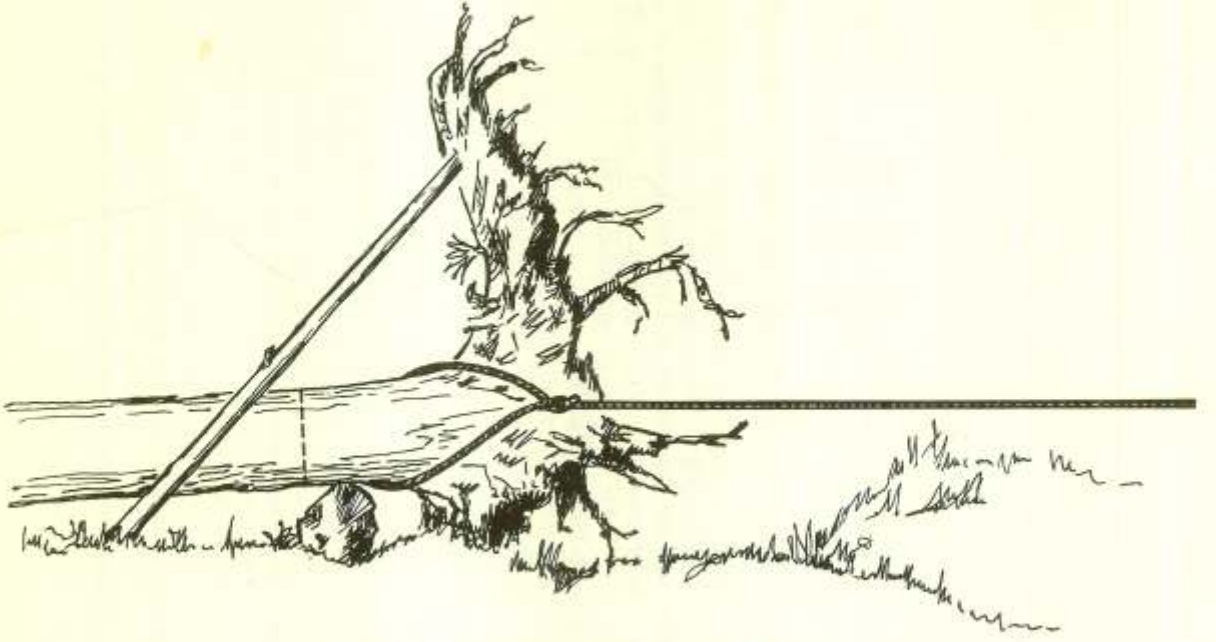

Fig. 47. Means of protecting the sawyer from an overturning stump.
The stump should be propped by supports or held in position by a cable. Dotted line indicates position of cut.

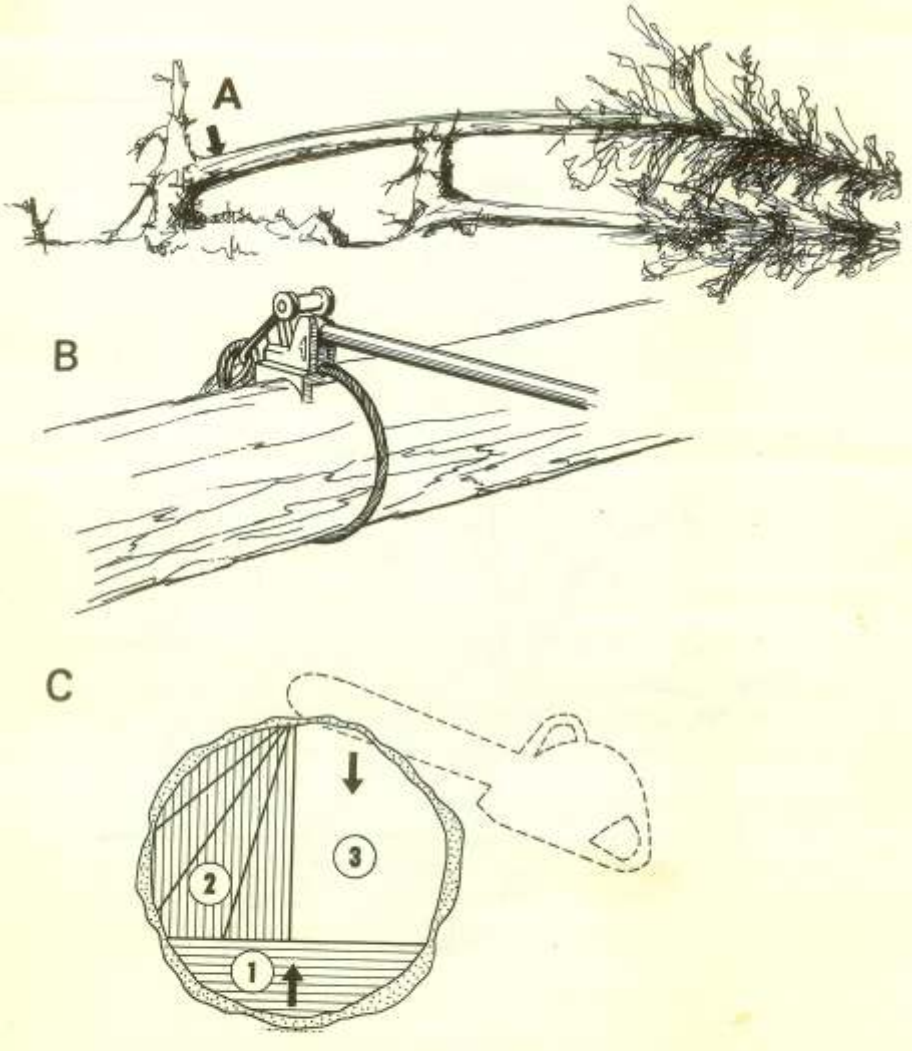

Fig. 48. Cutting a wind-fallen tree from a stump.
Cutting in such conditions is highly dangerous when the cut is under high tension (A). Pressure ropes can be helpful to prevent splitting (B). If one-man power saws are used, splitting can in most cases be prevented if the cut is made in the sequence indicated (C).

Fig. 49. Correct position for branching.
The safest practice is to stand on the side of the tree opposite the branch that is cut.

are cut. The worker must always look out for such dangers and place himself in a safe spot.

Cross-cutting (Bucking)

In cross-cutting (bucking) similar precautions to those in branching are necessary: a safe position for the worker and a careful watch on material that might get loose. In hilly country the sawyer should try to stand uphill. Cross-cutting will usually begin on the tree top, and thus gradually release the tension of wood from cut to cut. Power saws should be propped on the tree by their spurs if possible, in order to reduce the weight carried by the workers. Here again, the one-man power saw has the advantage of cutting wood under tension both more safely and faster, as has already been pointed out in connection with the cutting of wind-blown wood.

25. Transportation of Timber

The transportation of timber plays a very important role in many forest establishments. This is particularly so in remote regions where logs have to be hauled over long distances to roads, waterways, railway lines, etc. Moving of goods of heavy weight and irregular shape under varying conditions of terrain and weather can result in severe accidents if the necessary precautions are not taken. Fatalities or injuries leading to permanent disabilities are frequent in these operations. Strict precautions have therefore to be taken, and controlled with special care (fig. 50).

Manual Lifting, Loading and Carrying

Whenever practicable, mechanical appliances or at least animal power should be used for lifting and carrying loads. Manual lifting and carrying should be restricted as much as

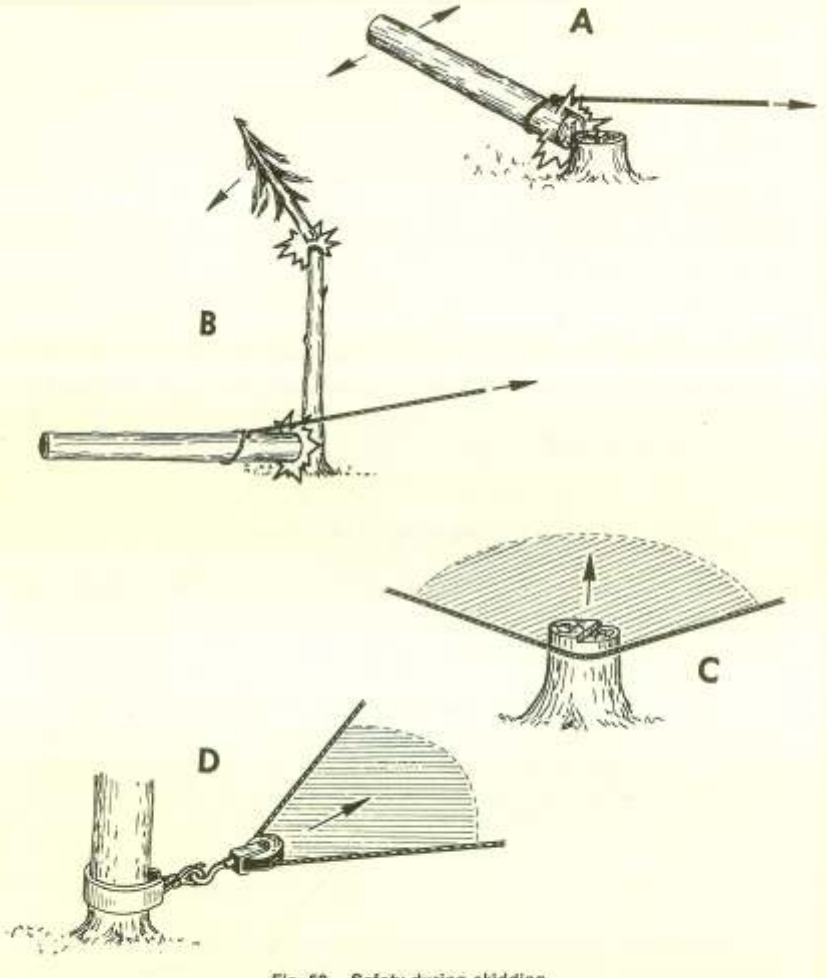

Fig. 50. Safety during skidding.
A. Safe distances must be kept from bouncing logs. B. Workers should look out for falling material. C and D. Workers should never stand in the bight of a line.

possible. Much energy can be saved by providing pickaroons, skidding tongs, wheelbarrows with rubber tires and other equipment.

Big bolts should first be split, and long and heavy logs should be cut into pieces if manual handling is difficult. The lifting and loading height and carrying distances should be as small as possible.

An axe should never be used for pulling or lifting logs since it might slip off and hurt the worker. When a pickaroon is hooked on a piece of wood, the worker should stand slightly to the side so that it does not hit him if it slips off. Pads of nylon fabric sewn on the trouser knees have proved to be good protection against injuries from pickaroons.

The worker should keep his back straight and use his leg muscles when lifting. Loads being carried should be kept close to the body and be well balanced, and the worker should again hold his back straight. He should select his path carefully and avoid obstacles.

Most accidents are due to slips, falls, treading in holes, stumbling over stumps or branches, striking obstacles, etc. If practicable, a path should be cleared in advance for repeated use.

When slopes are crossed the load should be carried on the downhill side. Loads should never be thrown down over the head. When logs are carried by a number of workers, the last worker should give signals for lifting and dropping. All the workers should be on the same side of the log.

The weight of a load carried by one man should normally be limited to 120 lb (55 kg), or less if loads have to be carried over long distances. The weight which women and young workers may carry should be substantially less and should not as a rule exceed 40 per cent. of that allowed for adult male workers. Young people should not be employed on jobs in which lifting, loading and carrying takes up a considerable part of the working time.

Skidding with Tractors and Animals

It is most important to select safe skidding trails, of sufficient width and suitable gradient. If necessary, they should first be cleared of branches and other obstacles, and they should be marked clearly. Stumps should be level with the ground except along steep slopes or precipices where they can serve as fenders. Bends should be sufficiently wide, and ample space should be provided for turning around. Much time and trouble can be saved if such preparations are made before skidding begins. In this way it is also possible to guarantee maximum protection for the remaining crop and young growth.

As a rule, skidding should not begin before the area is abandoned by workers not taking part in the operation. However, when felling and skidding are combined, the skidder should give a warning signal and wait for an answer by the feller before he enters any danger zone. Along the entire length of the skid track work should only be permitted if a safe distance from the track is maintained.

On slopes, all workers should keep on the uphill side of logs. Skidding across slopes can be done only if there is no danger of logs rolling sideways. Skidding downhill can be very dangerous if the log gets out of control and moves forward or sways sideways. Skidding uphill with tractor-operated winches is usually much safer.

In most skidding accidents men are either struck by objects or they slip and fall. Skidding crews should wear non-slip boots and move with great caution on difficult terrain. Young and alert men should be selected for setting chokers. They should never be required to run or walk fast. It should be borne in mind that all movements on difficult terrain are very strenuous and require a considerable amount of energy.

When logs are tied or untied it is necessary to make sure that they will not roll. If necessary, they have to be blocked before they are tied. Chokers, chains, tongs, etc., should be placed firmly on logs. Tongs can be handled safely if they are grasped

close to the points. In areas where there are poisonous snakes the place where chokers or chains are set has to be inspected carefully in advance. When arches or trailers are used the helper must stand clear when they are backed up. Loose loads have to be properly secured, if necessary by binder chains or ropes.

When loads are moving the greatest dangers result from logs striking obstructions and swinging round, small trees being knocked down, dead branches falling from standing trees which have been struck, and limbs and chunks thrown up from the ground by the load, line or vehicle. A safe position is the best defence against these accident risks. In addition, the wearing of hard hats is recommended. The danger of swinging and bouncing logs can be reduced if the front end is lifted upwards during skidding, and if crooked and twisted logs are cut into short lengths.

As described in Section 22, "Signalling", helpers and operators should communicate with each other by means of a clear set of signals. No equipment should be moved unless all helpers are standing clear. Normally, a distance of 16 ft (5 m) should be kept from the object to be moved. When long logs are skidded round bends, workers should always stand on the inside curve. It should be strictly forbidden to all persons to sit or stand on the load or to guide loads with hands, feet or shoulders.

Less frequent types of skidding accidents are strains and sprains of muscles and joints when freeing blocked logs or pulling lines. Strains can be avoided by a suitable application of mechanical aids, and by deliberately using the strong leg and arm muscles and relieving the back.

Skidding tractors should have an operator's cab. The tractors should be firmly anchored and aligned with the direction of pull if winches are operated. Loads should never be hitched so high that there is a danger of rearing. It is a dangerous practice to drag loose tongs, chokers and chains on the ground behind the tractor. Workers should never stand in the bight of a line, and should wear gloves as a protection against broken wire strands.

Animal skidding, like tractor skidding, requires much experience. The teamster should walk beside the animal or well

behind the load and not alongside the load. A safe distance of at least 5 ft (1.5 m) should be maintained between the load and the animal.

Operation of Cableways

During the operation of cableways precautions have to be taken in much the same way as in tractor skidding. Slips, falls, swinging and bouncing logs and running lines are the main causes of accidents.

Since a greater number of workers are engaged in cable operations, and the distance between the winch and men working on the line and at landings can be fairly long, smooth co-operation is needed within the crew. Signalling is decisive for safety. For some systems of cable haulage special signalmen have to be appointed. Cableways should be operated only by experienced men, who as far as possible should receive special training and hold a certificate.

During high-lead haulage no one should be endangered by the suspended load. Persons should never be allowed to ride on high-lead haulage systems. During stormy weather the operation should be discontinued. The same applies to all cable operations when a thunderstorm is approaching.

While unhooking heavy logs at landings many workers have lost their lives through being crushed by moving logs. Landings should be kept as clear as possible, and logs should be approached only after they have been securely landed and, if necessary, blocked.

Operation of Chutes

Safe operation of chutes is possible only if one log passes down the chute at a time. If the bottom landing cannot be seen from the top, no log should be sent down until a permissive signal has been received from the bottom. If several signalmen are posted alongside the chute, the feeder should always wait for the nearest signalman to give the signal. Signalmen should always stand at

safe places, if possible behind trees that give sufficient protection if a log jumps out of the chute.

No logs should be left lying in the chute. At the bottom end the wood should be stacked at places that cannot be struck by logs coming down the chute. No worker should ever enter the chute except during repairs, when the operation is at a complete standstill.

Timber Transportation on Waterways

If waterways are abundant they are often used for the transport of timber. There is a general tendency, however, to transfer timber transport from waterways to roads and railway lines, especially where methods of floating loose timber have been more primitive.

On the other hand, mechanisation has considerably improved the efficiency of certain methods of timber transport by waterways, as regards, for instance, building and handling rafts.

Only a few general safety aspects of this highly specialised activity will be discussed. Many of the safety rules given in Part II and other paragraphs of this section apply to the machines used for moving logs.

All structures used during timber transportation on waterways, such as gangways, booms and bridges, should be of adequate strength and buoyancy; they should be kept clear from obstructions and be provided with guard-rails, if practicable. Boats should be of sound construction and carry life-saving equipment. Waterways have to be kept clear of sunken logs, overhanging trees and other obstructions.

Workers engaged on waterways should be able to swim. They should wear life-saving vests and buoyant life-jackets or similar protection if employed at places where they could drown. They should not work out of sight of the other workers. Boots with non-slip soles are an advantage. In heavy rain or thick fog, or when the waves are higher than 3 ft (1 m), work on the water should be stopped.

When floating loose logs, workers should stand in safe places and be provided with sharp and strong pike poles if logs have to be guided. They should never be on river banks below booms that are being lowered into the water. Log jams should be cleared by experienced workers with the help of patrol boats, winches and tractors or hand spikes. Workers should get off as soon as the jam begins moving. While sluice gates are opened no workers should be downstream in the water, in boats or on rafts.

Raft building on land should take place on cleared and levelled ground. Skids used for rolling logs must be laid evenly and be firmly secured. Rafts should be built on ice only if it is thick enough to carry the load of the raft and the raft-building machinery. When rafts are lowered into the water all persons should stand clear. Boats should never be in the immediate vicinity.

When rafts are built in the water, this should be done sufficiently far away from other operations. Logs should be rolled into the water on skids and not be guided with hands, shoulders or other parts of the body. Jams should not be allowed to form, and the workplace should always be kept as tidy as possible.

Rolling logs into the water by mechanical means requires similar precautions to those described for skidding. When logs are rolled from stacks, they should be moved only after the slinger has withdrawn to a safe place and given a signal.

Mechanical Loading and Unloading

During loading operations the operator should have a full and unobscured view of the loads that are handled. If this is not possible, he should be directed by proper signals. Vehicles being loaded should be placed safely and braked sufficiently. When the vehicle is backing up, everybody should stand clear, and loading should never begin before the vehicle has stopped. Nobody should be in the cab or on the platform of a vehicle while loading is in progress, except when the loading device is operated from the cab (fig. 51).

Loading hooks and tongs should be securely attached. If hooks or tongs cannot hold the load safely, slings should be used to lift them. It is a great advantage to have self-opening slings and hooks that can be pulled off after the load is released. When bundles of logs are moved, only self-opening slings should be used. For guiding the movement of the suspended logs or bundles, gaffs or special rope guides should be used.

As far as possible, loads should be lifted and lowered vertically. No person should pass or stay under a suspended load. During loading, helpers should never stay alongside the load. If a vehicle is shifted forward before the loading operation is finished, this should be done at slow speed and only after ensuring that no logs will fall.

If skids are used for rolling logs onto vehicles, they should be placed firmly. Logs should be pulled onto the vehicle with two ropes. If only one rope is available, it should not be attached in the middle of the log, but first one end should be pulled up and firmly secured and then the other end.

Loads should be formed compactly so that no danger of projecting, shifting, swinging or falling exists. Protruding limbs or tree tops should be cut off. Only when the load is properly attached with binder ropes and chains should the vehicle be allowed to drive off. Caution is necessary when the binder chains are thrown over the load. During unloading no one should stand between the vehicles and the dump; the load should always be released from the side opposite the dump.

Figure 51 shows safe distances to be kept when vehicles are loaded or unloaded.

STACKING

Wood should be stacked on firm, level ground or some other secure base. It should never be stacked higher than necessary, and if placed along roadsides should never hamper the traffic.

To prevent any danger of collapsing, or logs falling or rolling off, the stacks have to be well secured. Different layers of logs

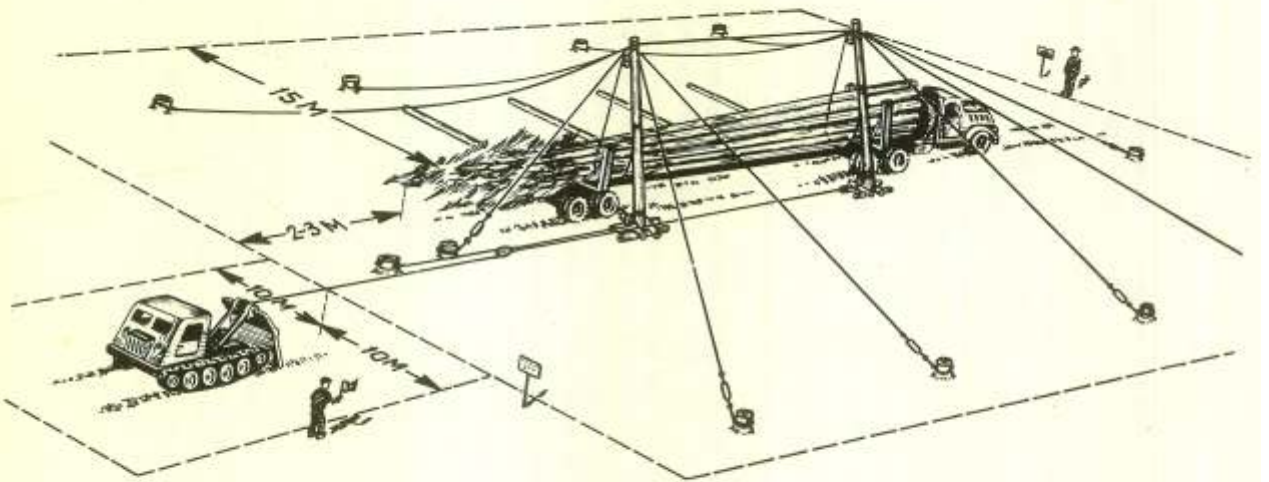

Fig. 51. Safe distances to be kept by workers from moving logs, machines or lines during transport and loading of wood.

should be separated by stickers, and each layer should be stepped back one log from the next lower layer. In big piles the logs should be laid so that there are butt ends at both sides. If necessary, stacks should be held together with chains, clamps or other means. Unstable stacks should be supported sufficiently or taken down, and should not be climbed by workers.

Short lengths of wood should not be stacked higher than 7 ft (2 m) by hand. Supporting stakes on the sides of stacks piled up parallel should be firmly secured against being pushed over by the weight of the stack.

Unstacking should always start at the top layer, and be done in such a way that the stack does not lose its stability and hooks and tongs can be attached safely to logs. Logs should never be pulled out from the bottom. For the mechanical stacking and unstacking of logs, self-opening slings should be used.

26. Clearance, Soil Cultivation and Planting, and Protection of Forest Crops

Clearance

Clearance of sites for planting, road construction, nurseries or landings frequently requires the removal of standing trees, the extraction of stumps and the disposal of slash. It is often not known that these preparatory operations are usually more dangerous than the subsequent main operations. As a result, clearance work is often performed by workmen who are neither sufficiently qualified nor sufficiently supervised.

Uprooting of stumps can be a particularly hazardous job. The heavy weight of stumps and their tendency to fall backwards if the roots are not all cut or broken can cause severe accidents. This risk has to be watched, especially when using machinery. Winches should be set up properly, and workers kept clear of stumps that might fall down or tilt backwards. Uprooting of

bigger stumps can be facilitated by blasting, the roots being subsequently removed by bulldozer blade.

When tractor-operated winches are used for extracting stumps, the tractor should be braked firmly. A most dangerous practice is the extraction of stumps by the moving tractor without a winch. If a high hitch is applied this can very easily result in rearing. In this way inexperienced drivers of agricultural tractors have in many cases caused severe accidents and damage to property.

Where heavy tractors fitted with bulldozer blades or special tree pushers (see fig. 12, p. 34) are available, and where the trees are not too big, uprooting is often performed by pushing standing trees over with the bulldozer blade or the tree pusher. During this operation the tractor driver is in great danger of being hit by falling branches or even by a breaking tree-top. Hence only tractors with a solid roof should be used for uprooting standing trees, and onlookers should keep a safe distance from the tree. If trees with large plank buttresses are pushed over this work is facilitated if the plank buttresses are first loosened by a vertical cut. For safety reasons, however, plank buttresses should not be cut off on the side from which the tractor attacks the tree.

If standing trees are pulled down by tractor-mounted winches, these, too, should be set up at a safe distance. Care has to be taken that the tractor is neither hit nor pulled over by the falling tree.

Occasionally trees are killed by girdling or application of chemicals to reduce the shade on road surfaces or on cultivated areas. If left standing and decaying for some time they can shed branches or even collapse, particularly during storms. They should therefore be removed before they create such hazards.

In the removal of small woody growth, cutting tools can easily become a major accident source. Scissor-type tools or saws are safer for this job than hoeing tools with sharp blades. A rigid control should ensure that safe working distances are kept between workers.

If wood chippers or mechanically operated rakes are used for the disposal of undergrowth and slash, care is required to prevent injuries from flying or other moving material. Manual handling of the material should be done with gloves as a protection against splinters and thorns.

During burning of slash the progress of work should follow the wind direction. Weather should be selected in which the material is not too dry, so that excessive heat is avoided. Equipment for fire-fighting must be kept ready where a risk of starting a forest fire might exist.

Soil Cultivation and Planting

Soil cultivation and planting are considerably less dangerous than most other forest operations. Nevertheless, it is worth while to observe safety precautions carefully, since accidents are concentrated on a few operations.

During manual operations, falls of persons and use of tools are the main sources of injury. Reliable footwear, a sufficient space between workers and proper maintenance of tools are the most important safety measures. To ensure that these and other precautions are taken, the operations should be carefully organised and regularly controlled.

If women or young persons are employed, a sufficient number of able-bodied workmen should be available for heavier jobs like earth work in difficult soil or transport of plants over longer distances on difficult terrain.

Inexperienced workers who are engaged for short periods only should be instructed and supervised with special care. They should be warned about harmful insects, snakes, plants or similar risks unknown to them.

If machines are used, the general precautions mentioned in Part II, Section 10, should be followed. On difficult terrain such as steep slopes or uneven surfaces covered with rocks, stumps and shrubs or traversed by ditches, machines should be operated at

low speed and with particular care. Helpers leading or following a machine are usually in greater danger than the driver. They should keep at a safe distance and direct the driver with proper signals. As far as possible protection against flying objects like stones or sticks thrown off by the working tools of the machine should be provided. The safest practice is to use machines in such a way that helpers are not necessary at all or their number is as limited as possible.

Soil cultivation and planting operations are often carried out in open areas in bad weather. Adequate shelter against wind, rain or sun should therefore be provided.

Application of Pesticides

Pesticides are playing an ever-increasing role in the protection of forest crops. Since many are dangerous for the persons handling them, precautions are of paramount importance.

Pesticides are often used for only a few days during the year. In addition, new products appear on the market at frequent intervals. As a result, safety rules are easily forgotten or neglected. For this reason supervisors and workmen should always reacquaint themselves with specific safety measures before an operation starts. The organisation of spraying should begin with a check of instruction charts for the pesticides used.

Protective equipment such as rubber gloves and aprons or cleaning material has to be kept ready at hand. Spraying tools should be tested in advance with water. Mixing containers and proper storing space have to be provided. The safety rules concerning the use of toxic substances as described in Part II, Section 13, should be followed carefully.

Spraying with very harmful substances should be carried out only by reliable adult workers under continuous supervision. All persons who are not immediately concerned with the operation should be kept away.

Fencing

Besides chemicals, certain mechanical means of protecting forest crops are commonly used. Among them fencing of young plantations is fairly frequent in certain regions, and causes a number of accidents.

Creosoting fence posts or handling creosoted posts requires protection of the skin, especially if workers have fair skins. Fence posts should be stored and distributed in such a manner that they cannot roll away. Ramming of posts can be greatly facilitated if manual or mechanical rams are used.

Handling of nails and wire, especially barbed wire, is best done by persons wearing heavy leather gloves and aprons and strong boots. As far as possible barbed wire should not be used. During wire stretching, workers should stand at safe places and avoid stretching up to the breaking point. When tensioned wire is cut both sides of the cut should be secured.

The workplace should be kept as tidy as possible during fencing operations to prevent workers from stumbling across wire or fence posts or stepping on nails. As in many other operations, the best safety precaution is the organisation of jobs with small crews following a properly developed standard working routine.

27. Road Construction, Quarries and Gravel Pits, Blasting

Road Construction

Where road construction is in progress roads should be closed or adequate warnings set up. Dangerous places such as open ditches or excavations should be fenced off and, if necessary, marked by red lanterns after dark. Loads, including moving or parked vehicles, should be at a distance of at least 2 ft (60 cm) from edges of excavations.

During excavation of trenches severe accidents or even fatalities can occur even in relatively shallow trenches if the work-

men are working in a bent position. Trenches more than 4 ft (1.2 m) deep should therefore be shored, with timbering for example. In unstable ground, vertical sheet piling and braces are needed. Workers should not work alone in trenches. They should keep a minimum distance of 10 ft (3 m) from each other.

Road banks should have a slope of not more than 45° in loose material. In moderately stable material a slope of 60° is permissible, and in stable material such as solid rocks, 80°.

During road construction on slopes, earth-moving machinery such as graders or bulldozers should not operate on slippery surfaces. Helpers should keep at a safe distance to prevent being caught by sudden lateral swings. Provision has to be made for safe parking of machinery and storage of fuel in the field.

If stones are crushed manually by hammers it is very important that workers should protect their eyes with wire mesh goggles, and keep at a sufficient distance from other workers and from unprotected persons. Where space is limited, bales of straw can be used to keep workers apart.

Quarries and Gravel Pits

Local quarries and gravel pits are often needed for road construction material. Men working in them are mainly endangered by falling or sliding material, or by falling down steep banks or faces themselves.

All quarries and gravel pits should be properly fenced. The overburden should be stripped at least 10 ft (3 m) from the edge. Overhanging trees should be removed. The bank of the overburden should be sloped to a gradient of 45°.

Faces of quarries should be inspected for loose material, especially after blasting and during freezing and thawing. Loose rocks should be removed at once.

Workers in quarries should wear hard hats. They should keep at a minimum distance of 10 ft (3 m) from each other wherever practicable, and may not work below other workers. For

work on places higher than 10 ft (3 m) or near steep faces, ropes must be kept available. At the floor of the quarry or pit retreat routes should be kept clear for sudden emergencies.

Undermining of quarries or pits or work on overhanging faces should be strictly forbidden. Work should always start at the top. The slope and height of faces depend largely on the composition and structure of the material. A slope of 60° and a face height of 40 ft (12 m) should not normally be exceeded in quarries. A steeper slope is allowable only under favourable conditions. If the material is difficult and unstable, quarries should be worked in steps not more than 10 ft (3 m) high and not less than 5 ft (1.5 m) wide.

In gravel pits a sufficient distance between banks and buildings, shelter huts or roads is important to avoid danger if slides occur. Banks should slope not more than 45° with hand loading and 60° with shovel loading.

Blasting

Blasting is a common practice not only in quarries but also during the construction of roads or ditches. Road surfaces, construction sites and other localities can easily be cleared of rocks or tree stumps by means of blasting.

As already pointed out in Part II, Section 13, the use of explosives requires particular care during storage and handling. Only qualified persons holding a special blaster's certificate can therefore be entrusted with blasting operations. Only they may charge holes and fire shots, whereas helpers may do only preparatory jobs such as making holes or shutting off the danger zone. Blasters and their helpers must be equipped with hard hats.

Electric detonators should normally be used for blasting. They should not, however, be used in the normal manner in the vicinity of power lines or radio transmitters, since electric currents may be induced in the firing conductors in the electromagnetic field. Special electric firing equipment is needed for such situations.

Cap fuses should be used only for small blasting jobs. It is important to test the burning speed of a sample of the fuse. The end of the fuse should be cut off squarely before inserting it into the cap. Caps should always be crimped with special cap crimpers. The fuse must provide a delay of at least two minutes to allow the blaster to reach a safe place.

Before charging, boreholes should be cooled sufficiently and should be large enough to allow smooth loading; primers should be prepared only immediately before loading. For tamping, non-sparking rods are required. The best tamping material is sand or soft clay; stony material, which can be thrown over wide distances, is extremely dangerous and must not be used. If rocks are blasted by laying charges on top of them, the surface must be free from stones as well. Blasting mats in front of or over the blast can protect nearby buildings.

Before firing, warning posts must be established at a safe distance from the blast, a circle of at least 300 yards or metres being kept clear. Firing must not be done after dark or in poor visibility. Proper signals must be given by the blaster before firing and when all is clear again.

The number of shots must be counted to make sure that all shots have gone off. After a misfire only the blaster is allowed to enter the area. He must wait at least 15 minutes before doing so. The misfire should be detonated by placing a primer on top of the first charge or by loading a new hole at a minimum distance of 1 ft (30 cm) from the old one. Blasting should be so organised that all charges, including possible misfires, can be detonated before dark. Sufficient time must be left to destroy unused explosives or store them safely.

28. Forest Fires

Fire-fighting requires an effective organisation and clear plans that can be carried out rapidly in an emergency. Rapid reactions and decisions are needed to prevent damage to property

or persons. Since fire-fighters' safety is easily neglected in the general excitement, everybody should be reminded to avoid all unnecessary risks.

Fire-fighters should be in good physical condition, special fire-fighting crews should be recruited only from men who are in an excellent state of health. They should receive special training in accident risks and first aid in fire fighting.

Sufficient rest periods and an adequate supply of food have to be provided to avoid over-exertion.

Fire-fighters should wear long-sleeved shirts and boots. A hard hat with a fire-resistant face shield is a good means of protection for men who have to work close to the fire. Asbestos or aluminised garments can be of further advantage. Oily clothes should never be worn.

Traffic accidents occur quite frequently if equipment or personnel are conveyed through the forest in a great hurry. Sufficient parking and turning spaces are necessary, and helpers to guide the traffic can be most valuable.

Teams of fire-fighters should be led by men who are familiar with the terrain. If great danger exists, special lookouts should be posted and suitable retreat routes selected. A sudden retreat in a panic has to be prevented by all means. If cut off, a fire-fighter should try to get into the area which has already burned down. Attention has to be given to spot fires.

Gullies and steep-sided valleys should be avoided at all cost during fire-fighting, because they allow the fire to advance faster than a man can run. Most fatalities in forest fire-fighting have been due to men being trapped in gullies or steep-sided valleys.

Burning trees should be passed uphill or above the lean. Special caution is needed near power lines. Equipment like flame-throwers or torches for backfiring should be handled only by experienced men.

When fire-fighters have to be accommodated in provisional camps, safe sites should be selected and reasonable sanitation provided.

Lookouts for the detection of forest fires should be of solid construction. Stairways, platforms and railings, in particular, should be inspected annually. Tops of stairways should be closed by trapdoors to prevent falls off the platform.

29. Transport and Travel of Personnel

Working conditions as a whole can be considerably influenced by the distance between the workers' homes and the worksites, and by the means of transportation. Long distances that have to be covered on foot can be very exhausting, especially in hilly country and in severe weather. They may even necessitate lodging the workers in camps, although they would be far more comfortable at home.

Motor Transport

Motor transport can improve this situation very much and enable the worker to save a considerable amount of time and energy. On the other hand, motor transport on roads can be a serious source of accidents, particularly in regions with high traffic density. Traffic accidents are frequently not only numerous but on the average more severe than accidents at work. It is therefore very desirable to make every possible attempt to avoid them.

Safety standards for the transport of personnel are usually higher if collective transportation is provided where driving can be entrusted to fully reliable persons and it is easier to carry out routine safety checks of cars and trucks. Vehicles used for passenger travel should comply with the requirements set out in Section 16 (Part II). Since safe passenger travel is not possible if no proper seating is available, tractors or log trucks, which as a rule have only sufficient space for the driver and his crew, should not be misused for the transportation of additional persons. Riding on hood, fender, running board or load must be strictly prohibited.

In cold climates vehicles for passenger transport should be sufficiently warmed before use, or the passengers should be otherwise adequately protected against the cold.

If workmen use their own means of transportation these too should be checked regularly for defects that might create accident risks. This is especially necessary for seasonal labour. Driving on forest roads is quite different from driving on public highways because of the narrower road widths, steeper gradients and inferior surfaces. For this reason collective transportation is particularly advantageous for seasonal labour, which may not be familiar with traffic hazards in the forests.

Bicycles and Motor Cycles

Workers riding on bicycles or motor cycles should be urged to secure their tools adequately, and to use protective covers on cutting edges in particular.

Roads

Forest roads should be kept in a safe state as described in Section 16 (Part II). A most important safety rule is to keep within certain speed limits. These should be indicated by sign-posts.

Waterways

Where roads are not available, waterways can be important for the transport of workmen. Boats used for this purpose should be equipped with life-jackets, lifebelts and lifelines and be manned by experienced boatmen. Workers should be able to swim and to perform artificial respiration. Accidents occur mostly if the boat is overloaded or the load is not properly balanced. The maximum safe load should be clearly marked and not exceeded, and passengers should be seated. Weather conditions have to be considered, too. In rough water or dangerous currents, boats should not be used for passenger transportation. If the boat capsizes passengers who have no life-saving equipment should take off heavy outer clothing and shoes, and try to hang on to the boat or other floating objects rather than attempt to swim long distances to the shore.

Travel on Foot

Walking is usually less dangerous than transportation. On ice-coated surfaces, however, bad falls can easily occur. Proper footwear with non-slip soles offers the best protection against this risk. In exceptional cases it might even be necessary to postpone travel until the grip of the road surface is sufficiently re-established, since work in the open air will often not be possible in any case.

In lonely regions persons should not travel alone. If this cannot be avoided they should always leave a notice to say where they may be found if they do not return on time. On difficult terrain safe routes should be selected. Dangerous or uncertain short cuts should never be taken. Compass and maps are necessary if orientation is difficult.

If a worker gets lost he should know how to react: climb to high places to see surroundings; follow roads, telephone lines or waterways; prepare good shelter before dark; if unsuccessful, stay in one place, conserve strength and build smoke fire for searchers.

Crossing frozen waterways or lakes on foot is dangerous if the ice is not at least 6 in. (15 cm) thick. Permanent crossings should be provided with a flooring of planks. A person who has fallen through the ice should try to reach solid ice and crawl on it by keeping his body straight and kicking and pushing with his feet. Rescuers should give support from a safe distance by means of poles, boards or ropes.

When danger of avalanches exists in mountainous regions, travel should be entirely excluded or be restricted to the early morning hours. Avalanche ropes and proper spacing between persons are necessary.

PART IV

DEVELOPMENT OF AN ACTIVE PROGRAMME OF OCCUPATIONAL SAFETY AND HEALTH

30. Regulations concerning Safety and Health Standards

A solid foundation of occupational safety and health regulations that clearly prescribe the standards to be observed by employers and employees is necessary in forest industries. Without them it would be very difficult, if not impossible, to enforce health and safety requirements.

In many countries basic safety and health regulations are embodied in the general labour legislation. This has a disadvantage if special problems relating to the forest industries are not included, or it is difficult to find provisions that have a bearing on forest operations in a voluminous and steadily expanding body of labour legislation.

It is therefore preferable to have special regulations for the forest industries, which have the additional advantage of being easier to keep up to date because they are more restricted in scope.

All the regulations should be written in clear language that will be understood by all concerned. All workers should be instructed in the regulations made for their safety. The instruction should be repeated at intervals. A new worker, or a worker who is transferred to an operation new to him, should never be started in his job until he has been informed of the safety regulations applying to it.

Two different kinds of regulations may be distinguished: official and voluntary. While official regulations contain provisions that are to be enforced by legal means, voluntary regulations or rules are normally supplementary texts that go into greater detail.

Official regulations on occupational safety and health in forest operations should precisely specify the minimum technical requirements to be observed. These requirements must always be practicable. It is useless and it will discredit the regulations as a whole if requirements are imposed that can never be reasonably satisfied. The general duties of employers and workers should be specified. Where no special regulations on occupational safety and health in forest operations exist, the ILO *Model Code of Safety Regulations for Industrial Establishments* [1] may serve as a guide showing the kind of text that can usefully be compiled.

Voluntary rules on occupational health and safety will naturally be of a more comprehensive nature. They can be used to amplify the official regulations and to make special allowances for local peculiarities. Since the rules are more flexible, they can be an excellent means of introducing new safety standards that have to be tested under practical conditions for some time to determine whether they can be incorporated in official regulations and, if so, how this can best be done. The two above-mentioned ILO publications may also be of use in this case.

It may be useful to combine all regulations in one volume which is given to the supervisory personnel and the workers. If a worker performs special operations only, an extract from the regulations might be preferable. In some countries every worker receives in writing a short description of his job with special stress on safe working techniques and accident prevention. No matter how the regulations are brought to the notice of the workers, the most important thing is, of course, that they are not only known but readily accepted and followed.

---

[1] A code of practice on safety and health in forestry work will shortly be published by the International Labour Office.

31. Inspection of Occupational Safety and Health

Some system of control is necessary to guarantee the application of regulations concerning occupational safety and health. There are a number of different ways in which this can be organised. There are many special governmental services for inspecting industrial establishments to determine whether the requirements laid down by the labour legislation are satisfied. Accident insurance agencies, employers' associations or trade unions sometimes assume this duty in whole or in part. However, inspection is more often entrusted to an independent authority that is not too closely linked with local interests.

A safety inspector has to be familiar with many different trades. Forestry differs so much from other occupations that an intimate knowledge of its working conditions and equipment is necessary if faulty judgments are to be avoided. Wherever possible, especially in extensive forest regions, the inspector should have received forest training himself. He must have not only a thorough knowledge of the technical side of forest operations, but also an ability to work amicably with forest personnel.

The main job of the safety inspector is field work, inspecting scattered working places at regular or irregular intervals. He should be permitted to inspect any forest operation without announcing his visit in advance. If working conditions are highly dangerous, he should be allowed to stop the operation. His status must be clearly defined so as to secure his complete independence. As a rule, he should try to avoid interfering with the forest management, especially if he is not a member of a government service but belongs to a private organisation such as an accident insurance company. He should try to act as an adviser whose assistance is welcomed and whose suggestions are willingly followed by the forest management and workers.

Popularisation of safety regulations should be one of the main concerns of the safety inspector. He should systematically find out and demonstrate which regulations are to be observed

primarily under given local conditions, explaining the reasons why. This is by no means an easy task, as it requires much flexibility and adaptability.

Periodic visits to logging camps or to operations where many men are occupied are especially important. Dangerous working places, the occupation of young, old and female workers and handling of dangerous substances, for example, should be controlled very carefully. In addition, special inspections are required when a serious accident has happened. Here it will be the inspector's task to find out whether any breach of safety regulations has been committed, and, if so, by whom. In such a situation he will frequently find little or no assistance at all in his endeavour to discover the cause of the accident, since his final judgment may lead to action being taken against local personnel. On the other hand, regulations are useless if they cannot be enforced, particularly where gross violations lead to serious injuries or even death.

The delicate task of the safety inspector can be carried out properly only by a highly qualified man, whose concern is not so much to enforce regulations as to develop wholehearted co-operation with employers and workers.[1]

32. Employment Injury Statistics

General

Employment injury statistics are an essential basis for accident prevention. They should be planned in such a way as to—

(a) show the magnitude of the employment injury problem as expressed by the number, frequency, severity (time lost) and cost of injuries;

[1] More detailed advice on safety inspection will be found in ILO: *Guide for Labour Inspectors*, Studies and Reports, New Series, No. 41 (Geneva, 1955).

(b) enable comparisons to be made between different forest undertakings, different periods, and possibly different countries; and

(c) permit the classification of accidents in a manner that promotes the development of an effective accident prevention programme.

Without the help of employment injury statistics it is very difficult, if not impossible, to solve the accident problem. Reliable figures on industrial accidents are required to assess measures of accident prevention, and the results of these measures can be evaluated only by appropriate statistics.

In many countries little or no information on forest accidents is available, although statistics on employment injuries generally have been compiled for many years.

Employment injury statistics have to be planned very carefully if satisfactory results are to be obtained. Some principles governing the collection, compilation and analysis of employment injury statistics in general and in forestry in particular are discussed in this guide. For further information reference is made to the resolution concerning statistics of employment injuries adopted by the Tenth International Conference of Labour Statisticians [1], and to a special publication of the FAO and the Economic Commission for Europe.[2]

Definitions

Employment injury statistics require clear definitions of the events that are to be included. Otherwise, no exact comparisons will be possible.

An essential item of employment injury statistics is the number of persons injured or killed. The term "employment injuries"

[1] For the text, see *Official Bulletin* (Geneva, ILO), Vol. XLVI, No. 1, Jan. 1963, pp. 133-143.

[2] *The Collection, Compilation and Analysis of Forest Accident Statistics* (FAO/ECE/LOG/29) (Geneva, 1958).

covers all injuries resulting from accidents arising out of or in the course of employment and all occupational diseases. An accident is caused by a sudden and unexpected external event; an occupational disease is the result of lasting detrimental influence such as noise and vibration. Occupational diseases in forestry are so far very limited in number. In the following text, therefore, the term "accident" is used in a broad sense to include events resulting in occupational diseases.

According to the international standards laid down by the Tenth International Conference of Labour Statisticians, accidents should be classified in terms of their consequences, using the following definitions on the basis of the information available at the time of compilation of the statistics:

(a) fatalities: accidents resulting in death (no matter what time has elapsed between the date of the accident and the date of death);

(b) permanent disablement: accidents resulting in permanent physical or mental limitation or impairment;

(c) temporary disablement: accidents resulting in incapacity for work for at least one full day beyond the day on which the accident occurred, irrespective of whether the days of incapacity were days on which the victim would otherwise have been at work;

(d) other cases: accidents resulting in incapacity for work lasting less than the period defined under *(c)*, and not involving permanent disablement.

In forest operations it will generally be sufficient to restrict accident statistics to the first three categories. To include in addition all those minor accidents which do not lead to an interruption of work would, in most cases, be impracticable. It might be possible, if the data permit, to distinguish between permanent total disablement (resulting in a permanent total impairment of the worker's capacity or the loss—or loss of use of—certain parts of the body, for instance loss of both eyes, hands or legs)

and permanent partial disablement (resulting in a permanent partial impairment of working capacity, e.g. due to loss of one eye, hand or leg).

Accident Rates

One of the fundamental aims of accident statistics is the collection of information on the number of accidents and their distribution within the undertaking. In order to make such figures comparable, they are related to the number of hours worked, to the number of full-time forest workers or to the amount of work performed, e.g. the volume of timber felled.

If the working time is known, the frequency rate of accidents can be calculated by relating the accidents in a given period to 1 million man-hours worked by all persons exposed to risk during that same period. The following formula can be used:

$$\text{Frequency rate} = \frac{\text{Total number of accidents} \times 1{,}000{,}000}{\text{Total number of man-hours worked}}$$

Where the number of man-hours worked is not known and the number of persons exposed to risk cannot be converted into man-hours, the *incidence rate* of accidents can be calculated by dividing the number of accidents (multiplied by 1,000) which occurred during the period covered by the statistics by the average number of workers exposed to risk during the same period.

By means of the accident frequency and incidence rates it is possible to compare different forest undertakings or forest undertakings with industrial undertakings at different periods of time, provided that in all cases the total number of accidents and of man-hours worked or the average number of workers employed is known.

Similar comparisons can be made of the severity of accidents. At the present time there is no international standard method of compiling severity rates. The American Standards Association

recommends that the number of man-days lost be related to 1 million man-hours worked. The following formula could be used:

$$\text{Severity rate} = \frac{\text{Total number of days lost} \times 1{,}000{,}000}{\text{Total number of man-hours of exposure}}$$

Here, records of the number of man-days lost are necessary. It may be quite a problem to provide them. For accidents leading to death or to permanent total or partial disablement certain charges for man-days lost are laid down. In the absence of an international table of such charges, the schedule of the American Standards Association may be of use.[1]

As a substitute for the severity rate, the number of fatal or permanently disabling accidents could also be related to the total number of accidents, etc. In this way, the comparison of accidents in different fields of activity will be more meaningful than if restricted to frequency rates only.

Classification of Accidents

Forest accident statistics should naturally comprise only employment injuries resulting from forest activities such as tree felling and planting. If forest undertakings also include agricultural or industrial establishments employment injuries occurring in them should be kept separate. This also applies to accidents on the way between the workers' homes and their workplace, and to accidents to administrative or supervisory staff.

Since an accident is usually determined by many different factors, the purpose of accident classification is to study its surrounding circumstances and to pinpoint the factors which are most frequently involved. Attention is then focused on those factors that can be influenced by accident-prevention measures.

---

[1] *American Standard Method of Recording and Measuring Work Injury Experience*, approved by the American Standards Association in 1954.

The following classifications have been recommended by the Tenth International Conference of Labour Statisticians:

A—classification of industrial accidents according to type of accident (this classification identifies the type of event which directly resulted in the injury (e.g. fall));

B—classification of industrial accidents according to agency (e.g. tool or equipment); this classification may be used for classifying either the agency related to the injury or the agency related to the accident;

C—classification of industrial accidents according to the nature of the injury (e.g. fractures or cuts);

D—classification of industrial accidents according to the bodily location of the injury.

Furthermore, the accident-prevention information can be made more significant if accidents are also classified by hazardous conditions (e.g. defects of agencies or lack of guards), by unsafe acts (e.g. violation of safety rules) by kind of activity (e.g. felling, skidding), by personal characteristics (e.g. sex, age, occupation, skill, experience on the job, etc.), by day of the week, by month of the year, by time of the accident in respect of the work schedule, or by working conditions (e.g. weather, terrain).

Collection of Statistical Data

The most common basis of forest employment injury statistics is provided by reports rendered by the local forest personnel on special forms. Such reports are used primarily for the compensation of accidents and only to a limited extent for the purpose of preventing them. They could, however, be adapted to serve this purpose better.

Separate forms solely for the purpose of accident prevention have the advantage that the information collected can be more specific and detailed. A sample of such a report is appended to

this guide. This report will normally be filled in by the foreman or the local forester. When practicable, a more detailed system of reporting can be used, consisting of three forms to be filled in by the injured person, the foreman, and the manager respectively.

When little knowledge of the forest accident situation exists and the introduction of accident reports might cause difficulties, systematic questioning of forest workers could help to provide some fundamental information. In this manner the circumstances of earlier accidents which are remembered and described by workers could be classified and analysed.

Although far less accurate than the data obtained through the reporting system outlined above, such a procedure might be a suitable substitute.

For very detailed accident statistics it will normally be sufficient if data is collected at certain intervals, for instance every five years. In the meantime, annual statistics providing information on the number of accidents, classified in terms of their consequences, and on their incidence (frequency, time losses, cost) will help to indicate the general trend.

The data for accidents in forestry, for accidents on the way to and from work and for occupational diseases should be presented in separate tables.

These annual statistics could be combined with controlled sampling for collecting more detailed additional information concerning a representative portion of the total number of accidents.

Compilation, Analysis and Presentation of Statistics

The statistical data collected should be compiled and analysed to draw attention to those facts that are important from the point of view of accident prevention. Furthermore, the significance of the findings has to be stated in order to prevent biased and erroneous conclusions. At first the data have to be summarised and tabulated in single classifications and cross-classifications. The fundamental tables so obtained should consist of actual numbers

and not of percentage figures. The following cross-tabulations will provide valid information for accident prevention:

- nature of injury and part of body affected;
- nature of injury and source of injury;
- source of injury and accident type;
- accident type and hazardous condition;
- hazardous condition and agency of accident;
- accident type and unsafe act.

In large forest undertakings employing a great number of workers the summarisation and tabulation can be facilitated by the use of punched cards. Where no punch-card machinery is available, hand sorting of edge-punched cards can be of great help. For details in this respect reference is made to the special FAO-ECE publication mentioned earlier.[1]

Statistics of employment injuries in forestry should be published regularly in special reports. The presentation of the results in these reports should be such as to enable conclusions to be drawn for accident-prevention purposes.

The numerical data should be shown in an attractive form, avoiding long and complicated tables with few or no explanations; some of the figures could be converted into clear and impressive diagrams. In this way the reports could be made very interesting as well as easily understandable and convincing.

33. Accident Investigation and Research into Health Problems

The compilation of statistics from accident reports will often not help to reveal the deeper causes that lead to accidents. Since there is usually a complexity of technical, sociological, psychological, medical and organisational factors involved in an accident, it is

[1] See p. 181.

highly desirable to know how these factors are represented. Moreover, accident reports are frequently inaccurate or even misleading if the reporter fears unfavourable consequences.

For these reasons, besides having accident statistics as described above, it will be very helpful if special accident investigations can be carried out. They should, however, be completely separated from inquiries concerned with the responsibility and the possible punishment of local personnel. The investigator should be fully acquainted with forest operations and preferably be a forester himself. It would be very useful if he could be stationed at a forest research station. Local accident investigations should take place as soon as possible after an accident has happened.

Naturally, only a small fraction of accidents can be investigated on the spot. Attention has, therefore, to be concentrated on serious accidents and new accident sources, e.g. new types of machinery.

Every fatal accident should be examined very carefully in order to find out which specific factors contributed to it. Since fatal accidents can be expected to account for one-third or even more of the total expenditure on accidents, successful accident-prevention measures could substantially help to reduce expenditure. Next to fatal accidents cases leading to permanent total or permanent partial disability should, if possible, be investigated in the field.

New machinery for cutting, branching, barking, chipping and transporting timber, for road construction, etc., frequently introduces new accident sources. Sometimes these accident sources are not clearly known in the beginning and show up only after a long period of practical work. This may even be the case when a well-known type of machinery is used for work under quite new conditions of forest stands, terrain and climate. Under such circumstances the accident risks can be assessed much earlier and better if all accidents are reported to a central investigator who sytematically traces the factors involved. In addition, a certain amount of field investigation would be necessary. In this way machines could be improved, safety rules developed and losses prevented in a short time.

Another problem that calls for special accident investigations is the exact assessment of accident costs. While the so-called direct accident costs are usually known, the indirect costs can only be assessed very approximately. The direct costs comprise compensation and medical care for the injured person. They are frequently covered by state or private insurance and are easily found from insurance records. The indirect costs comprise such items as costs of damage to equipment and material and costs due to decreased output during the absence of the injured workman and after his return.

On-the-spot pilot studies of different accident classes will help to furnish an idea of the extent of indirect costs. Such figures can be considered to be a valuable incentive for accident-prevention measures.

Research into certain health problems concerning forest operations has been carried out in only a few countries so far. Studies of energy expenditure of forest workers, nutrition and detrimental results of noise and vibration are typical examples. When there is a demand for local information on these or similar questions an appropriate research programme can be established. Usually co-operation between forest research stations and medical institutions will be necessary in order to ensure accurate results from the medical point of view.

34. Education, Training and Propaganda

Without a sound knowledge of the risks, occupational health and safety activities can hardly be carried on successfully. Every person, whether workman or member of the management, needs a certain degree of familiarity with potential sources of danger and means of protection against them. Systematic training and instruction is the only reasonable way by which such fundamental knowledge can be disseminated and implanted in the individual. A person should never be left to learn from his own faults.

Education and Training

The best method of safety training for workers is vocational training in which safe working techniques are demonstrated and applied in practice. Courses at permanent or temporary training centres with a qualified staff of instructors and a certain amount of equipment and teaching aids are needed for such training. In some countries accident insurance companies, having realised that training schemes result in a sharp decrease in accidents, bear the larger part of their cost.

Special courses for operators of dangerous equipment, such as power saws, tractors and cableways, are being provided on an increasing scale; sometimes no one is allowed to handle such equipment without holding a special certificate of competency.

If a regular system of vocational training for forest workers does not exist, instruction given at the worksite assumes additional importance. Even properly trained men should receive such instruction at certain intervals so that they do not drop into unsafe working habits.

Special meetings where accidents are discussed, films and slide shows are some further means of instruction. In a region where a serious accident has occurred the workers' increased awareness and readiness to receive instructions will make it easier for them to be applied in practice.

While field training will normally be carried out by special instructors travelling from one workplace to another, the local supervisor and foreman will have the important task of introducing newcomers to safe working techniques. A short written guide, well illustrated and stressing essential safety points, can supplement job instructions. Guidance has also to be given to men who are transferred to new jobs.

Since the supervisor and the foreman themselves play an important part in the safe organisation and conduct of work, they should receive special safety training adapted to their particular responsibilities; the same can be said of workers' safety delegates. Managerial training should also, of course, include safety in its

curriculum. No forester should complete his training without having acquired a sufficiently broad basis of safety knowledge.

Propaganda

Accident statistics have revealed that the majority of accidents are mainly the result of human failure and shortcomings. The so-called "human factor" is one of the key problems in accident prevention. Whereas purely technical questions, e.g. the guarding of dangerous parts of machines, can be solved relatively easily, it is difficult in many cases to persuade workmen to make proper use of the guards provided and to pay the necessary attention to safety regulations.

In the first instance, every effort should be made to make tools and machines foolproof and so reduce the importance of the human factor. It would, however, be wrong to concentrate solely on this point. It is one of the major aims of education to adapt the individual to the requirements of community life so that he will automatically fulfil them. Safety regulations should be regarded from this same point of view by the general public as well.

Apart from safety training, which at an early age implants consciousness of safety and danger in the human mind, safety questions must be the constant concern of the individual, of small communities, of organisations and of the general public. Only such an approach will in the long run result in an effective control of human failure. Safety propaganda should be a national concern and should take into account all age-groups and occupations. It should not be restricted to the workplace, but should include travel to and from work and family life as well.

The main aim of safety propaganda is to remind the workman that his personal interest as well as his responsibility as a citizen requires him to follow certain rules. These rules and the consequences of their violation have to be brought to his notice in such a way that his interest is renewed and revived over and over again. Furthermore, the dangers of new machinery and the contents of new regulations should be made known to him as soon as possible.

As industrial advertising shows, there are numerous ways in which to arouse the interest of the individual. Much consideration should be given to the manner of approaching different groups of persons—young or old, men or women, inhabitants of towns or villages. Similarly, propaganda for safety in forest operations has to be adapted to the forest workers to whom it is directed. The general state of education, traditions, modes of thought, responses, living conditions and so on have to be observed carefully. Some persons might respond very well to a kind of propaganda that will be rejected by others. Accordingly, only some general indications about different means of safety propaganda can be given here.

Safety propaganda should never create resentment, for nobody likes to be distrusted, criticised or offended. The individual should feel that his co-operation is needed, that he can render good service to himself and to the public if he keeps his eyes and mind open and looks out for any danger that might threaten himself or his fellow-workers. He should eagerly respond to calls for such co-operation and should know that his personal action is needed.

The word—written or spoken—and the image are means of communication that can be used in many forms, such as articles in papers, instruction booklets, pamphlets, lectures, discussions, radio programmes, posters, slides, films and television programmes.

A difference will have to be made between safety propaganda intended for supervisory personnel and that designed for workers. The former should receive detailed technical information and an appeal to their responsibility to protect men and materials. The latter must be approached in simple and clear language accompanied by impressive illustrations. A good slogan and an arresting picture will catch the worker's eye and remain in this mind.

If it is to be effective, safety propaganda should not allow the interest to flag but should always arouse it anew. Nothing can create a worse impression than a dusty, torn safety poster sticking on a wall for a long time, for safety in such a case will be looked upon as a topic of negligible importance. Posters must be frequently replaced to keep the workmen actively safety-conscious.

The provision of suitable pictures demonstrating safe and unsafe ways of working will be rather difficult and requires much skill. Drawings will in most cases give a clearer view of what it is desired to show, while photographs have the advantage of depicting real working life. Very impressive for the onlooker are photographs in which fatal accidents are shown, for instance a dead workman crushed under a tractor. It depends on the worker's response whether such dramatic images are useful or whether purely technical drawings or even humorous illustrations are preferable.

Generally speaking, a positive approach will be preferable for the workman. A picture showing a fatal accident might frighten him and thus have a negative result. On the other hand, it can be a very effective means of reminding the supervisor of his responsibility for the worker's welfare.

Slides and films can be helpful too. Films cost more, however, particularly if they are well prepared. Slides and films will reach only a limited audience because they are more or less restricted to permanent training centres where the necessary technical equipment for showing them is available.

Pamphlets and small instruction booklets have the advantage of being easily disseminated and reaching the remotest workplaces. Also successful is the periodic distribution of short notes on accidents that have recently happened. If they are prepared in such a way that the workmen not only read them but also discuss them amongst themselves, much can be achieved. The combination of such leaflets with competitions in which certain questions are to be answered and prizes distributed can be another effective incentive.

A very useful practice is to call the workmen together on one day during the year to a safety meeting during which safety regulations are quoted, accidents that have happened during the year are discussed, tools, machines, protective clothing, etc., are inspected and workers with a long record of accident-free work are distinguished or rewarded.

Safety propaganda should take account of the fact that in many regions severe traffic accidents occur frequently. Although

it will be hard to control them, they should nevertheless not be overlooked.

Very impressive for the workmen is an exhibition of tools and materials involved in accidents, e.g. hard hats shown together with branches that fell on them and unsafe tools that have caused accidents. Such an exhibition, which of course needs renewal from time to time, can be arranged by any big forest undertaking in suitable places, such as offices, where the workmen often go. Training schools can also have such exhibitions.

These few examples may give a general idea of the way in which propaganda should be tackled. There are many more ways of approaching the workers, but they will be effective only if safety propaganda is continuous and constitutes a permanent part of management activities.

35. Organisation of Activities concerning Occupational Health and Safety

The different activities dealt with in this part so far have shown that a variety of institutions are concerned with health and safety problems. Hence good co-operation is essential if the aim of protecting the worker is to be fulfilled to the greatest possible extent. Poor co-operation on the other hand could result in a waste of money and effort and neglect of important tasks. This is particularly true of forest industries with their scattered work-places and difficulties of communication.

In many countries forest industries play such a small part in the national economy that their problems will be fully recognised only if a common effort is made. The situation is similar if the forests are split up into areas of different sizes under different types of ownership.

The following are some of the many different organisations and parties that in one way or another might deal with health and safety problems:

1. *Forest workers' employers:*

   (a) state forest service;
   (b) communal forests;
   (c) private forest owners;
   (d) timber companies;
   (e) forest owners' associations;
   (f) logging contractors.

2. *Forest workers:*

   (a) workers' representative;
   (b) trade union.

3. *Government institutions:*

   (a) ministry of labour or ministry of health;
   (b) health and safety inspection service;
   (c) state accident insurance board.

4. *Other institutions:*

   (a) forest workers' training schools;
   (b) foresters' training schools;
   (c) forest research stations;
   (d) manufacturers of forest machines;
   (e) testing stations for forest equipment and machines;
   (f) accident insurance agencies.

The Task of the Employers

The employer has the main responsibility for accident prevention and occupational health. For this reason he must assume initiative and leadership in this field. Where small private wood lots exist, woodland owners' associations and similar representative bodies should most certainly take care of safety problems.

Within a forest undertaking the top manager should leave no doubt that he personally fully supports safety measures and feels

that safety should never be neglected for production. This attitude can be emphasised in no better way than by taking definite practical measures.

An annual safety plan can be a very valuable basis for safety measures to be taken within the undertaking, and can cover such questions as inspection of workplaces; investigation and discussion of accidents; purchase of new kinds of safety equipment; organisation of safety meetings, exhibitions and competitions; and distribution of posters, pamphlets, etc. Statistics, as already suggested, are an important source of information for the development and control of such measures.

Besides the organisation of safety activities within the undertaking, close contacts must be maintained with other institutions, such as accident insurance companies and government safety inspection services.

Naturally the manager will not be able to shoulder all the responsibility himself; he needs the co-operation of his workers. Some delegation of responsibility for safety problems is necessary in large undertakings, and ways and means of achieving this are described below.

Safety Engineers

If the undertaking is large enough the appointment of full-time or part-time safety engineers is the best means of making sure that safety activities are kept going. For industrial establishments some authorities consider that one full-time safety official is necessary for 200 to 300 workmen.

The competence of the safety engineer must be defined very clearly. His main function should be an advisory one, one of his principal concerns being to co-operate with local supervisors, foremen and workmen; only in situations of immediate danger should he be entitled to give orders directly. His advisory status will make his services more readily appreciated. It need hardly be mentioned that a safety engineer's job requires high technical

qualifications and outstanding personal qualities if it is to be well done.

Co-operation of Workmen

Past experiences have revealed that safety activities will be of little use if the active interest of the workmen is not awakened and maintained. This is by no means an easy task, since frequently ignorance—and even aversion—are encountered among them.

The best means of overcoming such obstacles is by enabling the workmen themselves to share safety responsibilities through their representatives. In some countries local safety delegates are selected from among the workers who are active in safety matters. Their main duties are to promote safe working habits on the worksites—seeing that safety regulations are observed and protective equipment used, looking after newcomers and participating in accident investigations. Safety delegates should be supported by the management, which should keep them well informed of accident statistics, most recent experiences, etc.

The local supervisor of operations should take every advantage of the support of his safety delegate. Here again, smooth co-operation is essential.

Trade unions have frequently demonstrated their interest in safety by including safety provisions in collective agreements, by supporting local safety delegates and by taking a positive attitude to all safety questions. Such action can also help to stimulate the interest of individuals and replace apathy by a sense of initiative.

Safety Committees

When safety activities are carried on in many quarters some kind of co-ordination becomes necessary. The creation of joint safety committees offers a good opportunity for exchanges of ideas, for co-ordination and for encouragement of the activities of all taking part in the safety programme.

Safety committee meetings, which should be well prepared, should be held periodically and attended by representatives of the

management, safety engineers and workers' delegates. A clear outline should be given of the safety situation, accident statistics, the results of investigations, achievements since the last meeting, and new problems and tasks to be tackled.

Round-table discussions, striking illustrations and graphs, and awards to distinguished members of the committee are just a few of the means by which committees can be kept vigorous and their meetings lively. The more active the participants in meetings, the better will safety ideas be spread and implemented in actual operations.

Safety Associations

It has already been said that, besides stimulation of activities within the undertaking, effective co-operation with outside institutions is also important. This can be facilitated by setting up safety associations or safety councils which take care of common problems and interests, with membership drawn from the many different organisations that deal with safety and health in forest operations. Examples in some countries have clearly demonstrated that a joint initiative can be a most powerful weapon in the war on forest accidents.

The quality and quantity of safety propaganda, safety pamphlets, training facilities, etc., can be considerably increased through united action. The development of safety regulations is another field of common interest, as is the testing of new machines and equipment for safety.

Here, close co-operation with dealers and manufacturers of forest tools and machines is desirable. Furthermore, research into health and accident problems could be stimulated and financed by safety associations.

The individual employer should, however, not content himself with paying his annual subscription to a central association. He should always realise that on his own premises he himself carries the primary responsibility for appropriate organisation and action in the field of occupational safety and health.

36. Medical Supervision and Care

Medical Examinations

In forest operations the workers must as a rule be in good physical and mental shape; persons who suffer from physical infirmities should not ordinarily be employed, especially if heavy manual work has to be done. Machines for sawing, loading, transport and the like have to be operated by men who can take quick decisions and have quick reactions and accordingly need to be well endowed with skill, versatility and intelligence.

Workers who are rejected by other industries because of poor health, low intelligence or lack of education should never be accepted for forest work.

It is very advisable to give men who are to be taken on for regular work a thorough medical examination. The examining physician should have a general idea of the physical and mental requirements of forest work, and decide whether the candidate is fit for his job. Normally, no person is employed who suffers from serious cardio-vascular and lung diseases, diseases of joints, inguinal hernia, skeletal and especially spinal troubles, deafness or poor sight. Exceptions are permissible only for light work such as nursery work and manual planting operations on easy surfaces.

In the course of time a forest worker's health may suffer from heavy work, exposure to noise and vibration, cold and wet and also unsuitable diet, and medical examinations should therefore be repeated at regular intervals. For younger and older workers the intervals should be shorter so that the development of the young and the fitness of the older workers can be effectively supervised. For young workers an annual medical examination is advisable as a rule; older workers should be examined every three years. Workers with weak health should be transferred temporarily or permanently to lighter work if such examinations indicate that this is advisable.

First Aid

First aid is the treatment given to injured persons in emergencies in the absence of qualified medical services. Since in forest operations it will be most unusual for a physician to be able to arrive at the scene of an accident until some time has elapsed, it is essential for forest personnel to know what to do in the meantime. Serious complications and even fatalities can be prevented if the workers strictly follow approved principles of first aid.

First-aid measures in forest operations depend largely on the remoteness of the workplace, the number of persons employed there, the nature of the work, environmental factors and the availability of qualified nurses, physicians and hospitals. Much variety will be found in these respects and only some general recommendations can be given here.

When forest workers live in camps far away from the nearest settlements and motor transport is not possible, men with a thorough practical knowledge of first aid, a comprehensive first-aid kit and a first-aid room are necessary. In such circumstances at least two persons in the camp, for instance the foreman and the cook, should have a detailed knowledge of first aid for injured persons.

Furthermore, the right steps in cases of complaints and illnesses such as acute colds, toothache, appendicitis, epilepsy and heart disorders are important. Requirements are similar in countries with medical facilities not yet fully developed, especially in remote areas.

Here a good knowledge of first aid is particularly important where workers are performing such dangerous jobs as felling or transporting trees.

Somewhat less elaborate first-aid measures are required in a densely populated region with easily accessible workplaces motor transport, excellent telephone communications and an ambulance available for the hospitalisation of injured workers within an hour of the accident. Nevertheless, the basic principles of first aid have to be observed here too.

First-aid Kits.

From the preceding paragraphs it may be concluded that the first-aid kit will differ greatly with local conditions When small groups of workers are engaged in felling operations, for instance, a first-aid kit is necessary for dressing minor injuries like small cuts and bruises and for the provisional treatment of serious injuries. This kit should be contained in a strong, conspicuously marked, waterproof box. When movable shelter huts are used in the immediate vicinity of the worksite, the first-aid box could be kept in one of them, since they are readily accessible. The box should have the following minimum contents:

- roller bandages, 2 in. × 4 yd (5 cm × 4 m);
- padded standard dressings, small and medium;
- sterile compresses, 4 in. × 4 yd (10 cm × 4 m);
- triangular bandage;
- spools of adhesive plaster, $^3/_4$ in. × 1 yd (2 cm × 1 m);
- safety pins;
- 1 pair of stainless steel scissors;
- 1 stainless steel forceps;
- a disinfectant solution;
- 1 tourniquet;
- 1 thermometer;
- 1 first-aid guide.

It is an advantage if the first-aid guide has a few blank pages on which the use of the above articles, replenishments and regular control by the forest personnel can be noted.

If workers are widely scattered during operations they should, in addition, have a pocket-size first-aid kit.

If a large number of men are working together, a larger first-aid box may be necessary, which might contain a more plentiful supply of the above materials and additional equipment such as

burn dressings, splints, soap and towels, as well as certain medicaments. A first-aid room in a logging camp also requires more equipment and materials.

The first-aid kit needs to be supplemented according to the kind of injuries that can be expected. For men fighting forest fires burn dressings are more important. When the danger of snake bites exists, a combined first-aid and snake-bite kit is recommended, containing a tourniquet, a scalpel for making incisions and a suction pump for extracting venom. Frequent handling of dangerous toxic materials calls for the supply of appropriate antidotes.

Motor vehicles used for the transport of personnel need a special first-aid outfit. Since several persons may be injured at the same time if there is an accident, there must be enough bandages and dressings for treating severe open wounds.

First-aid Instruction.

The employer is responsible not only for the supply of first-aid materials, but also for giving adequate first-aid instruction to his workers.

Because of the high frequency and severity of forest accidents, basic instruction in first aid should be given to all workers. Such instruction should comprise at least four lessons and be regularly repeated every three years in two refresher lessons. The main part of the instruction should be devoted to practical exercises and demonstrations relating to the injuries that can be expected in local conditions of work.

As already mentioned, complete, comprehensive first-aid training is necessary for some of the men who work in bigger teams or in camps. No worker should become a foreman without having received a certificate stating that he has successfully undergone such training.

First-aid instruction should form part of the regular vocational training of forest workers, or be given separately, or be combined

with special courses on accident prevention. Local physicians and in some countries the Red Cross, can help with this instruction. In addition, short illustrated guides specially adapted to the first-aid requirements of forest workers have been found to be very useful.

Experience has shown that men who have received first-aid training suffer fewer accidents than others, probably because they are more safety-minded. This is another reason for organising proper first-aid instruction for the workmen.

Extent of First Aid.

Minor injuries are usually treated by the workmen themselves without interrupting work or seeking the advice of a doctor. This is all right as long as the worker is really dealing with minor injuries such as slight scratches, cuts or bruises. During first-aid courses the men should be clearly informed which cases warrant immediate stoppage of work, and when a doctor should be consulted to prevent infections or disablement, especially with deep cuts and large open wounds.

Older workers tend to continue working even after they have suffered serious injuries. It is advisable to explain to them that this attitude may lead to prolonged periods of disablement.

It is most important that the right action should be taken by workers when a serious accident occurs. They must know the limits of their ability to help the injured person, and make a quick decision as to what medical help should be sought and how it should be obtained. When serious bleeding has been stopped or immediate artificial respiration has been given in cases of drowning or breathing exhaust gases, the injured person should be bedded comfortably while arrangements for transportation are made and medical help is sought. Injured persons who are unconscious must be laid carefully on one side and their airways kept clear to prevent them from suffocating. Fractured bones or dislocated limbs have to be splinted, sticks or pieces of bark being used as splints and any available soft material for padding. Stretchers can be prepared by using poles and blankets, jackets or pieces of wire mesh.

When an ambulance is within easy reach it is usually better not to waste time calling a local doctor but to transport badly injured persons to the hospital immediately. It may be useful if certain meeting points are fixed in the forest and if maps are provided for ambulance drivers to enable them to use the shortest route and prevent detours.

Radio communications can be a further valuable help in reducing the time elapsing between accident and medical treatment.

In very isolated regions helicopters constitute an ideal means of transporting injured persons. The marking and preparation of landing places must be known beforehand, and appropriate relations established with existing helicopter bases.

Medical Services

Apart from the first-aid provisions and medical examinations already discussed, special medical services for forest labourers are normally not required.

If, however, local medical facilities are inadequate, it may be worth while for the forest undertaking to provide general medical, dental and surgical care for its employees and their families.

For a small number of workers a dispensary with a qualified nurse might be sufficient for ordinary health supervision. For a large number of workers a part-time or full-time physician and an infirmary or hospital for the treatment of sick workers and their families are useful. Such medical facilities can also be shared by a number of smaller logging enterprises.

Where medical staff are available their services are useful not only for the immediate treatment of injured or sick persons, but also for drawing up and supervising a preventive health programme. This is of particular importance in tropical countries, where great care must be exercised to control diseases caused by insanitary conditions or transmitted by insects, such as typhoid, cholera, dysentery and malaria.

The inspection of housing and camping sites, the application of insecticides and similar activities should therefore be entrusted to the medical staff. Besides these responsibilities the medical staff should of course be responsible for first-aid measures and, if physicians are employed, for the medical examination of the workers. Even where the general medical facilities existing in a country are fully sufficient, it can be an advantage for a large forest organisation to employ a doctor to make medical examinations of workers and deal with all problems relating to occupational health.

37. Logging Camps and Housing

Nowadays the number of logging camps is decreasing since in many parts of the world transport facilities are very advanced and forestry is rapidly developing so as to permit permanent operations under a sustained-yield policy. In remote regions, however, workers must still be provided with temporary living quarters. Standards for such camps—taking local conditions into account—should be laid down by the public authorities and observed by employers and workers, and the camps should be inspected by public officials.

Depending on the time a logging camp will be in use, more or less comprehensive requirements have to be met. The longer the camp is to be used and the greater the number of persons it is intended to lodge, the higher the standard of accommodation should be, particularly if climatic conditions are severe. Whereas in the earlier days large bunkhouses used to be constructed to accommodate 50 or more men in one room, today small units for six to ten men are usually built. Prefabricated houses are commonly used; trailers, too, are considered appropriate.

Care must be taken that camps are in healthy situations, are well drained, are protected against vermin and are kept clear of waste by disposing of it in a hygienic way. Camps that are maintained over a longer period than approximately four weeks should be properly equipped with cooking and sanitary facilities. It is an

advantage if sleeping quarters are separate; they should provide sufficient air space, height and floor space.[1] Each sleeping room needs at least one window that opens into the open air. Each worker should be provided with a separate bed and bedding. Suitable washing facilities are important; they should preferably include a hot water supply and showers. For drying wet clothes special drying rooms are necessary.

Permanent Housing

The development of permanent forest management necessitates the construction of permanent settlements where there may not have been any before. Throughout the world there are many examples of new villages for forest workers which were carefully planned and constructed by forest owners. However, such villages will satisfy the needs of the forest worker and his family only if the general comfort can compare with housing offered in towns, and if shops and a school, post office and similar communal facilities exist. Consequently, the construction of new villages is normally justified only if they are sufficiently large, or if they are in the neighbourhood of towns or other settlements.

In densely populated regions scarcity of housing may be a problem. Here the worker who is in need of accommodation will be very glad if he can move into a house provided by his employer, or if public funds are made available which will enable him to have his own house built. Similarly, it will be appreciated if old houses owned by forest workers are modernised by the installation of sanitary facilities such as cold and hot water supply, water closets and bath-tubs. Aiding the forest worker in this way is a good means of improving the workers' living conditions and securing a sufficient labour supply.

[1] The ILO Code of Practice on Safety and Health in Agricultural Work published in 1965 states that: "The sleeping quarters should provide at least 14 m² (60 sq. ft.) floor space per person, and have a minimum height of at least 2.5 m (8 ft.)"

Tropical Camps

In developing countries forest settlements should be planned with special consideration for proper sanitation. Particularly in tropical regions it is of vital importance for the well-being of the workers and their families that water supplies should be adequate in quantity and quality and that waste should be properly disposed of. Workers who live in unhygienic surroundings can never be expected to have a full working capacity. Their absenteeism rate is bound to be high because of the many diseases that they can contract, for example dysentery, typhoid, cholera and infestation with hookworms, roundworms or shistomiasis. Germs of these diseases are carried from stools or urine of people suffering from the diseases by way of flies, unclean food, dirty fingers or polluted water. The best means of controlling these diseases are proper sewage disposal and water purification.

In certain cases, vaccination against typhoid and cholera may nevertheless be advisable as an additional precaution.

Poor housing conditions can furthermore be the reason for the spreading of certain insect-borne diseases like malaria or typhus. Rooms, therefore, should be sufficiently lighted and ventilated to keep all kinds of vermin out. Where malaria is endemic at least the sleeping quarters should be screened carefully, or mosquito nets should be used. In addition, the interior of houses should be sprayed with insecticides such as DDT at regular intervals. Mosquito-breeding places like rubbish heaps near houses should be destroyed or sprayed.

If family dwellings are provided they should contain enough room space to prevent person-to-person infection. Not more than four persons should live in one room. Two-room dwellings are to be recommended with separate kitchen, washing and lavatory facilities for each family.

Where housing conditions and sanitation, especially in tropical countries, are poor, absenteeism due to diseases can be several times higher than absenteeism due to accidents, so that these matters are of the greatest importance.

39. Workmen's Compensation

Over 30 years ago the International Labour Organisation developed minimum standards that have since been adopted by many countries for the compensation of workmen in cases of accident.[1] It is generally accepted today that standards of this kind are necessary. Compensation should include adequate payment of workers in cases of incapacity, and of their dependants if they are killed. Furthermore, medical aid and vocational re-education should be provided.

There are many different ways in which compensation is administered, for instance by state institutions, public accident insurance boards, private insurance companies or employers' mutual insurance associations. Sometimes all industries are combined but more often separate agencies exist for different industries, or for public and private employers. Frequently accident compensation is combined with insurance against sickness, invalidity and old age.

Normally the agencies concerned with accident compensation develop a keen interest in accident prevention. Differential premiums depending on the actual accident rate constitute a very effective incentive to forest undertakings to keep accident rates as low as possible.

---

[1] Workmen's Compensation (Agriculture) Convention, 1921; Workmen's Compensation (Accidents) Convention, 1925; Workmen's Compensation (Minimum Scale) Recommendation, 1925.

APPENDIX

MODEL ACCIDENT REPORT FORM

1. Identification No. .....

2. Employer ..... 3. Address .....

.....

4. Industry .....

Injured Employee

5. Name ..... 6. Address .....

7. Age ..... 8. Sex ..... 9. Grade .....

10. Permanent or seasonal ..... 11. Occupation in forest work .....

.....

12. Length of service:

with employer ..... in forest work .....

13. Attended training courses:

length ..... nature .....

The Accident

14. Place .....

15. En route ☐ ..... not en route ☐ ..... to ☐ or from ☐ work

16. Hour ..... 17. Day of week .....

18. Month ..... 19. Year .....

20. Activity

(1) Timber and pulpwood felling ☐
(2) Fuelwood felling . . . . . ☐
(3) Trimming . . . . . ☐
(4) Cross-cutting . . . . . ☐
(5) Barking . . . . . ☐
(6) Splitting . . . . . ☐
(7) Skidding . . . . . ☐
(8) Piling . . . . . ☐
(9) Loading-unloading . . . . ☐
(10) Transport, horse. . . . . ☐
(11) Transport, tractor . . . . . ☐
(12) Transport, truck . . . . . ☐
(13) Transport, water . . . . . ☐
(14) Transport, air . . . . . ☐
(15) Transport, other (specify) .....
.....
(16) Forestry, survey . . . . . ☐
(17) Forestry, measurement . . ☐
(18) Forestry, marking . . . . . ☐
(19) Forestry, scaling . . . . . ☐
(20) Forestry, planting . . . . . ☐
(21) Forestry, other (specify) .....
.....
(22) Charcoal operations . . . ☐
(23) Other (specify) .....
.....

21. Type of Accident

(1) Falls of persons:
same level . . . . . ☐ different level . . . . . ☐
(2) Struck by falling objects . . . . . ☐
(3) Stepping on, striking against or struck by objects, excluding falling objects . . . . . ☐
(4) Caught in or between objects . . . . . ☐
(5) Over-exertion or strenuous movements . . . . . ☐
(6) Exposure to or contact with extreme temperatures . . . . . ☐
(7) Exposure to or contact with electric current . . . . . ☐
(8) Exposure to or contact with harmful substances or radiations. . . . ☐
(9) Other (specify) .....
.....

22. Agency Involved [1]

Machines

(1) Motor saw . . . . . ☐
(2) Barking machine . . . . . ☐
(3) Other (specify) .....
.....

Means of transport and lifting equipment

(4) Hoist . . . . . ☐
(5) Conveyor . . . . . ☐
(6) Tractor . . . . . ☐
(7) Car or truck . . . . . ☐
(8) Other vehicle . . . . . ☐
(9) Aircraft . . . . . ☐

Hand tools

(10) Axe . . . . . ☐
(11) Saw . . . . . ☐
(12) Peavy or cant hook . . . . ☐
(13) Barking tool . . . . . ☐
(14) Other (specify) .....
.....

Other equipment

(15) Wires or cables. . . . . ☐
(16) Electric apparatus . . . . ☐
(17) Pressure vessel . . . . . ☐

Material, substances and radiations

(18) Trees . . . . . ☐
(19) Logs or bolts . . . . . ☐
(20) Branches . . . . . ☐
(21) Chips or splinters . . . . ☐
(22) Chemicals . . . . . ☐
(23) Flammable substances . . ☐

Working environment

(24) Heat . . . . . ☐
(25) Cold . . . . . ☐
(26) Water . . . . . ☐

[1] Indicate whether this classification is used for classifying the agency related to the injury or the agency related to the accident.

When this classification is used to classify an agency related to the injury, the items selected for coding should be those which directly inflicted the injury without regard to their influence in initiating the event designated as the accident type.

When this classification is used to classify an agency related to the accident, the items selected for coding should be those which because of the hazardous nature or condition precipitated the event designated as the accident type.

Other agencies, not elsewhere classified

(27) Animal (specify) .....

.....

(28) Other person . . . . . ☐

(29) Other (specify) .....

.....

(30) Was agency in motion?

Yes . . . . . ☐ No . . . . . ☐

(31) Part of agency involved (e.g. vehicle brakes, axe handle, horse's leg, etc.)

.....

---

23. Nature of Injury

(1) Fractures . . . . . ☐

(2) Dislocations . . . . . ☐

(3) Sprains and strains (including hernias due to over-exertion) . . . . . ☐

(4) Concussion and other internal injuries . . . . . ☐

(5) Amputations, enucleations. ☐

(6) Wounds (cuts, lacerations, punctures, open wounds; excluding amputation and superficial wounds) . . . . ☐

(7) Superficial injuries (abrasions, blisters, superficial wounds, etc.) . . . . . ☐

(8) Contusions, crushings, bruises . . . . . ☐

(9) Burns . . . . . ☐

(10) Poisonings . . . . . ☐

(11) Effects of weather, exposure (frost-bite, heat-stroke, lightning shocks, etc.) . . ☐

(12) Asphyxia (drowning, suffocation, etc.) . . . . . ☐

(13) Effects of electric current (electrocution, electrical shock) . . . . . ☐

(14) Other and unspecified injuries (injuries which cannot be classified elsewhere, such as infections) . . . . ☐

24. Bodily Location of Injury

Head

(1) Head, unspecified . . . . ☐
(2) Eye . . . . . ☐
(3) Ear . . . . . ☐
(4) Nose . . . . . ☐

Neck

(5) Neck . . . . . ☐

Trunk

(6) Chest (ribs, internal organs) ☐
(7) Back (spinal cord) . . . . . ☐
(8) Abdomen (including internal organs) . . . . . ☐
(9) Trunk, unspecified . . . . ☐

Upper limb

(10) Shoulder . . . . . ☐
(11) Upper arm. . . . . ☐
(12) Lower arm . . . . . ☐
(13) Hand (except fingers alone) ☐
(14) Fingers . . . . . ☐

Lower limb

(15) Hip . . . . . ☐
(16) Thigh . . . . . ☐
(17) Knee . . . . . ☐
(18) Leg (lower leg) . . . . . ☐
(19) Foot (except toes alone). . ☐
(20) Toes . . . . . ☐

Multiple locations

(21) Head and trunk or limb(s) ☐
(22) Trunk and limb(s) . . . . ☐
(23) Upper limb(s) and lower limb(s) . . . . . ☐

General injuries

(24) Circulatory system in general . . . . . ☐
(25) Digestive system in general ☐
(26) Nervous system in general ☐
(27) Other (specify) .....

.....

Unspecified location

(28) Unspecified location . . . ☐

25. Hazardous Conditions

(1) Defects of agencies . . . . ☐
(2) Lack of necessary personal protective equipment . . . ☐
(3) Improper or inadequate clothing . . . . . ☐
(4) Excessive noise . . . . . ☐
(5) Inadequate ventilation . . . ☐
(6) Improper illumination . . . ☐
(7) Use of inhelrenty hazardous materjal or equipment . . . ☐
(8) Use of improper tools . . ☐
(9) Use of hazardous methods or procedures . . . . . ☐
(10) No guarding or inadequate guarding . . . . . ☐
(11) Improper piling of material, etc. . . . . ☐
(12) Other (specify) .....

.....

26. Unsafe Act

(1) Cleaning, oiling, adjusting or repairing of moving, electrically energised, or pressurised equipment . . . . . ☐
(2) Failure to use personal protective equipment . . . . . ☐
(3) Failure to wear safe personal equipment . . . . . ☐
(4) Failure to secure or warn. . ☐
(5) Horseplay . . . . . ☐
(6) Improper use of equipment ☐
(7) Making safety devices inoperative . . . . . ☐
(8) Operating or working at unsafe speed . . . . . ☐
(9) Taking unsafe position or posture . . . . . ☐
(10) Inattention to footing or surroundings . . . . . ☐
(11) Driving errors . . . . . ☐
(12) Other (specify) .....
.....

27. Unsafe Personal Factor

(1) Improper attitude . . . . . ☐
(2) Disobedience . . . . . ☐
(3) Operating without authorisation . . . . . ☐
(4) Taking risk . . . . . ☐
(5) Lack of knowledge . . . . ☐
(6) Lack of skill . . . . . ☐
(7) Physical defect . . . . . ☐
(8) Mental defect . . . . . ☐
(9) Other (specify) .....
.....

28. Prevention

Steps to be taken to prevent future similar accidents: .....
.....

Steps already taken to prevent similar accidents: .....
.....

The above facts are true to the best of my knowledge

..... 19..... ....

Date Signature Title

Statement of Supervising Officer

Briefly describe how this or similar accidents can be prevented

.....

.....

.....

.....

..... 19 ....

Date Signature Title

Final Report

(To be completed by foreman or medical officer)

29. **Classification of Disability**

(1) Temporary . . . . . ☐ (3) Permanent, total . . . . . ☐

(2) Permanent, partial . . . . . ☐ (4) Death . . . . . ☐

30. Number of days lost or charged:

..... from ..... to .....

31. **Clinical Diagnosis** .....

.....

..... 19 ....

Date Signature Title

INDEX

OTHER ILO PUBLICATIONS

Safety and Health in Agricultural Work: A Code of Practice

This code of practice recommended by a meeting of experts contains basic guidelines concerning safety in farm buildings and silos, fire protection, safety in operations with farm machinery, in clearing, felling and soil preparation, hoisting and transport equipment. It also deals with general hygiene and the precautions to be taken when using dangerous substances.

Safety and Health in Forestry Work: A Code of Practice

This code of practice contains a set of rules concerning safety in the use of tools, engines and electrical, hydraulic and other equipment, and in a variety of forestry and transport operations. It also deals with the precautions to be taken against poisonous plants and animals and dangerous substances, with medical care, safety organisation, and accommodation and feeding of workers.

Prohibition of the Sale, Hire and Use of Inadequately Guarded Machinery

A preliminary report prepared for the International Labour Conference on the situation as regards prohibition of the sale, hire and use of inadequately guarded machinery. (ILC 46/VI/I).

Guide for Labour Inspectors

Broad outline of the essential principles of inspection and the methods and procedures of enforcement, advice and inquiry.

Plantation Workers

Report of an international inquiry carried out in four African, four Asian and four Latin American countries. It provides a wealth of information on labour conditions and problems and standards of living in banana, cocoa, coffee, rubber, sisal, sugar and other plantations.

Reprinted By

The Forest Development Corporation of Maharashtra Limited