LOGGING INDUSTRY RESEARCH ASSOCIATION

NEW ZEALAND

PROJECT REPORT

DEVELOPMENT OF SAFE FELLING AND DELIMBING TECHNIQUES WITH CHAINSAWS

P.R.14 1980

LOGGING INDUSTRY RESEARCH ASSOCIATION (INC.)

P.O. Box 147 Rotorua New Zealand

N.Z. Logging Industry Research Assoc.Inc.

Project Report No.14
1980

DEVELOPMENT OF SAFE FELLING AND DELIMBING TECHNIQUES WITH CHAINSAWS

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PREPARED BY:-

N.Z.Logging Industry Research Association Inc.

and

Swedforest Consultancy AB
Sweden.

- INTRODUCTION -

BACKGROUND TO PROJECT

In June 1979 the Accident Compensation Commission granted LIRA $30,000 toward a research project in logging safety. Consultants were subsequently employed to do investigations into safer felling and delimbing techniques for New Zealand conditions.

To advise on this project, LIRA formed an industry working group, composed of expert people involved in various aspects of logging training and safety. Their role was to help select and guide the consultants, and at the conclusion of the project, to assist in the implementation of the findings.

Following preliminary field work and analysis carried out by LIRA, the selected consultants, Swedforest Consultancy AB of Sweden, undertook field work and demonstrations in March-April 1980, and tabled their recommendations in a report titled "Development of Safe Logging Methods", in May 1980.

This report to LIRA was considered in June 1980 by the working group, who accepted the main part of its recommendations for improving working techniques. To implement the findings within the New Zealand logging industry, the working group formed a number of more specialised sub-groups to undertake the further investigational work required.

This LIRA Project Report now presents the Swedforest Report - as modified or commented on by the working group - as fully supported recommendations for action within the logging industry in New Zealand. LIRA has further taken the initiative in launching the various sub-groups to implement the findings and exhorts industry to support this work, in the interest of improvement to safety and efficiency in this vital area of logging.

- SUMMARY OF RECOMMENDATIONS -

A summary of the major findings of a meeting of the LIRA working group on the 24th of Jume 1980, which can be taken as recommendations to the logging industry, are:-

1) That the techniques for felling and delimbing in radiata pine thinnings and clearfelling in smaller sized conifers, as developed as tested by Swedforest and LIRA, be introduced on a broad scale.

2) That the techniques currently used in clearfelling radiata pine old crop were found to be acceptable providing that existing safety regulations were followed. It was considered however, that further investigations and development work is required, particularly with regard to driving and directional felling, and on publicity of good working practices.

3) The recommendations with regard to equipment were accepted in principle, with some details on the availability or practicability with regard to New Zealand still having to be defined. The major proviso here being that the total "system" needed to be adopted, i.e. integrated technique, equipment, and protective clothing.

4) The recommendations on centralised training of instructors and introduction of vocational training for loggers was accepted in principle, with the details in need of further refinement.

To implement the approved findings of the report the working group then set up the following sub-groups charged with specific duties:

a) Clearfelling Working Group - to do further work in examining driving, scarfing, and backcutting practices to reduce wastage, and also work on directional felling of difficult trees, primarily in P. radiata old crop.

b) Training Group - this sub-group was formed under the control of the Logging and Forest Industry Training Board, to set up a training for trainers scheme, and to provide suitable training aids for it.

c) Accident Reporting Group - to recommend a co-ordinated accident reporting system within the industry, aimed at improved statistical analysis of accidents to focus on prevention rather than to apportion blame.

The working group also charged LIRA with the duties of further investigation in the application or modification of the systems for minor species; steep country felling; and work at landings. It was also asked to co-ordinate the specifications of criteria for protective clothing so that manufacturers could be approached for the development of such equipment.

- WORKING GROUPS -

The LIRA Working Group formed to advise on and guide the project was:-

W. Andrews - Kaingaroa Logging Co. Ltd.
N. Baker - Tasman Pulp & Paper Co.Ltd.,
D. Bird - N.Z.Forest Service (Waipa Logging Division)
M. Dobson - Forestry Training Centre
L. Donaldson - Department of Labour
V. Donovan - LIRA (Chairman)
W. Evans - N.Z. Loggers' Assoc.
J. Fitzpatrick - Accident Compensation Commission
L. Howard - Kaingaroa Logging Co.Ltd.
E. Johnston - Logging & Forest Industry Training Board
J. Mato - Fletcher Forests Ltd.
M. Newbold - Logging & Forest Industry Training Board
P. O'Sullivan - Contractor
J. Pomare - N.Z. Forest Products Limited
W. Sexton - Department of Labour
B. Vercoe - N.Z. Forest Service

The sub-groups formed to implement the findings are:-

Clearfelling Working Group

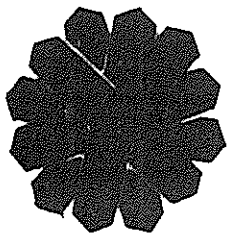
D. Bird - N.Z. Forest Service
J. Gaskin - LIRA (Chairman)
P. O'Sullivan - Contractor
J. Pomare - N.Z. Forest Products Limited
M. Tapsell - Kaingaroa Logging Co. Ltd.
B. Vercoe - N.Z. Forest Service

Training Group

V. Donovan - LIRA (Chairman)
J. Fitzpatrick - Accident Compensation Commission
J. Malcolm - Forestry Training Centre
M. Newbold - Logging & Forest Industry Training Board

Accident Reporting Group

H. Barker - N.Z.Timber Employees Industrial Union of Workers
L. Donaldson - Department of Labour
G. Duley - N.Z. Forest Products Limited
J. Fitzpatrick - Accident Compensation Commission
G. Wells - LIRA (Chairman)



SWEDFOREST CONSULTING AB

DEVELOPMENT OF SAFE LOGGING METHODS

NOTE: This Report is presented in its final form as approved by LIRA and its Working Group, as a recommendation for implementation in the New Zealand logging industry.

Italicised notes within the body of the report are the comments or modifications inserted in the original report by LIRA, and are considered essential to the report's interpretation for action by the logging industry in New Zealand.

CONSULTANCY FOR
NEW ZEALAND LOGGING INDUSTRY
RESEARCH ASSOCIATION
by SWEDFOREST CONSULTING AB
1980

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SUMMARY AND RECOMMENDATIONS

This report is the result of a study executed for New Zealand Logging Industry Research Association by Swedforest Consulting AB of Sweden.

The main objects of the study was to develop and recommend

- safe felling and delimbing techniques
- safe equipment
- protective clothing
- a training scheme for the recommended techniques

The field work was done in the Rotorua area during February and March 1980 and consisted of

- a survey of
  - existing methods
  - equipment in use
  - protective clothing in use
- development and testing of methods, equipment and protective clothing
- demonstrations

The survey showed:

- That methods used in thinnings could be improved and made safer.
- That methods used in clear fellings often were executed in a dangerous way as existing safety regulations were not followed. Driving seemed e.g. to be a part of the existing felling pattern.
- That chainsaws used often were too heavy and not equipped to an acceptable standard from a safety point of view.
- That felling aids were practically non-existing
- That the only protective clothing commonly used was hard hat and boots.

Techniques for felling and delimbing in Pinus Radiata thinnings were developed and tested. It is recommended that these methods are introduced on a broad scale basis.

The techniques used in clearfelling old crop Radiata were after testing found to be acceptable, provided that existing safety regulations were followed. *(Swedforest recommended that all types of driving should be forbidden but this is not accepted as desirable or practical until further investigations are done).*

Lighter chainsaws were tested and the following sizes of saws and bars are recommended. *(Related to butt diameter as indicated in Appendix 6 and to the total system. There could be exceptions for steep terrain.*

	Displacement	Bar Length
Thinnings	40-65	13-15 inch
Clearfelling-second crop	60-80	15-18 inch
Clearfelling-old crop	85-100	20-24 inch

Different types of felling aids were tested. The following recommendations are made:

- Thinnings and clearfelling-second crop:
  Every faller should be equipped with a felling lever, a turn band and a wedge. *(The recommendation for pulp hooks for every faller, and portable winchs at every gang were not accepted).*
- Clearfelling-old crop:
  Every faller shall be equipped with a felling wedge.

Personal safety equipment were tested and it is recommended that the following items should be used. *(That use be compulsory was not accepted at this time because suitable items were not readily available).*

- helmet
- visor
- earmuffs (or plugs)
- protective leg wear *(full leg protection)*
- safety boots

It is further recommended that a standing committee with representatives from manufacturers of and dealers in protective clothing and representatives from the logging industry is formed to coordinate the development of this type of equipment. The committee should also take part in the formulation of standards.

To get background information for the study a survey of logging accidents was conducted.

The accident survey showed that 31 % of the logging accidents were directly caused by the chain of the chainsaw. Of the chainsaw accidents 40 % happened to the hands and 41% to the legs. The major part of these accidents can be avoided if chainsaws with safety components and protective clothing are used.

An extensive training scheme is recommended which is called "Individual Training by Instructors". The idea behind the scheme is that instructors are trained centrally. After termination of the training they shall work as instructors on the different working sites. Every logger shall get that amount of training he needs in order to be able to perform his job with correct techniques.

To introduce the training scheme a "Campaign against Logging Accidents" is recommended.

Very few training institutions exist for vocational training in logging. It is felt that this sector need to be developed. It is therefore recommended that vocational training for loggers be developed.

It is recommended that the different organisations involved in accident reporting cooperate to introduce a common format for the reporting itself. (See 2.3).

1 INTRODUCTION

1.1 Terms of Reference

In March 1979 New Zealand Logging Industry Research Association (LIRA) and Swedforest Consulting AB agreed that Swedforest would carry out a study on a consultancy basis concerning "Development of Safe Logging Methods".

According to the agreement the assignment would involve:

- Examination of the present methods, trees and terrain characteristics.

- Development of a suitable felling method that could be applied in all clear-felling practice, (in the main in trees exceeding 60 cm, butt-diameter.)

- Development of a method for felling, delimbing and pulpwood cutting in pine thinnings, particularly for steep country cable operations.

- Demonstration of the developed methods to trainers and other key personnel.

- Outlining of requirements and rough drafting of a handbook and instruction material for training purposes.

It was emphasized that a main requirement for the assignment would be:

- "to examine the New Zealand situation and develop techniques suitable for this environment, not simply an importation of techniques designed for other environments".

1.3 Organization and Accomplishment of the Study

The study was performed by a team consisting of 2 Swedforest consultants (Petter Otterstedt, Interforest AB and Rune Gårdh, Swedish Forest Research Foundation) and 2 LIRA staff members (John Gaskin on full-time and Viv Donovan, LIRA project leader on part-time). A working group with representatives from LIRA, the logging industry, Accident Compensation Commisssion, Labour Department, NZ Timber Industry Employees' Industrial Union of Workers, the Group Training Scheme and the Loggers' Association had been established prior to the arrival of the consultancy team.

At the first meeting with the working group it was decided to divide the study in three phases, namely:

1. Information and examination
2. Method development and testing
3. Demonstration and reporting

During "Phase 1" the team studied ongoing felling operations in both thinnings and clear-fellings. Pinus Radiata was the dominating species. 22 fallers were studied and interviewed. The findings from this phase and the recommendations for the next phase were presented to the working group in a paper named "Summary of the Information Phase". A tentative programme for "Phase 2" was suggested and agreed upon.

As a background for the study, information about logging accidents were gathered and presented in a paper to the working group.

The recommended felling and delimbing methods as well as safety equipment were presented in the field to the working group and to other representatives from the logging industry and their contractors.

2 ACCIDENTS IN THE LOGGING INDUSTRY

2.1 Official Accident Statistics

The availability of accident statistics is very meagre in New Zealand. Available official statistics indicate however, that the logging industry has unacceptable high accident frequency rates (FR) compared with other industries. Only coal-mining has a higher frequency rate than logging (FR = the number of lost time injuries per 100 000 manhours).

The injury severity rate (ISR) for logging accidents is much higher than for other occupations (ISR = the number of manhours lost per 100 000 manhours worked).

The disability rate (DR) is also higher in logging than in any other occupation (DR = Total number of calendar days lost per accident averaged over all accidents).

The table below shows some figures for 1970, the last year from which these statistics are available. (Source: Department of Statistics).

	Logging	Coal-mining	Loading ships	All manufacturing industry
FR	18	22	8	7
ISR	20 200	2 900	7 600	1 600
DR	187	29	123	47

Statistics from the Department of Labour show the following figures for "bush undertakings" including all types of forestry work (logging, silviculture, etc.) for the years 1977 and 1978 (it was not possible to obtain any figures for 1979!).

2.2 Investigation of Logging Accidents in the Bay of Plenty Area

In order to get a better picture of the total number of logging accidents, their causes and injured parts of the body, accident reports were gathered from the five logging organizations operating in the Bay of Plenty area for 1979.

The organizations had in total around 840 loggers employed. In total 203 logging accidents were recorded. Note that in this figure are all accidents recorded including minor ones not causing lost time. Note further that only logging accidents were recorded. The following operations are thus included: falling, bucking, delimbing, measuring to length, skidding, hauling, loading of trucks and all movements at the work site.

This means that as an average every fourth logger met with some kind of accident during 1979 at his work site.

The total number of accidents were distributed on injured part of the body and on direct cause of the accident as shown in the table below.

Direct cause	Part of body									
	Head	Eyes	Neck Shoulder	Abdomen back	Arm	Hand	Leg	Foot	Total	%
Falling tree	1		2			1	3	1	8	4
Branch, saw dust, etc.	9	10	3	1	2	1			26	13
Chainsaw	2		1	4	4	25	27	2	65	32
Handtools	1					1	2		4	2
Machines	4	3		8	1	11	9	2	38	19
Logs	2		1	4		1	17	3	28	14
Fall of person	1		1	5	2	1	17		27	13
Other	1			1		1	4		7	3
TOTAL	21	13	8	23	9	42	79	8	203	100
%	10	7	4	11	4	21	39	4	100	
%	32				25		43		100	

In order to know the total influence of the chainsaw on the accidents also the accidents indirectly caused by the saw were recorded and broken down as shown in the table below.

Of the total number of accidents 90 were directly or indirectly caused by the chainsaw.

Suboperation	Cause								
	Kick-back	Trip Slip	Lash by branch etc.	Chain break	Sharp chain	Other causes	Indirect by chain saw	Total	%
Tree felling	8	1	1	1		1	15	27	29
Delimbing in forest	6	2					3	11	12
Bucking and delimbing at landing	13	3	1	4		1	22	44	49
Walking		4						4	5
Other operations			1		3			4	5
TOTAL	27	10	3	5	3	2	40	90	100
%	20	11	3	6	3	2	45	100	

Accidents indirectly caused by the chainsaw dominate. Example of such accidents are that the feller is hit by a falling tree or branch and that a bucker is hit by a cut-off log. Astonishingly, near 50 % of the accidents occur at the landing. Of the directly caused accidents the kick-back ones are not surprisingly the most common. The severity of these last accidents is without doubt also worst.

Of the 90 accidents caused directly or indirectly by the chainsaw about 60 % occurred in clearfellings and 40 % in thinnings. This tallies well with the distribution of manhours on thinnings and clearfellings and the conclusion is thus that the accident frequency rate does not differ significantly between thinnings and clearfellings.

3 EQUIPMENT

3.1 General

One prerequisite for safe logging methods is to provide the loggers with reliable and safe tools. It is of utmost importance that the tools are tested under practical conditions before they on a broader scale are distributed to the loggers.

In this paragraph chainsaws and felling aids suitable for New Zealand conditions will be discussed and recommended mainly from a safety point of view.

3.2 Chainsaw Size

A trend toward light weight saws is clear today. Perhaps most visible in northern Europe and Canada but also for example in plantation forestry in Australia. The expressions "light weight saw" or "light saw" are used for saws which have comparatively limited dimensions with relatively small displacement (40-65 cc), and a bar of 11-15 inches (27-37 cm). This type of saw is suitable for forests in the temperated zones and for plantation forests in the subtropics and the tropics where the maximum butt-diameter is 55-65 cm.

As the light weight saws are more suitable for delimbing the relative time spent on this operation is an important factor when choosing the right saw. Time studies in New Zealand show that 65 % of the total tree felling time is spent on delimbing in Radiata thinnings. Even if the delimbing time could be reduced with a better technique the time will in most cases exceed 50 %. The maximum bar length for a good delimbing saw is about 15 inches though 11-13 inches is preferable.

3.3 Chainsaw Components

The chainsaw is a dangerous tool. It is therefore important that the hazards are reduced as much as possible. Various safety components are available today, which are either built in or optional on the saws. The chainsaws sold on the New Zealand market are unfortunately often lacking the optional components. In the survey presented in Appendix 1 it was found that the only safety component in common use was the safety chain (around 50 %) and vibration damping. But for example chainbrakes and front handle guards were almost totally missing.

The safety mitt was used to near 100 % (see Paragraph 4, Protective Clothing).

Safety Chain

The safety chain is constructed to minimize kick-backs. It does, however, not eliminate them totally. Swedish investigations show that the kick-back tendency is less for the safety chain compared to ordinary chains and the force of the kick-back movement is reduced by more than 40 % (Reference Nos 15 and 16, Appendix 8).

Front Handle Guard

The front handle guard protects the left hand from touching the chain if it slips from the handle, often it also initiates the chainbrake if the saw is mounted with such a device. The normal front handle guard protects only when the saw is used for up- or downward cutting. In this aspect the mitt is a better safety component as it functions also when the saw is cutting horizontally.

Other Safety Components

It is necessary that the saw is equipped with a throttle control lock in order to prevent inadvertent throttling.

If the chain brakes serious injuries may happen to the right hand. To protect the hand the saw should be equipped with a rear handle guard and a chain catcher.

To reduce the noise the saw must be equipped with a muffler. The total sound of the saw shall not exceed 100 dB.

The spurting of saw dust is a nuisance for the faller. It is an advantage if the saws can be constructed in order to reduce this.

3.4 Chainsaw Maintenance

The maintenance of the chainsaw was often found to be bad as reviewed in Appendix 1.

It must be strongly emphasized that a correct maintenance of the saw is a must from a safety point of view. Many accidents are related to bad maintenance, e.g. dull chain, worn-out chain, broken or damaged links, not functioning chain brake.

The maintenance must be organized in an effective way, it is therefore recommended that a strict maintenance scheme is introduced. An example of such a scheme is given in Appendix 5.

It is recommended that the employer is actively engaged in the maintenance of the equipment irrespective of who owns the saw. A minimum engagement is a regular control of the saws from a safety point of view.

4 PROTECTIVE CLOTHING

Protective clothing is here defined as "all types of personal safety equipment worn by the faller".

Often it is not possible to create an environment where machines and tools are so safe that all types of accidents can be prevented. In such environments the people have to be equipped with safety gear to protect the body from potential accidents.

To study and recommend suitable protective clothing was therefore an important part of the project.

The present situation as reviewed in Appendix 2 was not encouraging. In common use were only helmets and boots to 100 %, earmuffs (or plugs) to about 40 % and safety mitts to near 100 %.

The most vulnerable parts of the body for chainsaw injuries, legs and hands, were not protected with exception for the protection given by the safety mitt.

It is normally a difficult and time consuming procedure to introduce and convince workers to use protective clothing. Unfortunately it is sometimes not possible to reach any results if the use is not legislated.

With this difficulty in mind it is important that the gear is attractive and comfortable to wear. It is difficult to develop protective clothing which shall meet so many demands as those for a logger, since the environment changes so much, not only with the season but also during the same day. The clothing must be warm when it is cold, it must be airy when it is hot, it must be impermeable when it is wet etc. This means that compromises have to be done with the result that it perhaps is felt too uncomfortable during certain conditions. It must however, be kept in mind that the most important thing is to protect the logger himself from injuries.

To coordinate the work of developing protective clothing it is recommended that a standing working committee is formed. The committee should comprise representatives from the industry and the manufacturers. The committee should set standards and stimulate the development of better clothing and equipment.

In this connection it is important to underline that a lot have been done, during the last years, to develop safe methods and there is a clear tendency in the industry against safer methods today.

The developed and recommended methods are described in Appendix 4.

It is felt that the methods developed for work in thinnings and for clear-fellings of minor species or smaller second crop have so many advantages over the prevailing methods that they can be fully accepted by New Zealand loggers if the methods are introduced in a successful way and if they are used together with recommended tools and other gear.

It must be emphasized that felling and delimbing methods adapted to steep terrain were not tested and developed due to a strike at NZFP and limited time. It is felt that suitable methods should be studied more. The basics will however, be same as for the recommended methods.

Concerning methods for clearfelling old crop it was found that existing methods were acceptable if they were conducted according to the Safety Code and other regulations.

The frequent use of driving to take down hang-ups and set-back trees is very dangerous. It is therefore recommended that this habit should be forbidden. This rule should be clearly stated in the Safety Code.*

Instead of driving it is recommended that trees with a backward lean should be left until they could be felled in the direction of the lean without hitting any standing trees and preferably after that other felled trees have been removed.*

* *Whilst agreeing that "driving" is too prevalent and very dangerous LIRA and its working group have not accepted that driving at this time can be totally forbidden. Further work has thus been commenced to examine the practice of driving with a view to recommending the practices and ruling that should be adopted.*

6.2 Training and Training Facilities at Present

Training of loggers are today performed as "on-the-job training" by the forest companies and Forest Service. The only training on chainsaws conducted by a training institution is a 2-day "Chainsaw Operators Course" held at the Forestry Training Centre at Rotorua.

Supervisors (woodsmen) are trained within the Forest Service and get a 3-month mainly practical training in logging including chainsaw operation and the safety aspects on logging.

The training for N.Z. Certificate in Forestry includes an optional block course in "Logging and Forest Engineering" of four weeks. A prerequisite for this course is a completed logging assignment.

Those who have passed this course are familiar with chainsaw operation and logging safety.

The on the job training performed by the logging companies in the Bay of Plenty area is today influenced by the "Group Training Scheme". The plans are that the group training scheme should include every logger in the whole industry. Today (March 1980) are about 400 loggers certificated, of them are about 80 senior loggers.

The total number of loggers in New Zealand is about 3 000. A great part of these are contractors or employed by contractors.

Within the group training scheme the newly employed get an individual introduction to logging for some days, normally by a training officer. After that he works together with an experienced logger within a normal gang. No formal courses are today required to be promoted within the scheme. The group training scheme is planned to be extended also to contract workers.

a proven efficient and safe technique but not necessarily be among the most highly productive ones.In order to keep the instructors "in shape" it is recommended that they continue to work as loggers when they are not acting as instructors. The instructor shall be employed by his own company but work both with the company crews and with contract crews.

The total length of the central training is suggested to be around 8 weeks, partly in the classroom and partly in the field. *

The course is recommended to cover at least the following subjects:

- Chainsaw and chainsaw maintenance (5 days)
- Safe methods (20 days)
- Safety regulations (1 day)
- Teaching techniques and organization of training activities (10 days)
- Psychology (1 day)
- Organization of logging operations (1 day)

The times given are only tentative.

"Safe methods" include only one week's training with a teacher, the rest of the time will be used by the trainee himself to put the finishing touch to his technique. During the period when the trainer works in his normal gang he will be frequently visited by his teacher.

The first, third, sixth and the last week are suggested as central training under a teacher (classroom, workshop, field) and the remaining weeks as practice.

* *The practicability of such a long course in the current industry environment was not accepted by the working group. The specific needs in terms of time and content for courses will be examined and actioned by the working group set up in combination with the Logging Industry Training Board.*

Training of Beginners

The total time for the basic training of beginners is set to 6 weeks (30 days). The time is tentatively utilized as follows: *

- Introduction, accident statistics, safety questions, protective clothing (1 day classroom)
- The chainsaw and its maintenance (4 days, classroom and workshop)
- Introduction to the basic techniques and the use of felling aids (14 days, classroom and forest)
- Organization of logging operations (1 day, excursion)
- Practical work in a normal gang (15 days, forest). The teacher will pay a visit about every second day.

The theoretical part of the training could either by performed centrally (e.g. Forestry Training Institute or in the future a Vocational Forestry School) or locally by the companies. If the companies shall organize this training the courses must be open also for non-company employed personnel.

Introduction for Professionals

No strict limit is drawn between beginners and professionals. Practical considerations will here be more important than the time spent on logging.

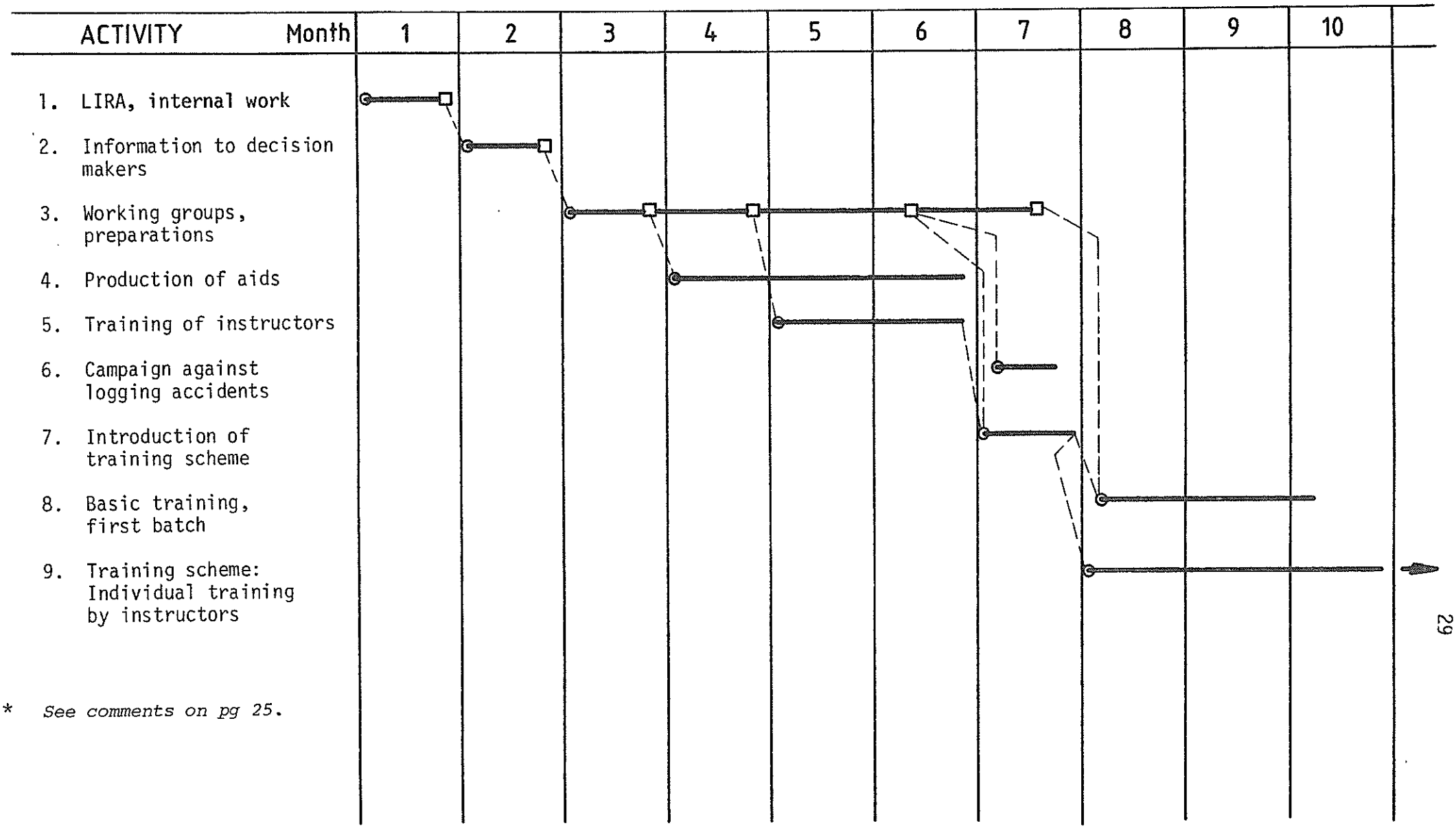
It is calculated that information about the training programme combined with a filmsession etc. and one day for demonstrations in the field would be sufficient. Around 20 persons can participate in each evening session and 1-2 gangs per demonstration day in the field.

Individual Training by Instructors

After that basic and introductory training is performed, the on-the-job training directed by an instructor can start.

* *See comment on pg 25.*

LOGIC SEQUENCE PLAN FOR TRAINING IN SAFE LOGGING METHODS



* *See comments on pg 25.*

Training of Instructors (5)

To save time it is suggested that the training of instructors could start before the aids are produced. The instructor group could be used as a test and reference group for produced aids.

Campaign against Logging Accidents (6)

It is recommended that in connection with the start-up of "Training by Instructors" a broad scale campaign against logging accidents is launched.

Cooperation with the press, radio and television would be an advantage.

Introduction of "Training Scheme" for Professionals (7)

To get as good an impact as possible it is suggested that the proposed training scheme "Individual Training by Instructors" is performed at the same time as the campaign above.

Basic Training, First Batch (8)

The start-up of this activity is flexible. It is of course desirable that it starts even before the time indicated in the chart but can without much disadvantages, be delayed if preparations are not ready.

Training Scheme "Individual Training by Instructors" (9)

It is important to start this activity in connection with the campaign and the introduction of the scheme.

6.5.3 Booklet for Chainsaw Operators

It is not recommended that a special booklet is produced in New Zealand. The expenses would be far too high for the limited number which can be sold. Instead it is recommended that books available from abroad are used. These publications have probably to be complemented with techniques for felling of old crop Radiata.

The Swedish manual "The Chainsaw - Use and Maintenance" is found to be the best book to distribute to chainsaw operators and is recommended. (Ref. No. 4, Appendix 8).

Extracts from this book or other books could be used to compile a pamphlet about chainsaw operations techniques for a wider distribution.

6.5.4 Films

It is recommended that a professional film is made about safety questions in logging. A suitable title could be "Logging Accidents".

An idea of the contents of such a film is outlined in Appendix 7.

6.5.5 Videotapes

It is recommended that video-technique should be used first of all in direct teaching situations. The trainee can study himself on the screen during a working sequence, see which faults he is excercising and then try to rectify them.

Video-technique can also be used for showing ordinary films.

To produce instruction films with video-technique is possible but to get good ones is a rather professional job. Nonetheless it is recommended that it would be used to show short sequences where editing is not necessary.

TABLE LIST OF DIA SLIDES

Number	Name	Content	Application	Approx. number of slides	Details
1	Logging accidents	The same idea as the described film with the same name	Introduction Information	30	Paragraph 6.5.4
2	Thinning Felling technique	Detailed stepwise description of the recommended technique	Training	40	Appendix 7
3	Delimbing technique	Detailed stepwise description of the recommended technique	Training	40	-
4	Felling aids	Different felling aids and how to use them	Information Training	20	-
5	Protective clothing	Personal safety clothing and the reasons to use them	Information	20	-
6	How to take down "Hang-ups"	The danger of hang-ups. Different aids and techniques used to take down hang-ups	Training	40	-
7	Falling of difficult trees	Problematic falling situations and discussions how to solve them.	Training	40	-

As mentioned the work to create safer logging methods have to continue.

The progress of the training programme has to be followed closely.

As new machines are introduced and as new techniques are developed there is a risk that new types of accidents will happen. The trend in accident statistics has to be followed closely.

FINDINGS FROM INFORMATION PHASE

1 EQUIPMENT

1.1 General

The present status of the equipment used by the loggers was studied first of all from a safety point of view, but the efficiency and work quality aspects were also looked upon.

1.2 Chainsaw

Saw size

The chainsaws used were often too heavy and equipped with too longbars. Nearly 50 % of the studied fallers used a saw which with preference could be lighter. In this connection it is worthwhile to mention that a lighter saw as a rule has a lower displacement, lower effect and a shorter bar.

The situation was the same both in thinnings and in clear fellings. Normally a relatively smaller saw was used in thinnings, though occasionally saws with 22 inches (55 cm) bars were used for felling and delimbing trees with a maximum butt diameter of 25 cm.

Chainsaw Components

The following was found concerning the way the saws were equipped:

- Safety chains (different makes and models) were used on more than 50 % of the studied saws.

- The saws were not equipped with chainbrakes, neither automatic nor manual.

- Front handle guards were not mounted on the saws (with the exemption of one model).

2 PROTECTIVE CLOTHING

Protective clothing is here defined as "all types of personal safety equipment worn by the logger".

The present situation was not encouraging only helmets and safety boots were used (100 %).

The helmets were of good quality. About 25 % of the helmets were fitted with earmuffs. A visor was mounted on one helmet only.

The boots were generally made of leather and most often of high quality, but unnecessarily heavy (1.2-1.6 kg) due to a very thick steel toe cap.

When it comes to other gear they were only occasionally seen or non-existing. The following could be mentioned:

- Earmuffs (or plugs) were used by 41 % of the fallers
- Visor was used by one faller only.
- Leg protection was used by one faller (a divided apron) only
- Hand protection, mitts were mounted on all saws but one. The mitts were used regularly by all fallers but two. Occasionally the mitt was not used, especially when delimbing in the forest. Gloves were not used.
- Blouses with signal colour (red or other light colour) were not in use.

To sum up: A typical New Zealand bushman is protected at the top (hard hat) and at the bottom (boots), but in the middle nothing but shorts and a singlet.

It was further observed that,

- the scarf was in general too narrow
- the scarf was often unnecessarily deep
- the top and the bottom cuts did often not meet (it is more difficult to achieve this when the bottom cut is made first). This observation tally well with the findings made by Gaskin (Felling Technique Study).

3.4 Backcutting

It was found that the backcut was often performed without control of where the scarf was, thus causing that the holding wood was cut through

It was further found that the backcut was unnecessarily high above the scarf, this made it difficult for the faller to judge the correct thickness of the holding wood.

The faller did often continue to cut after that the tree had started to fall thus causing unnecessary hazards withut gaining anything.

3.5 Delimbing

As mentioned earlier in this appendix heavy saws with long bars were normally used for delimbing. Normally the faller walked on the log and delimbed the tree with the top of the bar. This technique was somtimes also applied when working at the landing.

It is impossible to apply a correct delimbing technique with this type of a saw. The delimbing technique was with some few exceptions far from acceptable for the following reasons,

RESULTS FROM THE "TESTING AND DEVELOPMENT PHASE"

1 INTRODUCTION

As a result of the information phase it was decided to test equipment brought from Sweden during various conditions and to test certain working techniques found suitable in other countries.

New methods and some ideas developed during the information phase were also to be tested as well as new ideas cropped up during the continuing work. This phase of the project is perhaps best described as the method development phase. In this connection it is important to underline that a lot of work remains to be done.

Many questions are only touched and have to be studied further. Other questions are left without any measures at all. Problems have also occurred at which,at this stage,no acceptable answers could be given.

2 EQUIPMENT

2.1 Chainsaw Size

Tests were performed in order to find out whether lighter saws could be used under actual conditions. The results show that this is possible. Generally it was found that the lighter saws caused less fatigue, this was particularly evident in steep terrain and the shorter bars eliminated many risks for kick-backs especially during the delimbing.

If the bar length is not enough, for example bucking of piled logs, the logs can be separated by a machine. The wearing of the saw especially the chain is harder for bucking than for falling and delimbing, which indicates the need of a relatively stronger saw.

2.2 Chainsaw Components

Chainbrakes

Automatic chainbrakes were tested and found to function well. It was found to be important that the chainbrake was properly adjusted and that the braking mechanism was kept clean.

Front Handle Guard

Loggers sometimes complained that the front handle guard was a nuisance i.e. the guard hampered the work and in some situations shortened the effective bar length. This was tested and found to be a minor problem compared to the advantages (less scratches and squeezes of the left hand).

Concerning tests with gloves in connection with safety units, see Paragraph 3 of this appendix.

Bumper Spikes

The bumper spikes were found to be a nuisance when delimbing and were thus removed. There seemed to be no disadvantage to work without the spikes on the tested saws. Heavier saws were not tested without spikes.

Husqvarna Felling Lever

This tool seems to function well in all types of thinnings and in second crop. The tool stays in the wood when used and does not compact wood in the stem or break out wood from the stump.

Sandvik Felling Lever

It was important to insert the lever deep into the kerf otherwise the wood was broken out of the stump.

Pulp Hook

The pulp hook was tested in combination with a felling lever to take down hang-ups. It functioned well if the trees were not too big and the hang-ups not to difficult to take down.

The hook was also tested to turn the stem when delimbing. It functioned satisfactorily, though some training is needed to get used to the tool.

The hook was also tested to drag shortwood to a chute. To use hooks when dragging is a traditional method in Scandinavia and functions well but needs a rather sophisticated technique to funtion well. This method must however be preferred to carry the logs.

Turnband

The band was tested as a tool to take down hang-ups. It functioned well in all types of thinnings were the trees could be dislodged by turning. The band was not tested in clearfellings.

Type B: Equipped with a Swedish manufactured visor and earmuffs which could be tipped up by a lever. The earmuffs were also adjustable.

Earmuffs

Both types of earmuffs were comfortable to wear. The tip-up type is preferable as the earmuffs easily can be lifted from the ear with only one hand and without touching the muffs.

Visor

The essential tip-up function of the used visors functioned well on both helmets. A drawback with the screen type visors is that the light is reduced. This is a big problem especially under bad light conditions and in wet weather. The Swedish visor had a more wide mesh thus giving more light. This type of visor is therefore preferable.

3.2 Protective Leggings

Trousers made of nylon with sewn - in multiple nylon gas padding were tested. The paddings cover the front of leg from the ankle up to waist. The trousers were light and easy to wear. They did not hamper the movement during the work. Some complaints were heard that they were too hot during summer. The trousers are, however, less hot than other types of working trousers e.g. denim jeans.

3.3 Gloves in Combination with Mitt

It did not function well to wear any kind of gloves in combination with the mitt. It was too complicated to put the gloved hand into the mitt. Especially was this problem noticed during the delimbing operation when the left hand had to be used for clearing purposes.

A very open and shallow scarf between 75-90^{o} was tested. The reason for this open scarf was that the holding wood should act as a hinge until the tree was on the ground. This functioned well in the thinnings. Another reason for using a shallow scarf was that the leverage point was brought forward thus giving more efficiency to the felling lever. *

* *In some cases, where a rise in terrain close to the stump forces the felled butt up, slabbing of the butt log may occur. Thus a modification of the scarfing technique, to give a deeper scarf, is required in these situations.*

In clearfelling old crop it was not feasible with such an open scarf and the holding wood broke away before the scarf was closed. It was found that the scarf should, if possible, not be less than 45°. *

* *LIRA's working group considered the technique with a wide open scarf of more than 45° was unproven in old crop, and could be detrimental to quality log value. The problem of drawn wood was not solved. Further work was required and will be actioned.*

In clearfelling second crop the scarf could with preference be more open than for clearfelling, the importance for a scarf more than 45^{o} does, however, not seem to be significant.

In old crop was the bar too short for making the top-cut with one downward motion. It was found that the best result was given when the top-cut was done from both sides.

The developed scarfing technique is described in Appendix 4.

4.4 Back Cutting

Basic to back cutting technique is that a correct amount of holding wood is left as a hinge. Normally the holding wood shall be defined by two parallel cuts.

In thinnings no disadvantage was found if the back-cut was done at the same level as the scarf-cut. Instead it is easier to judge the correct amount of holding wood. It is also easier to lever down a tree if there is no longitudinal wood to be broken.

The delimbing result was superior to earlier used methods.

The developed technique is described in detail in Appendix 4.

In delimbing of second crop clearfellings the same technique as for thinnings was tested and found applicable. As the trees were to heavy to be turned it was not possible to limb the trees underneath.

The same technique was also tested at old crop trees at the landing. It was found that in principle the same technique was applicable. Due to the few remaining branches and the far distance between the nodes it was often not possible to follow the same systematic pattern.

DESCRIPTION OF TESTED EQUIPMENT

1 CHAINSAWS

1.1 Husqvarna 444 SG

Displacement 44 cc
Weight empty with 13 inch bar 6.1 kg
Equipped with:

- Front handle guard
- Automatic chainbrake
- Devibrated handle bars
- Device for air bag
- 325 micro - chisel - windsor chain

1.2 Husqvarna 162 SG

Displacement 61.5 cc
Weight empty with 15 inch bar 7.3 kg
Equipped with:

- Front handle guard
- Automatic chainbrake
- Devibrated handle bars
- Device for air bag
- 3/8" Super 70 Oregon chain

1.3 Jonsereds 90

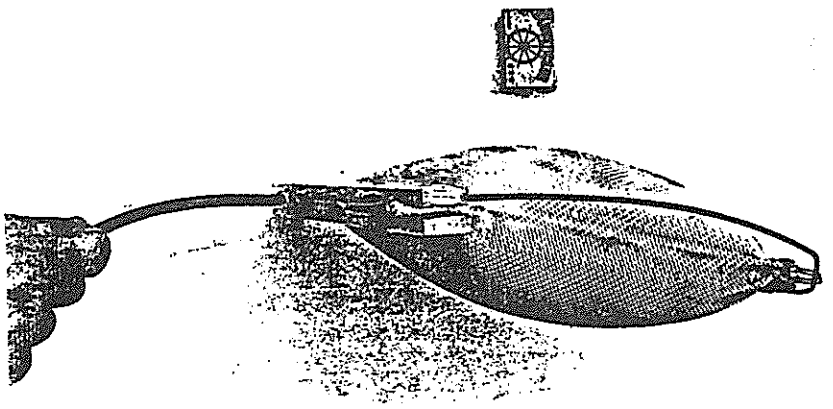
Displacement 87 cc
Weight empty with 22 inch bar 8.5 kg
Equipped with front handle guard and devibrated handle bars
3/8" Super 70 Oregon chain

2.3 Husqvarna Double Action Lever

Weight	1690 g
Length	790 mm

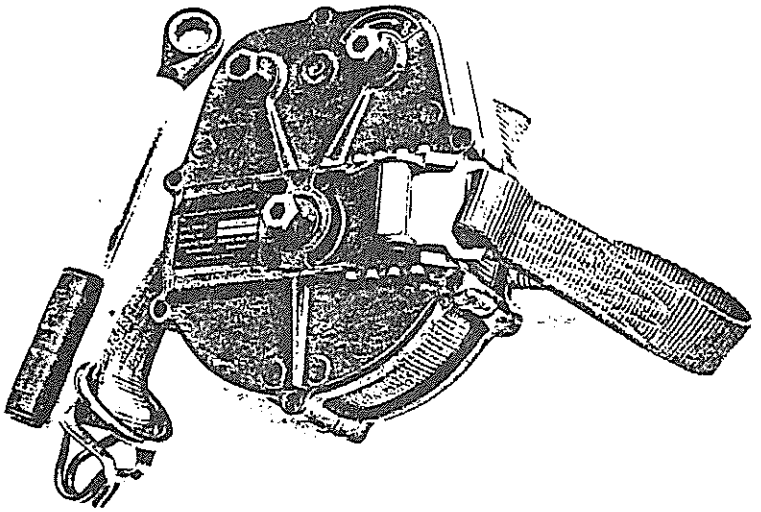
2.4 Air Bags "Nordfeller", two Sizes

Weight	360 g and 600 g
Dimensions	180 x 135 mm and 250 x 200 mm
Lifting height	75 mm and 100 mm
Capacity	3 tons and 10 tons



2.7 "Tenox" Portable Winch

Weight	7500 g
Dimensions	270 x 215 mm
Length of tape	9400 mm



2.8 Pulp Hook

Weight	25 g
Length	210 mm

RECOMMENDED METHODS FOR FELLING AND DELIMBING PINUS RADIATA

1 FELLING

1.1 General

The goal of tree felling is to fell the tree in such a direction that the following suboperations are helped as much as possible. A prerequisite is that the work is performed in a safe way.

The direction of felling, wanted and possible, depends on the weighing of a lot of different factors, type of transport, delimbing and/or bucking in the forest, lean of the tree, shape of crown, wind, terrain and other trees in the compartment. The faller must assess all these factors which influence not only the tree to be felled but more often a group of trees to be felled. A misjudgement may often be enough to set up a dangerous situation.

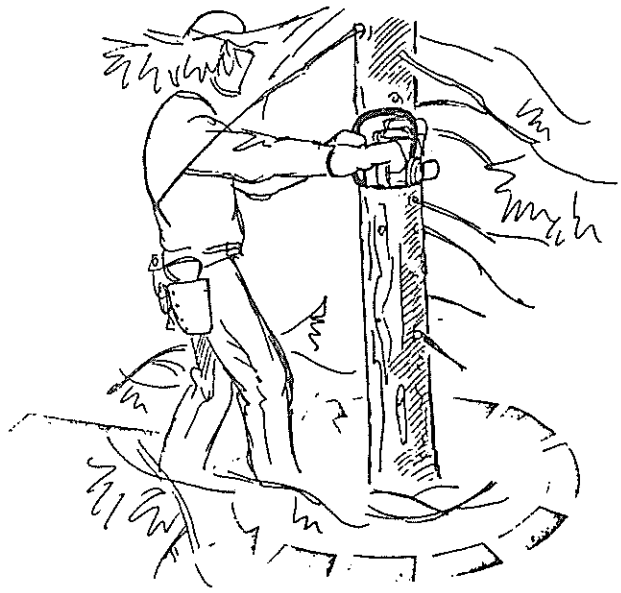
1.2 Thinning

1.2.1 Cleaning around the Tree

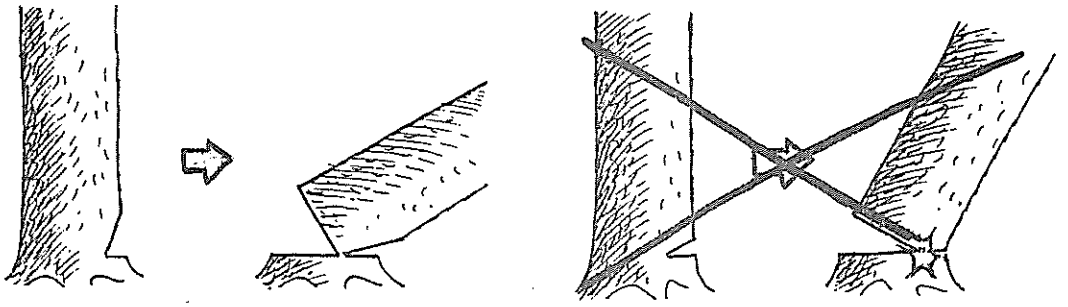
The cleaning around the tree includes removal of bushes, fern and slash within the working area and cleaning of the escape route diagonally backwards from the tree. The hazards of a kick-back are less if the cleaning is done by a backward running chain.

1.2.2 Butt-trimming

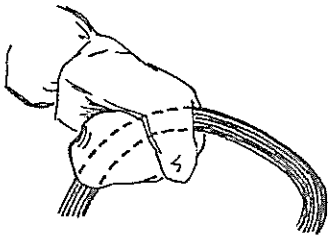
With butt-trimming means removal of those branches which is a hindrance for the felling. The work starts with the faller



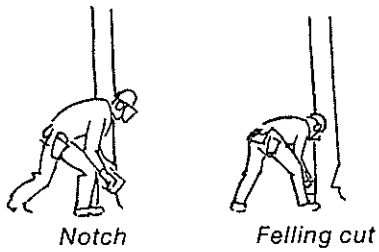
The scarf shall be as open as possible, 75^{o}-90^{o}, so that the holding wood is not broken but steers the tree until it hits the ground.

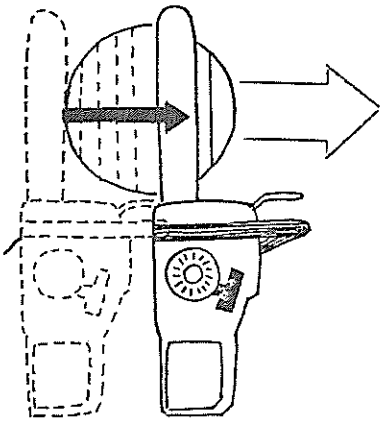


The scarf cutting starts with the upper cut (or face cut). By holding the saw in the bend of the front handle a suitable angle of the upper cut is reached. By supporting the left shoulder against the trunk and the right arm against the right knee the back in unloaded and it is easier to direct the saw.

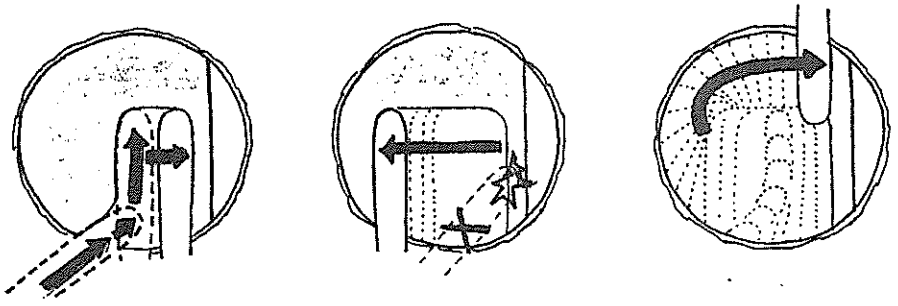


The point at which the upper cut is started will determine the depth of the scarf. The depth of the scarf must be big enough to give wanted amount of holding wood. Normally this means about 1/5 of the butt diameter. The guidebar should be kept horizontal. The depth of the undercut is controlled by looking down the kerf of the upper cut.





For trees thicker than the bar length but thinner than the double length of the bar, the back cut starts with a boring cut just behind the holding wood and continues with sawing forward to the holding wood. When the thickness of the holding wood is correct, the cut is completed with a straight backwards cut, to prevent the nose damaging the holding wood. The cut is completed by sawing around with a backwards running chain leaving a correct thickness of the holding wood on the other side. When starting the boring cut backward running chain must be used in order to avoid a kick-back.



1.3 Clear Felling - Second Crop

The working technique does not differ from the one described for thinnings. Boring cuts have, due to the bigger dimensions, to be used more frequently. If the scarf is open enough the holding wood will normally be intact until the tree hits the ground.*

1.4 Clear Felling - Old Crop

The basic rules for felling old crop are as for thinning and clear felling - second crop.

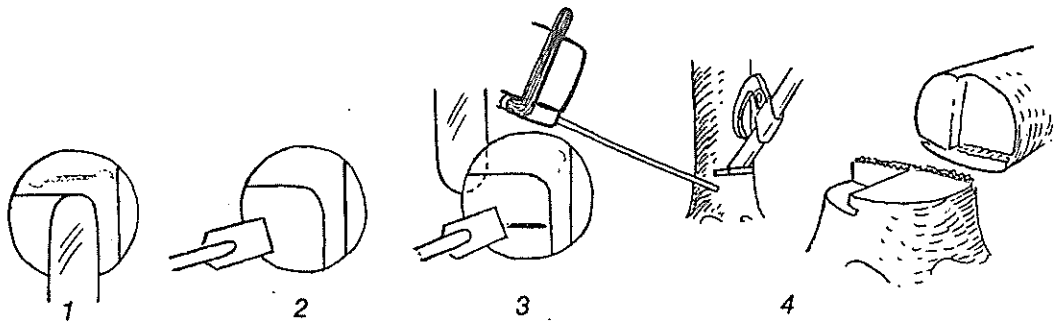
The holding wood does normally break irrespective of the angle of the scarf and the thickness of the wood before the tree hits the ground. *

**LIRA considers that there are problems in applying the shallow scarfing technique to larger trees for the reason mentioned on Appendix 2, pg 9. Further testing aimed at defining the limits for successful application on such scarfs are under way.*

1.5 Felling of Difficult Trees

It is more difficult and hazardous to fell trees which differ from the normal pattern. Special care has to be taken in these cases.

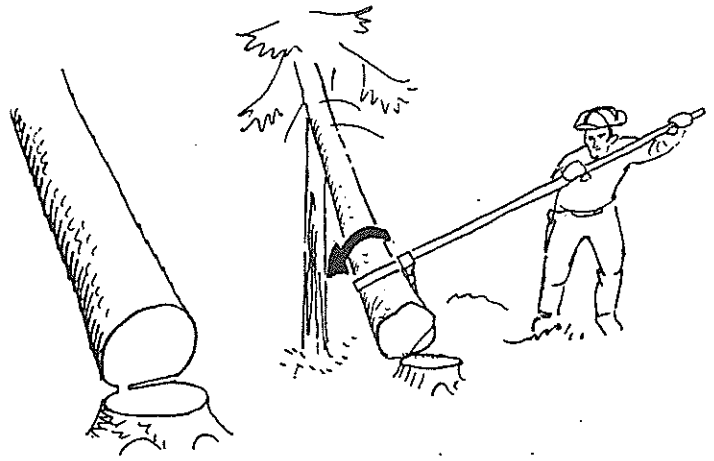
In first thinnings more or less all trees can be felled in desired direction if a lever is used. For small diameter trees it is difficult to insert the lever behind the bar without touching the chain. In this case the method of double backcut could be used.



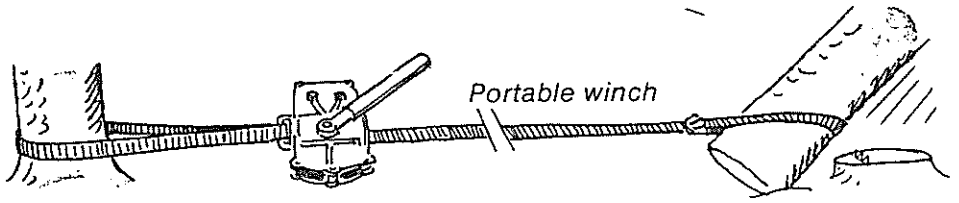
1.6 Dislodging Hang-ups

In thinnings most hang-ups could be dislodged with the felling lever in combination with a hook or with the turnband.

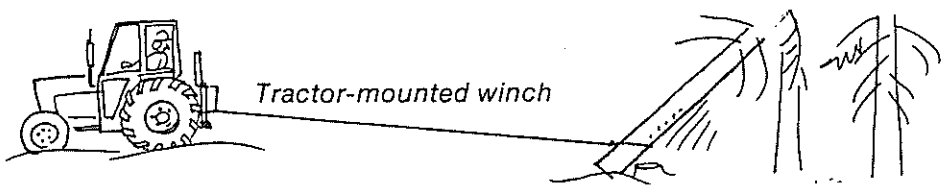
If a hung-up occurs the holding wood should only be cut to about 75 %. Then the tree could be turned down without the butt end digging into the soil.



For dislodging difficult hang-ups, e.g. if the tree is caught in a double leader, a portable winch can be used.



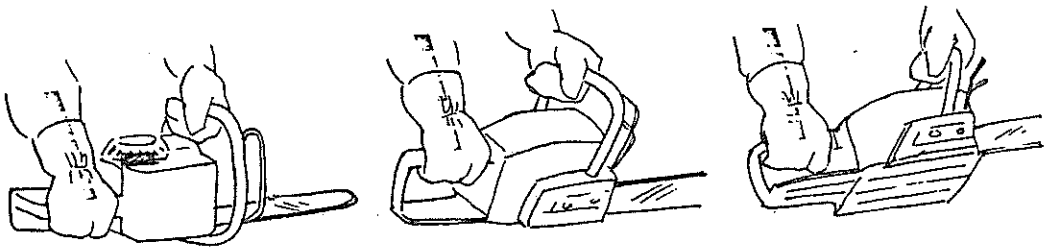
If a tractor is available at the working site it can with preference be used. Especially for big trees this method is recommended.



Driving is a dangerous method and shall not be accepted *

* *Note LIRA comment on pg 21.*

For a flowing delimbing the rear handle has to be turned in the right hand and the left hand be flexible in the front handle, meanwhile the saw is still kept in a firm grip.



To avoid hazards it is important that thicker branches and branches under tension are cut from the correct side so the saw does not get stuck.

2.2 Technique

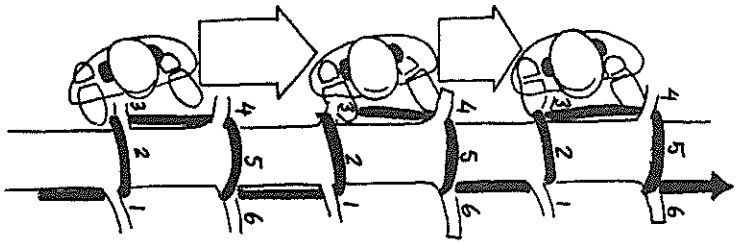
The developed delimbing technique means that the saw is moved with the flat sides of the bar against the trunk. The saw glides in a zig-zag pattern along the trunk.

The technique could be described as a cycle with 6 steps:

Step 1 Stand on the left hand side of the stem. Start to cut limbs on the opposite side of stem with the saw resting on the trunk. Use forward running chain.

Step 2 The saw is then pulled over the trunk against the operator. The bar on the trunk, still using a forward running chain. The saw itself resting on the thigh. The branches on the overside of the stem are cut in this way.

Step 3 To cut the limbs on the left side of the stem the saw is tilted still supported by the thigh and the stem. The limbs are cut with backward running chain.



If the nodes are more than 30-40 cm apart the saw is moved dioganally over the stem directly after the completion of step 3. The operator takes a step forward and the cycle starts with step 1 again.

The underside of the trunk can be delimbed after every second step 3. The saw is then moved backwards with forward running chain and the right hand is supported by the right knee.

The delimbing of the underside can also be done on the way back to the butt after that the trunk has been turned. The delimbing may be done either with forward or backward running chain depending on which side is the more convenient for the operator. The trunk must always act as a guard between saw and operator.

1

MAINTENANCE SCHEME FOR CHAINSAWS

1 GENERAL

A systematic maintenance of equipment is a must in modern technology. Not least is this important when the equipment is used under heavy conditions unprotected from weather and wind as in the forest.

The utmost responsibility that the equipment is in a good and safe running order must rest on the employer and his supervisors.

The operator must be trained to know his chainsaw so he can do the daily service and also feel, see and hear if anything on the saw does not function properly.

Is is important to emphasize that the first aim of the scheme is to prevent breakdowns not to repair them.

The maintenance scheme is divided into four different levels namely,

- maintenance during work
- daily maintenance
- weekly maintenance
- 2-month control and maintenance

2 MAINTENANCE DURING WORK

The maintenance on this level is done by the operator himself at the working site, e.g. every time he is refilling fuel and oil.

To perform this job he shall be equipped with,

- combination spanner
- screwdriver for ajdustments
- grease gun
- round file

	ACTION	REASON
3.2	Clean the cooling vanes of the cylinder.	To protect the engine from overheating and reduce the risks of fire.
3.3	Clear around the clutch, the sprocket and the chainbrake device.	Important for the safety of the operator and smooth running.
3.4	Clean the saw body	It is a good routine to work with clean tools. If the dirt is not removed every day it is stuck and difficult to remove.
3.5	Clean the bar groove and the oil holes. Turn the bar.	The bar lasts longer and is more evenly worn.
3.6	Change chain	The chains last longer if two chains are used and interchanged every day.

4 WEEKLY MAINTENANCE

A good routine is to finish the week's work with a thorough maintenance of the saw. The weekly maintenance can be described as an enlarged daily maintenance.

4.1	Lubricate the clutch bearing.	To prevent the chain to rotate when the engine is idling.
4.2	Clean and check the starter mechanism.	To minimize the risks for breakdowns and other disturbances.
4.3	Clean the cooling fan.	A dirty fan does not give enough cooling.

A journal shall be kept of the 2-month controls. The journal shall consist of a check list with the above listed points so every point can be ticked if OK or a notification made if not. After repair or exchange of broken part the saw has to be checked again and a note made in the journal of the job performed.

APPENDIX 6: SELECTION OF SUITABLE SAW AND BAR LENGTH

Bar Length inch	Bar Length cm	Effective bar length without spikes	Effective bar length with spikes	Maximum Butt-diameter for boring without spikes	Maximum Butt-diameter for boring with spikes	Saw size displacement in cc	Suitable for the following types of chainsaw operations
13	32	25	- 1)	60	-	40-50	Felling and delimbing - First and second thinnings Delimbing at landing.
15	37	30	- 1)	72	-	50-70	Felling and delimbing - Second and third thinnings and clear-felling second crop. Delimbing at landing
18	45	38	35	90	84	70-90	Felling and delimbing - Clear-felling second crop Felling - Old crop.
20	50	- 1)	39	-	93	90-110	Felling - old crop. (Depending on tree size.) Bucking at landing - " -
24	60	- 1)	48	-	115		

1) Not recommended.

EXAMPLE OF AUDIOVISUAL AIDS

1 GENERAL

In this appendix are given some examples of training aids to be used for the recommended training schemes:

- A dia-strip series: Working techniques felling
- Transparencies: How to use a chainsaw
- Film: Logging accidents

It must be noted that the dia-series and especially the film have to be gone through much more in detail.

2 WORKING TECHNIQUE FELLING WITH CHAINSAW A DIA STRIP SERIES

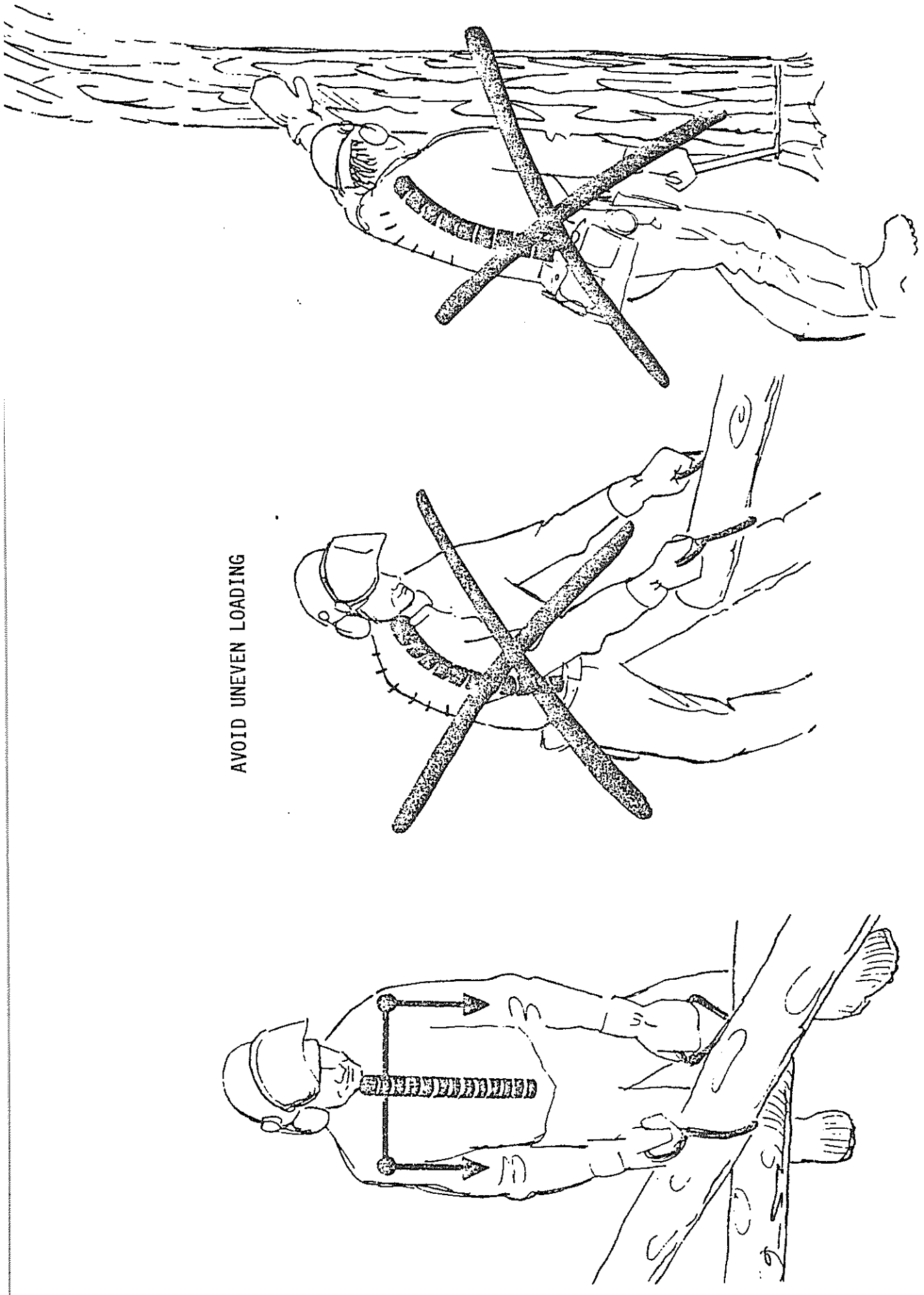
This dia-series is suitable to use in direct training situations. The instructor talks to the pictures. A tape with the speaker text could also be used in connection with the pictures.

Picture No	Description
1.	Faller equipped with personal safety gear.
2.	Saw equipped with safety components.
3.	Suitable felling aids.
4.	Start of chainsaw.
5.	Assessment of felling direction.
6-7.	Cleaning around the tree.
8-9.	Butt-trimming
10.	Aligning the felling direction.
11.	Correct holding of the saw for the upper cut of the scarf.
12.	Support of left shoulder against the tree.
13.	Upper cut, diameter <bar length

1. THE SAW ON THE GROUND

2. THE REAR HANDLE BETWEEN YOUR LEGS

PICTURE 3

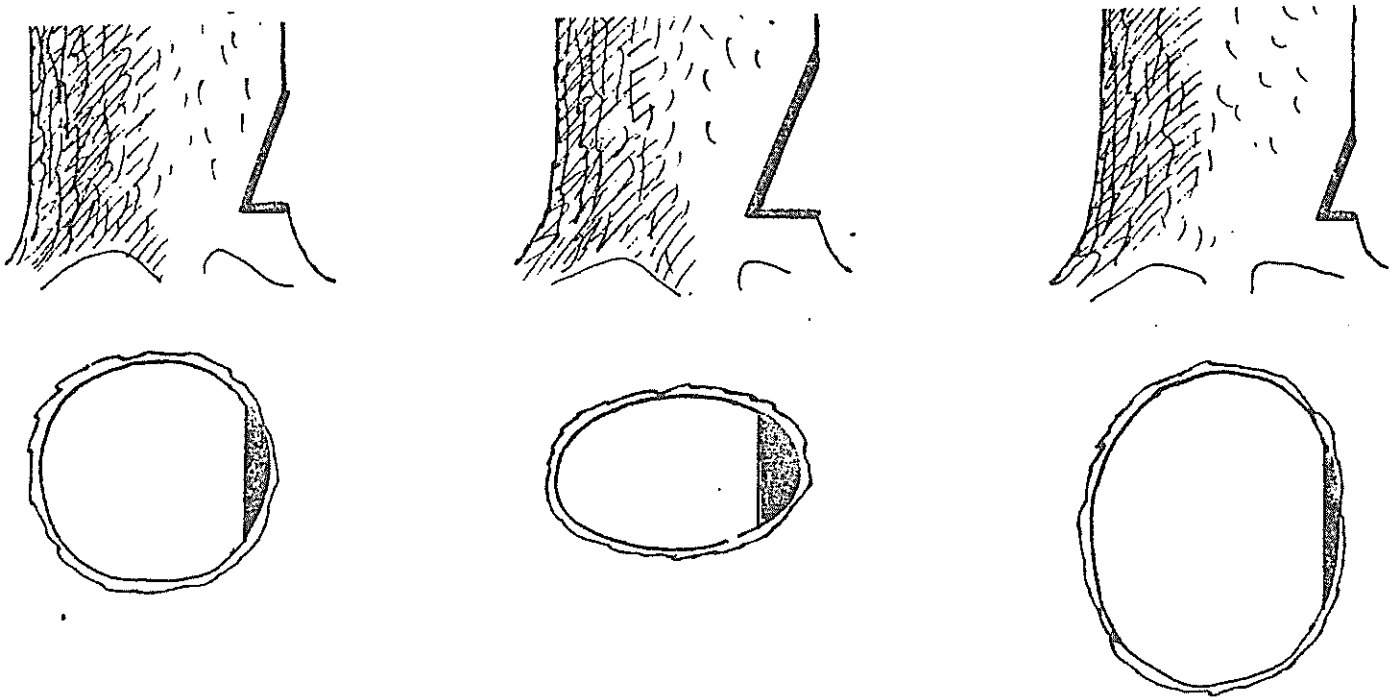


AVOID UNEVEN LOADING

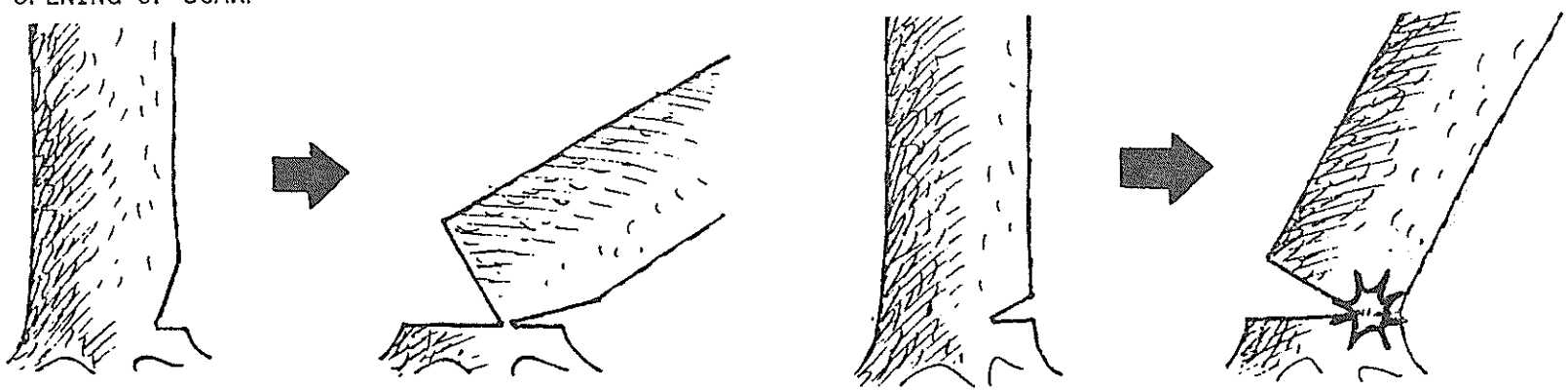
CLEANING AROUND THE TREE

PICTURE 5

DEPTH OF SCARF

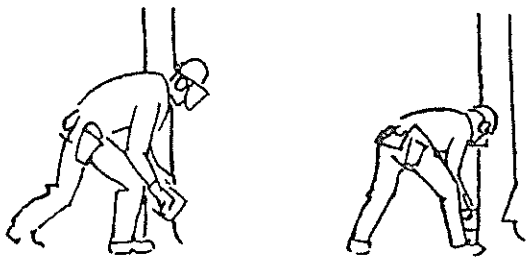


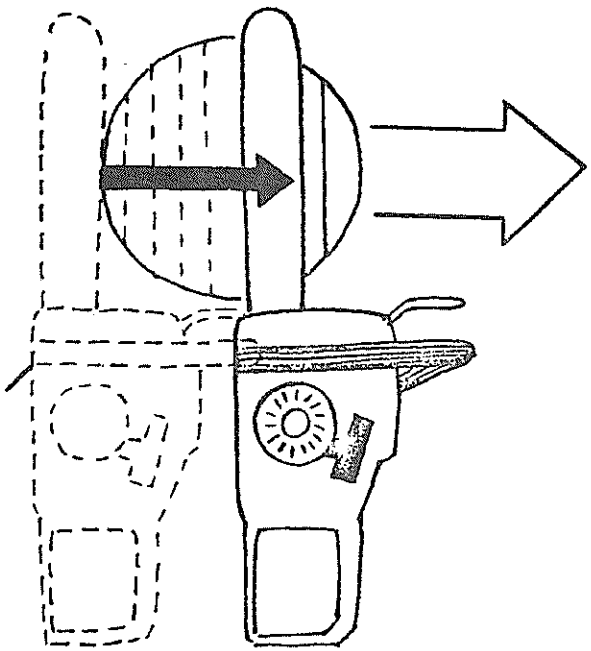
OPENING OF SCARF



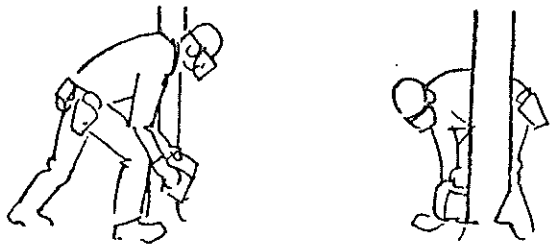
PICTURE 7

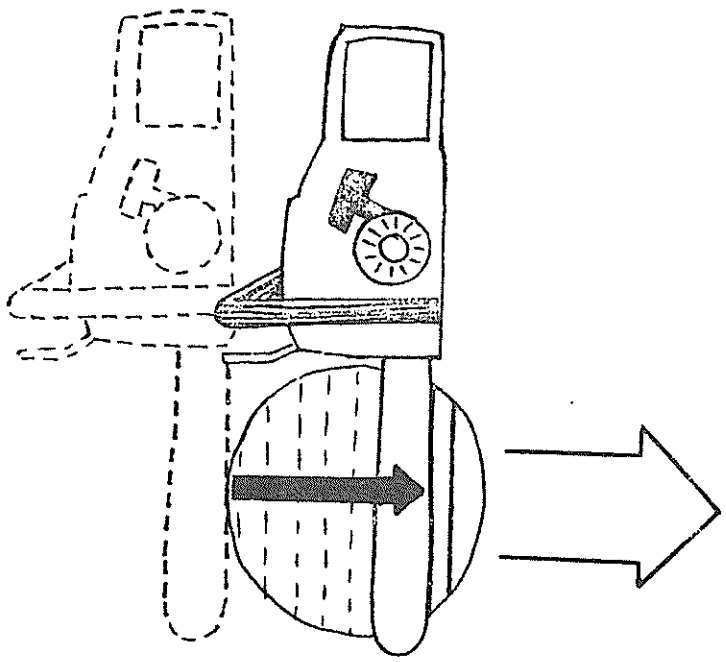
1. TREES WHICH THE BAR CAN PASS THROUGH





FORWARD RUNNING CHAIN



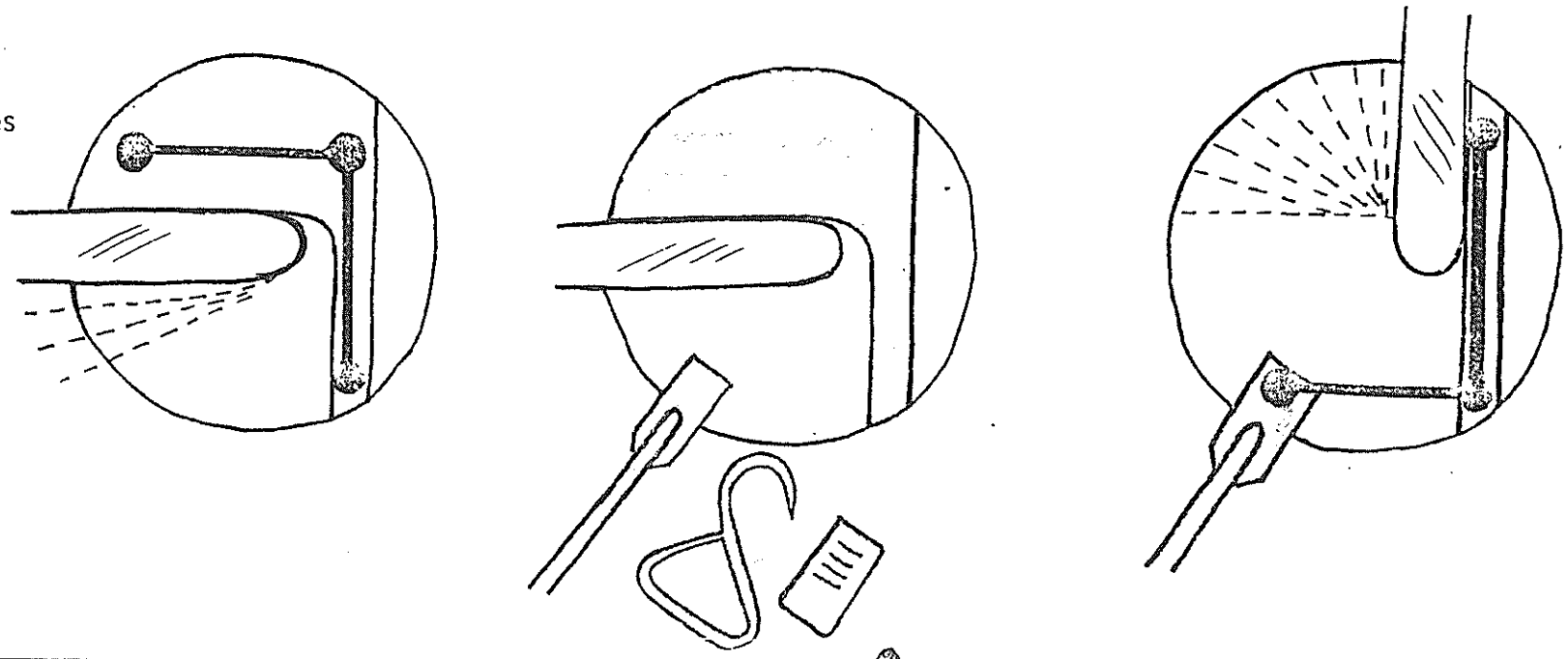


BACKWARD RUNNING CHAIN

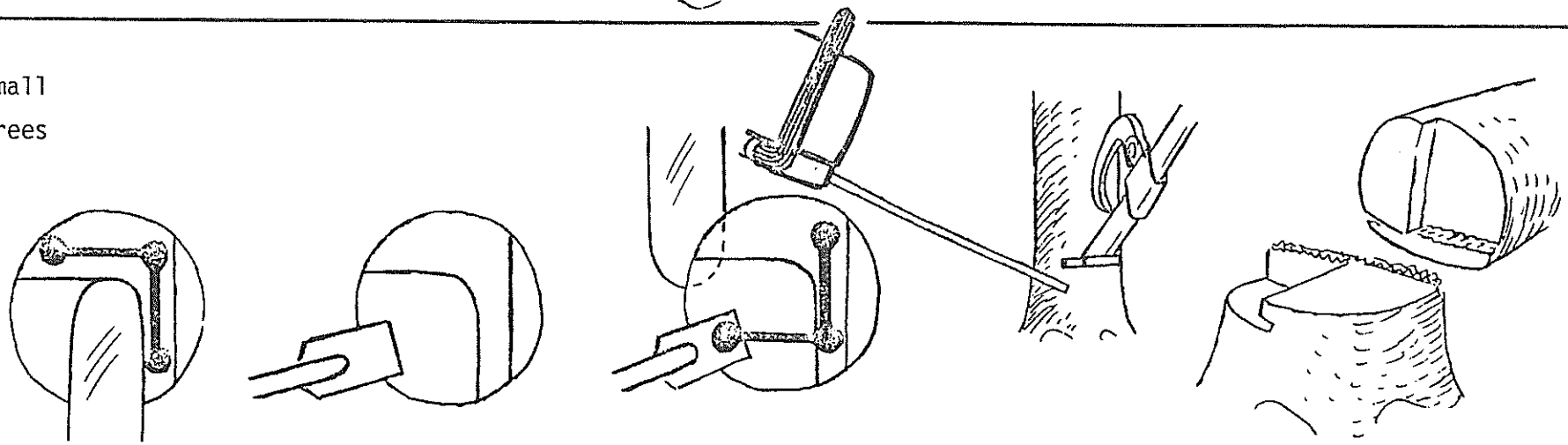
PICTURE 9

GUARD AGAINST TREES SITTING BACK

Big
trees

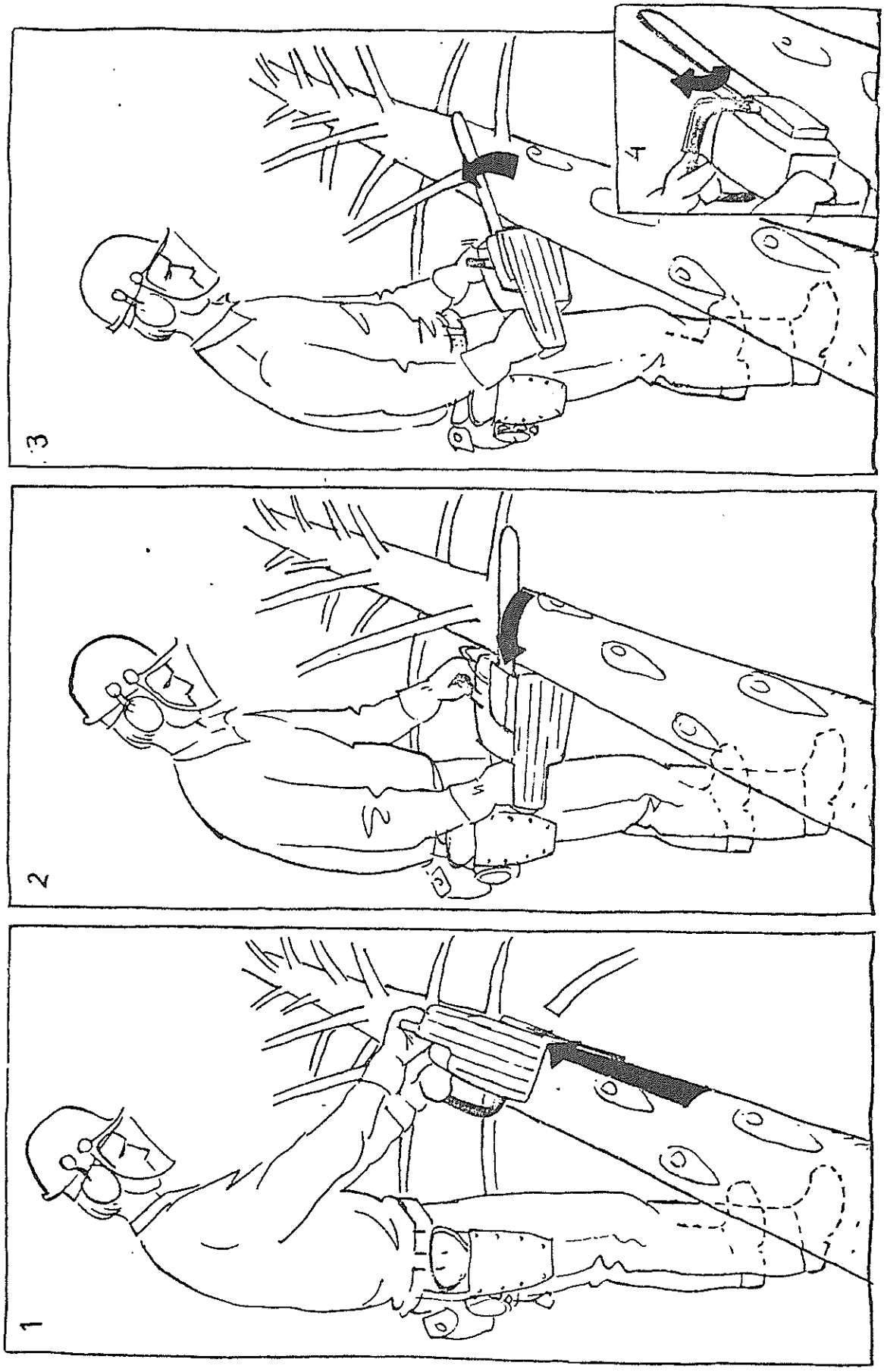


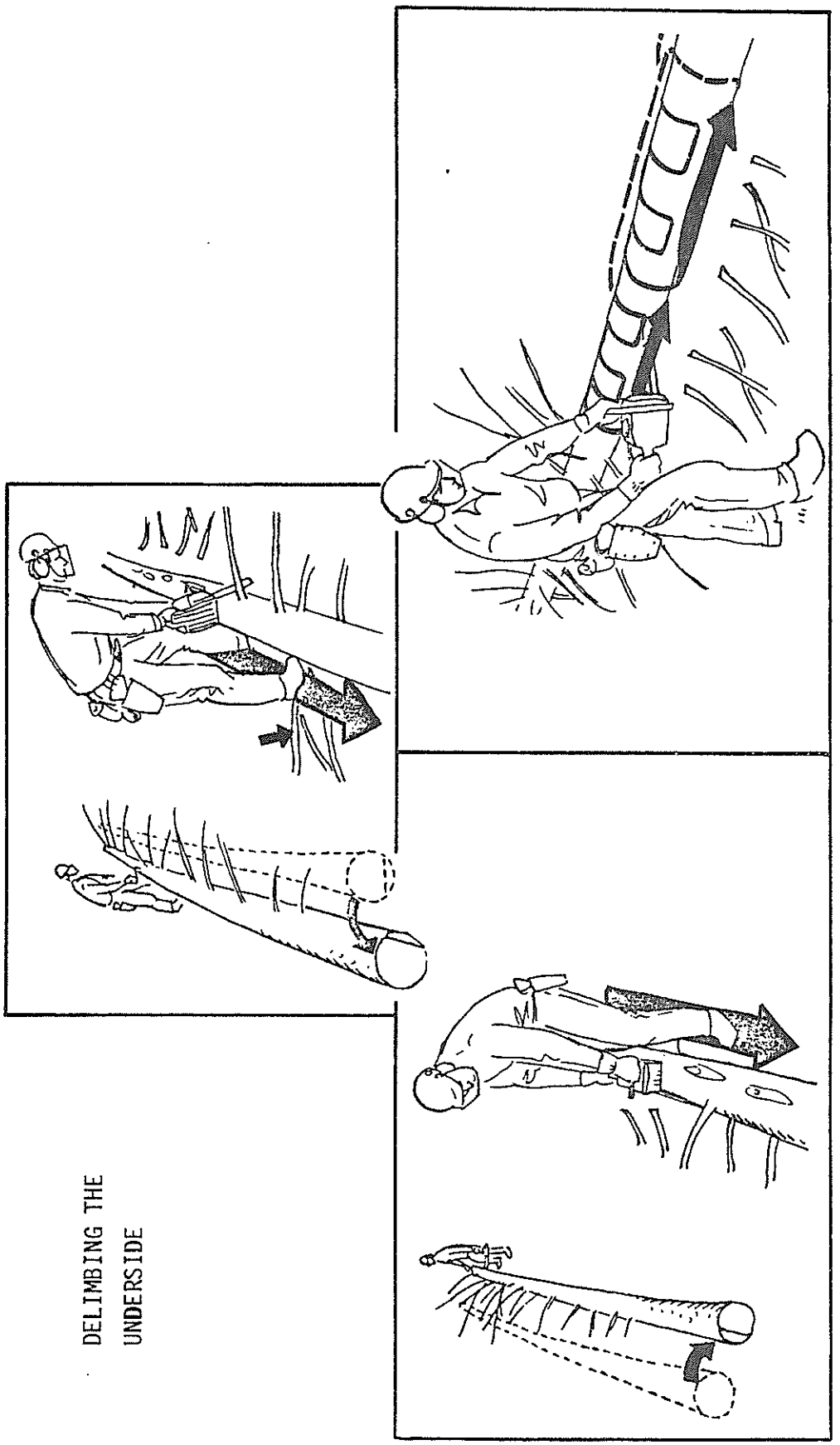
Small
trees



PICTURE 11

DELIMBING





DELIMBING THE
UNDERSIDE

3. Short interview with a physician about different types of injuries.

4. Summary of what accidents means to
- the individual
- the family
- society

Use interviews. Mention also what an accident may cost and the loss of production.

5. What can be done to prevent accidents?

5.1 Information
- about risks
- safe methods
- safe equipment
- etc.

5.2 Training in safe techniques

5.3 Discussions at the job site

5.4 Safety committees

5.5 Safety officers.

6. Final

6.1 The same beautiful forest view as in the introduction. Sound of a chainsaw.

6.2 A faller is seen felling a big tree in a correct way.

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