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Design and implementation

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PART I - EDUCATIONAL TECHNOLOGY AND HUMAN REQUIREMENTS

1. INTRODUCTION

A forest technician provides an essential link between the relatively small number of professional and research workers in a forestry organization and the very much larger group of vocational and manual workers who execute the day-to-day work of the organization. The knowledge and skills required for this task cannot readily be acquired by "on-the-job" training or by private study. For the development of a substantial cadre of forestry technicians within a reasonable period of time, a carefully planned training programme, linked with practical experience, is considered necessary.

The purpose of this manual is, therefore, to review, and in some cases to re-define, the requirements and procedures for forestry training at technical level. It relates to countries where forestry already plays, or is destined to play, an important part in the development of the community in its widest sense.

In Part I, the manual attempts to cover the basic aims and methods of this type of training, the range and length of courses likely to be required, the recruitment procedures for students, and the selection and training of teaching staff. Part II gives the range of physical facilities and equipment which are considered desirable to meet the training objectives. The appendices give additional detailed information, including a core curriculum.

Because of the wide range of conditions which are likely to be found within the countries that this manual must serve, it cannot be too specific with many of the suggestions. However, it can point the way to a number of options in certain circumstances. The one most suited to local requirements may then be selected, or used as a basis for further development.

2. TRAINING REQUIREMENTS FOR FOREST TECHNICIANS

A technician requires, primarily, a broad understanding of the interrelationships of forestry, farming, grazing, water supplies, and wildlife in his working area. He needs to learn the contributions that all these activities can make to the well-being of the population of the area in both goods and services. More specifically he, or she, needs to acquire the capability of translating oral and written instructions from professional staff, or research workers, into language or programmes of practical activity which junior grades of staff can fully understand and implement.

The forest technician requires the skill to interpret or understand, within the framework of existing knowledge, the results obtained in the field and to draw attention to any apparent abnormalities or unusual conditions that have arisen. The technician must also understand the needs and aspirations of the local people and be trained and willing to meet these requirements within the limits of good forestry practice and the funds available. Skills of leadership, planning, instruction and communication are also necessary for the technician to enable him to motivate and develop the labour force or the local community to undertake increasingly complex tasks for the public good.

In many instances, training may also be required to provide knowledge, experience and skill in a wide range of activities which in a more developed society could be acquired by personal experience or by a broad education. Examples are familiarity with maps and plans, the conduct of official business and preparing concise and lucid reports.

Training may also be required to produce an attitude change from the outlook of a young student to that of a mature government, or corporate official, into whose hands considerable responsibility for funds, equipment, materials and employment is placed. For this, a high degree of self-discipline and integrity in conduct and decision-making is required and training should be oriented, at all stages, to develop these qualities.

Finally, training at this level should be sufficiently intensive to provide a forestry organization with a cadre of knowledgeable, skilled and motivated technical workers. It will then be possible to select from among them well-qualified candidates for advancement to higher technical or professional posts.

3. TECHNICAL TRAINING IN RELATION TO OTHER FORMS OF TRAINING

A forestry technician, by virtue of the link the post provides between professional staff and lower supervisory staff or manual workers, must acquire a range of skills and knowledge which, to some extent, will overlap with the levels both above and below the post. A broad understanding of the task is also required in order to integrate successfully advice received from many specialist sources.

A technician who is in close contact with skilled forest workers, requires initially a degree of understanding and competence in forest operations in order to determine if standard techniques or procedures are being efficiently carried out. A thorough knowledge of various operational performance rates is also required, both to plan time schedules for different tasks and to identify individuals who may require further training to reach satisfactory standards of performance. A further requirement is the ability to teach workers new skills and to upgrade existing skills within the workforce.

The technician, therefore, requires a background of scientific knowledge linked closely to the ecological conditions and day-to-day operations of forest areas. Insight into the planning and organizing functions of a professional forester is also essential, to be able to understand the importance of following approved techniques for forest operations and the necessity for accuracy in data submitted for either record or planning functions. However, the technician's interests should lie more in the outcome or application of theories and formulae, rather than in their scientific basis or derivation. Ideally, sufficient competence in an international language should be acquired to enable reports and technical papers to be read both to widen knowledge and reinforce interest in the job.

4. DIFFERENCES FROM OTHER FORMS OF TRAINING

4.1 Differences from professional training

A technician's training should differ from that of a professional forester whose education will normally be based on generalized theories or concepts from which he has been trained to derive, on his own, specific solutions to particular problems. The technician, on the other hand, is not likely to have had the time or the opportunity to develop this generalized approach. Closer guidance is, therefore, required on techniques and standard procedures derived for him by the professional staff. Nevertheless, an adequate range of discretion should be left for the adoption of techniques and procedures considered to be the most suitable for the various situations encountered.

Whilst the training of a professional officer must equip him to integrate ideas or data from many sources in order to develop plans or instructions, a technician requires more interpretive skills both to read and extract from such documents the information on which he must act. A technician, therefore, requires training in the logical arrangement of the contents of instructions, which will ensure that they are passed on properly to workers and correctly executed. For this, the regular use of written instructions in the training programme is an important aspect.

4.2 Differences from vocational training

Vocational training must initially place greater emphasis on certain personal skills in order that these skills can be passed down to the workforce. Vocational training, therefore, concentrates more on precise performance within defined limits of programmes or work techniques and aims for the effective use of labour and resources provided. A technician's training presumes a greater freedom in decision-making on the techniques to be applied and the ability to integrate costs or production data from vocational or lower level supervisors, in order to give professional staff a clear picture of the status of operations within a working area.

5. AIMS OF TECHNICAL FORESTRY TRAINING

5.1 Overall aim of the training

The overall aim of the training must be to produce a person with the basic physical, manual and mental skills to cover the range of operations which a forest technician is currently likely to meet and a degree of interest and adaptability to acquire additional skills as these become necessary. To this must be added a well-defined body of knowledge of forestry technology and practice, as well as ecological topics, to enable suitable techniques to be applied in appropriate circumstances which are in keeping with the overall ecological and development needs of the area. The technician must also be able to recognize abnormal conditions or results and to describe these precisely, when seeking specialist help in solving any problems that may result.

5.2 Specific aims of the training

5.2.1 Planning skills

A technician must be taught a range of planning skills or techniques which fall within the framework of responsibilities at technical level. An understanding is required of how to schedule a programme of work over a period of time in relation to climatic conditions, the possible labour supply and any variations in cash flow or allocations. Additionally, some knowledge of planning the use of transport and equipment is required to maximize the benefits of any expenditure incurred on these items. The technician should also be able to define monthly or weekly work schedules which conform to longer term plans, and to monitor progress and cost at frequent intervals to detect, as early as possible, any deviations from the overall plans. Skills in planning may also have to extend to personnel matters, including scheduling vacations and training courses to fit in with planned operations. Knowledge of budgeting and expenditure control is also required as well as familiarity with the reporting procedures adopted by employers.

5.2.2 Supervisory skills

The training must also equip the technician with the knowledge and skills necessary for undertaking supervisory duties and, with further experience, to be able to undertake the day-to-day management of a forestry enterprise.

5.2.3 Management of tools, machinery and equipment

The technician must have an adequate knowledge of the range of tools, machinery and equipment currently available for the tasks which have to be performed. The need to obtain information on new developments through literature and contacts with suppliers has also to be pointed out. The technician's responsibility for looking after and maintaining in good order all such materials which are made available must similarly be stressed. In addition, the technician must be made aware of the need to balance the supply of material resources and personnel required for the performance of any given tasks.

5.2.4 Relevance to other rural activities

An awareness is required of the social and development values of forestry to the community and of its close relationship to agriculture and other rural activities. The technician should also be equipped with the knowledge and skills necessary to motivate local people to work for an improvement of their living conditions.

The training of technicians for service in a specific country must always be closely linked to the real needs of that country. No matter how attractive the syllabus or programme of another country may look, the basic criteria in syllabus construction must always be the requirements of that particular country or area at that stage of development, and how it can best be conveyed to the level of candidates available.

6. DESIGN AND IMPROVEMENT OF CURRICULA AND SYLLABUSES

6.1 Curriculum content

The basis for development of a relevant curriculum must be an initial wide-ranging study of all the operations currently being performed by staff at the technical level in the employing organizations. Initial information on this can be gathered from a study of the budget and any written instructions issued to staff on technical operations, administrative or reporting procedures. This should be supplemented and verified by a close study of work in the field, and in the offices, of staff of this category. It may lead to a better understanding of the true role of the target group if some observations are also made of the groups of employees immediately above and below the technicians being studied. Detailed job descriptions, where they exist, supported by simple activity samples of field and administrative tasks, can lead to the definition of several broad categories of work and areas of knowledge and skills which appear to be important in the role of the technical staff. Some informed opinions on the relative importance of these broad categories of work and areas of knowledge and skills can be acquired by listing them and then devising a rating scale. A wide range of experienced staff of the technical level and above are then invited to complete the assessment sheets, bearing in mind the importance of each topic in the foreseeable future (i.e. a 5 to 10-year perspective). Rating can be done on either a 5 or 7 point scale. Verbal definitions should be given of the meaning of each rating point to the field staff completing the assessments. An example of a 5 point scale is given below:

Rating points	Degree of knowledge/skills required
1	Little or no knowledge/skills required
2	Some knowledge/skills required
3	Relatively good knowledge/skills required
4	Very good knowledge/skills required
5	Specialist knowledge/skills required.

A list of possible topics which staff may be asked to assess is given in Appendix 1. This would refer to a forest area where there is a relatively low level of educational and technical development and hence there is considerable emphasis on the more technical aspects of the forest operations. For each topic, the median point of all the responses can be worked out and the subjects ranked in order of the degree of importance according to the ratings. Whilst this can be a valuable guide in curriculum development and syllabus construction, it must be borne in mind that the responses will be largely influenced by the degree of experience, and to some extent the educational background, of those who made the responses. Hence, actual teaching times required will not necessarily correspond to the ratings.

6.2 Decisions on course format

At an early stage in curriculum development, a policy decision must be made as to whether the course content is to be integrated into a few relatively broad areas of study, linking related topics, or divided into several separate course units each allocated specific teaching times and credit hours. The choice between these systems is likely to be strongly influenced by the general pattern of education adopted within the country for technical courses in other disciplines. It may also depend upon whether the training organization is largely autonomous and producing candidates for a limited field of employment, or integrated into the general pattern of technical and professional education. In this case, course credits may be interchangeable with other fields of study.

A course format made up of a few wide-ranging areas of study allows greater flexibility whilst staff are still trying to define more precise training needs. Limited, specific course units, on the other hand, lead to greater clarity and precision of material to be taught, but should not be regarded as immutable. Regular and careful scrutiny of their relevance to the overall aim of the course is required. Core curricula for various types of courses are given in Appendix 2.

6.3 Syllabus construction

The list of subjects identified as essential for the course should be ranked in order of importance and then scrutinized by a small group of experienced forest staff, of whom several should have had a fair amount of teaching or instructional experience. If the organizations concerned intend to train candidates for employers outside the public sector, the opinions of these employers should also be represented in this group. For each subject selected as relevant to the course, a series of course objectives should be derived, setting out clearly what the aims of teaching in that topic ought to be. Examples of Course Objectives based on those used at a forestry school in a developing country some years ago are given in Appendix 3.

When a series of Course Objectives have been defined, they can be made more specific by developing a series of Achievement Targets, precise statements derived from the broad objectives of what a student should know, or be able to perform, on completion of the course. Though both Course Objectives and Achievement Targets may initially have to be defined in rather general terms, both can, and should, be redefined more specifically at regular intervals. This will enable the course to match more closely to the ultimate job requirements. Examples of Achievement Targets for the relevant Course Objectives from the same source are also given in Appendix 3.

6.4 Syllabus development

These stages of syllabus construction must lead to the identification, by a group of instructors, of the items of knowledge or skills - mathematical, verbal, or physical - a student must acquire in order to reach the defined Achievement Targets. From this a series of Course Outlines can be constructed, which after further discussion can be developed into detailed statements of Course Contents. In many cases, this would consist in a particular topic of a brief statement of background information on the topic, ideally gathered from local experience, to establish its relevance to the programme in general. Secondly, it would include a general description of the application locally of any techniques or procedures involved, giving objectives and reasons for the work. Finally, a step-by-step description of the procedures would be included, with details of any equipment required and any records which have to be kept.

A concluding summary, restating the most important aspects of the study, is usually necessary. Suggestions of any practical or written exercises required to consolidate the knowledge or skills should be included. This material is best developed in a series of short, precise paragraphs which can form the basis of teaching handouts, and, in due course, a teaching manual for the course.

6.5 Time scale

Initially, this must be derived from within a more or less arbitrary framework of overall time available for the whole course, divided roughly into various sections related to the importance of each part of the daily work of the field staff. This, however, can only be a very rough guide to the time allocation required for each broad section of the syllabus. Preliminary preparation of the teaching notes can then proceed. As this takes place, adjustments will have to be made to the provisional time allocations given to the main subjects, in order to accommodate material found to be essential, if the defined Achievement Targets are to be reached. In some cases these targets may have to be modified, if found to be too ambitious for the time available.

Whenever possible, trial runs of sections of the course may be made on limited groups of students, such as during in-service courses, to measure the time requirements for such sections and to determine their effectiveness. Pruning of some material which could be taught, but which may not be vital, may have to take place to keep the course material within the time limits proposed.

Eventually, a syllabus can be prepared allocating blocks of time for certain items of closely related material. Later, a "Scheme of Work" should be prepared by the instructor giving more precise teaching targets for each hour of the course. Further detailed revision of the Course Content or time allocation can take place if, during teaching of the course, an accurate daily "Record of Work" is maintained detailing the topics actually

covered within each hour. This calls for a lot of hard work and interest on the part of the instructors, but is well worth the effort.

6.6 Cross-checking of syllabus content

As the syllabus sections and time allocations are developed, careful cross-checking must be carried out to ensure that skills required in one topic, but taught under another, have in fact been adequately covered before they are required. This procedure increases in importance the more a course is broken into short, discrete course units. Checking can best be carried out by setting out Schemes of Work in related subjects, in parallel columns, in a form using a vertical time scale to show clearly when each topic will normally be covered in the course. Adjustments may be required in certain programmes to ensure that different topics keep in step with each other.

6.7 Relationship to university and overseas courses

A possible short-cut in curriculum development, involving a wide-ranging review of what is taught either at university level or in similar forestry schools in other countries may seem attractive, but may be totally misleading. It may cause inclusion in the syllabus of items which seem academically attractive, but may be of little relevance to a particular country, at its present stage of development. This may lead to theoretical training in certain subjects, before there is a substantial body of local knowledge, or indeed any field activity to justify the course. An initial wide range of course titles built up in this way may simply lead to an unnecessary and unrewarding search for any available material to fill out the courses. In these circumstances, the courses are unlikely to be relevant to the real needs of the country concerned.

6.8 Sub-division of topics

Bearing in mind the difficulties of recruiting suitable teachers, and the time taken for them to build up skills in teaching and acquire detailed knowledge of local conditions, it is advisable for an initial programme of training to start with a syllabus limited to a few main broad topics. This allows greater flexibility in teaching. Sub-divisions of major subjects, e.g. the separation of forest protection from a general course in silviculture, should take place only when sufficient local material has been accumulated to justify establishing a course in its own right, and when there is adequate staff to cover the variety of topics.

6.9 Inclusion of basic studies

A question of some importance is whether a technical course of this nature should include a period of basic, non-forestry studies. Generally it is best if candidates can be recruited with the necessary qualifications in basic sciences, mathematics and language to avoid this, and to allow all available time in the course to be devoted to relevant technical studies. If the basic qualifications of candidates prove inadequate for the understanding of the more scientific parts of the course, a programme of basic studies in subjects such as chemistry, mathematics, physics, biology, etc. may have to be devised. The material taught, and the exercises or experiments undertaken in this programme should, however, be specifically aimed at assisting teaching in the later technical parts of the course. This may involve a considerable period of research and cooperation between the basic studies and technical instructors concerned, to devise a relevant training programme.

It is no part of the function of a technical training programme to provide bridging courses leading to university entry later. These can more properly be provided in other institutions such as junior colleges or continuing education centres. A technical forestry course should concentrate its activities on more clearly defined objectives.

6.10 Validation of courses

Validation of courses must depend to some extent on the level of development of the employing agencies. Where there are clearly defined functions or standards of performance for staff members of particular grades, graduates from training programmes can be graded by their superior officers on their ability to meet these requirements, within a specific time, after completing their training. Where this indicates any recognizable pattern of

deficiencies in their performance, a review of the course must be undertaken. Both field staff and teaching staff will normally take part in such reviews.

In some cases the training institution may in fact be running ahead of field procedures and it may not be possible to validate the course in this way. A periodic review should, however, be made by the most experienced field officers available, and the training staff. This review should seek to measure the range of knowledge and skills the graduates possess and to assess how relevant they are to the current needs of the employers.

6.11 Handouts and training manuals

The development of an instructor's teaching notes into class handouts, and the use of these in teaching programmes should receive careful attention. Handouts are fully justified when the complexity of the material being taught is such that it cannot be conveyed adequately, either orally or by visual aids such as chalkboard notes. An example might be the precise wording of forest laws or regulations. If they are used at all stages of a course, they may lead to inattention in class and excessive dependence on the handout for later study. This may not always give satisfactory results. It requires a high degree of skill on the part of an instructor both to retain the interest of a class and to gain their active participation in learning, if students know they will get it all in the handout at the end of the lesson. Handouts may, therefore, be of greater value when used to summarize a substantial sub-division of a topic, before the instructor moves on to the following section, rather than as a daily teaching aid.

Class handouts, after 2 or 3 years' use and careful revision, should form the basis of a comprehensive teaching manual on the topic. This, in turn, can become one segment of a teaching manual for the whole course. Such a manual, whilst depending heavily on individual instructor's notes and handouts, should be extensively edited by one person to secure a uniformity of style, language, sub-division and numbering through the course, and directly related to any sub-division or numbering system used in the syllabus. When such a manual has been produced, the emphasis and pattern of the teaching can change. Students can be allocated adequate amounts of time to study the manual and class teaching can concentrate more on practising skills, or using information they may have obtained from their guided private study.

The construction of a training manual is a considerable task and once completed, teaching staff may feel they can relax and depend upon it as their main source of teaching material, for a considerable period. Material very soon goes out of date, however, either due to further research or to change of emphasis in the course. Therefore, to be effective, the format of the manual must be such that small sections of a few pages can be discarded and rewritten, without upsetting the flow or numbering of the material. A loose-leaf format is most useful for this purpose.

7. ORGANIZATION OF PRACTICAL WORK AND STUDY TOURS

7.1 Importance of practical work and tours

To be really effective, a forest technician should have a practical outlook, be capable of using tools and equipment and be able to cope with all manner of forest conditions. It is essential, therefore, that a forestry training programme at technical level should include a great deal of practical work and opportunities to visit a wide range of forest sites.

However, it is not sufficient simply to provide tools and equipment and then leave the students to work without guidance. This aspect of their training must be properly planned and closely linked with the theoretical instruction. To make the maximum use of the time allocated for practical work, it has been found that various types of training areas should be established. Details are given below and also some guidance on the planning of study tours.

7.2 Initial demonstration and training area

Ideally a training institution should have 2 or 3 field training areas. One of these should be a series of plantations of differing age classes and, if relevant, different species, and a reasonable amount of natural forest. This should be under the exclusive control of the institution. One staff member should exercise a supervisory or coordinating function over the whole area. The detailed practical exercises should, however, be planned and supervised by the staff member of whose course they form a part, within the agreed framework of management for the training area. The area should, therefore, as far as practicable, be operated under an approved management plan, similar to those in use throughout the forest district concerned. In general, however, unit areas to be treated will be considerably smaller than those of a full-scale plan.

The area should provide facilities for demonstrations and initial practice of forestry techniques by students. At this stage of their training, the quality of performance will be variable and the output generally low. These factors tend to upset operational plans, if such initial training activities are carried out in a forest under a normal management regime, hence the need for designated training areas.

7.3 Practice yard

Depending upon the nature and range of operations required in the Demonstration Forest, the use of a Practice Yard may be justified. This will enable initial instruction in tool maintenance and correct working techniques to be given to students, before they take part in exercises in the Demonstration Forest. This should ensure that they operate efficiently and safely.

An open yard, preferably with a limited covered working area, should be established sufficiently close to the teaching block to permit quick access on foot. However, it should also be far enough away, or sufficiently well screened, to avoid undesirable noise reaching the teaching area. The yard should contain facilities for tool maintenance and supplies of logs for practising axe work and sawing techniques. A further area in which students can use tools for working the soil or fire-fighting tools, has been found to be useful.

7.4 Training forest

Following initial practice in a demonstration area, it is desirable that students should have access to a large-scale forest, not too far from the school, which has examples of as many types of field activities as possible. This allows full day exercises or longer periods of practical training during the course, with the minimum amount of travelling time.

The definition of a large-scale forest depends upon local management objectives, but something with an annual working area of at least 1 ha. for every student using it is desirable. The area must be sufficiently large to allow each student adequate scope to practice skills such as planting, tending, pruning, thinning, etc., or corresponding skills in natural forest techniques. On the other hand, it should still be sufficiently compact to allow a class to complete an operation over a unit area, such as a compartment, without having to call in workers to complete the task. If this is required, it may lead to variations in standards of performance, which can complicate record keeping for the local manager.

7.5 Training in planning and supervision

During initial practice, and in some cases in the early stages of full-scale operations, the work should be planned and closely supervised by instructors. They must ensure that proper techniques are applied and that a good organizational structure is established to provide for the control of the operations. As soon as the techniques and patterns of work are well established, student leaders should be allocated, on a periodic basis. They will draw the necessary tools and equipment from stores; issue it to group members; allocate tasks and rates of output; verify that the work has been carried out in a satisfactory manner; and ensure that the equipment is returned in good order. Exercises in such supervisory functions, and experience of the various problems which may arise, are as important as experience in the tasks themselves.

7.6 Training in community forestry and extension

In areas where community forestry or extension programmes play a significant role in the work of the forest authority, students should have ready access to several areas in which active community forestry programmes are in operation. Either through their own instructors, or with the aid of community forestry staff from the authority, they should be able to carry out case studies of local needs and aspirations. They should also participate in discussing, planning and facilitating realistic community forestry projects and in evaluating their results.

The area to which they have access must be reasonably large and contain a considerable number of identifiable communities with whom they can work. If this is not so, students may tend to visit particular communities at too close intervals of time to generate any really fresh ideas or proposals on community needs. The task may then degenerate into a form of ritual discussion and planning, and fail to identify problems arising in communities not yet oriented to this type of work.

Students are unlikely to remain long enough in an institution to see the full implementation of any proposals they may draw up, but they can be graded in a careful review of written reports on one or more set tasks. They can widen their knowledge by studying projects at various stages of implementation.

7.7 Study tours

A programme of touring, preferably combined with practical studies and exercises, in ecological conditions which are not represented near the training institution, should be included in the training programme. It is, however, often difficult to achieve a satisfactory balance in such a programme.

If the country is extensive, with widely differing ecological and social conditions, there may be a need to extend touring to cover as many variations as possible of the conditions. If, however, this involves long journeys and frequent changes of camp, students tend to become tired and lose interest as the tour proceeds. A tour based on a large number of visits to different activities may lead to an excess of experiences, more than a student can reasonably assimilate within a limited period. Field officers often show great enthusiasm for their work and tend to crowd into a short visit as much activity as possible. Opportunities for students to practice new techniques for a day or two throughout the programme are desirable, though both the level of performance and work output may be low, as the group is unlikely to be able to spend enough time to master a new technique fully. If it is practicable, a number of short tours of 2 weeks' duration with fewer objectives may provide more useful experiences, but these in turn may involve greater expense and more unproductive travelling time.

A programme involving a camp in one particular area for a period of 6 to 8 weeks provides the opportunity for more detailed experience in the techniques and working conditions of the area, but it will not provide the range of experience desirable when widely varied ecological conditions are met with in the country.

7.8 Work experience

A valuable contribution to practical training is to encourage students to seek paid employment in forestry activities during vacations. This is not so easy in some countries as it is in the temperate zones where a season of annual vacations, or favourable working conditions, creates a demand for temporary employees. Vernacular language, lack of suitable accommodation, food preferences, etc. all create problems initially. It is worthwhile, however, exerting a good deal of official pressure on local staff to accept trainees, and to assist them in overcoming these problems. Experience in actual working conditions, especially outside a student's home area, is likely to give a very valuable insight into workers' attitudes and motivation, as well as practical experience in forestry activities.

8. TEACHING AND TRAINING METHODS

8.1 Class teaching

In some of the countries for which this publication is intended, a major element of direct teaching, i.e. the transfer of knowledge or experience from instructor to student, may still be essential. Students from rural backgrounds may lack many of the basic experiences of tools, materials and literature that one could reasonably expect of students from more wealthy and developed areas. Moreover, in their struggle to gain an education, usually in very difficult circumstances, their previous experience has conditioned them to concentrate on absorbing material taught, often with considerable accuracy of recall, but not always with a full understanding of its practical applications. Sometimes, there also tends to be a strict compartmentalization of knowledge, one subject being regarded as a thing in itself, with no direct bearing on other subjects taught. This attitude must be broken down and students trained to seek information for themselves and to use knowledge from one topic to solve problems in another. This cannot normally be done in one single step as soon as teaching commences; the results would in some cases be complete bewilderment and considerable loss of teaching time.

In these circumstances, well-prepared class teaching must first establish the need for, or utility of, an item of knowledge or skill in relation to local environment or probable job requirements. The matter should then be explained or demonstrated in its basic concept, using simple terms and as few alternative language expressions as possible. It should also be related to local or regional conditions as closely as possible.

Where a teaching task involves a fairly complex operation, made up of several sub-operations, e.g. the task of "planting", it is important at this level of training to "set the scene"; that is, to review or describe briefly the overall task before describing and studying each of its component parts in detail. If this is ignored, it may be difficult for students to relate the component parts to each other or to determine their relative importance. A final review, linking up the parts taught and integrating them into the composite picture of the operation, is equally essential.

8.2 Student participation

Students should be encouraged to comment on or question the material being presented to them. Time should be allowed in each teaching unit for an interchange of questions between students and instructor to clarify points of doubt, or to verify for the instructor if the matter being studied has been adequately understood. However, the instructor must be careful to control question time and keep it objective, otherwise valuable class time will be lost. Where convenient, classwork should be allocated to test the comprehension of individual students and to allow additional private practice.

8.3 Lectures

The formal lecture has, in general, only a limited value in technical training. Lecturing can only be an effective teaching technique where the students are of a high level and are able to extract, from a flow of descriptions, the key material to be recorded in notes in order to reconstruct later, any detailed concept which has been presented.

The lecture approach normally requires extensive background reading by the student to supplement the information gathered in the classroom. Frequently there is a shortage of printed material at the required level, and what may be available may deal with the topic in general terms, rather than in the more detailed and specific approach required by technical students. Where students have the necessary knowledge and skills to benefit from lecture-type teaching, one might well consider whether they would not be better suited to professional rather than technical level training.

The problem lies mainly in extracting the key elements from the material presented by a teacher. The more detailed presentation of ideas with chalkboard notes, diagrams, or visual aids of various sorts, and the interplay of questions which should form part of a well-constructed lesson, is likely to suit a wider range of technical students.

8.4 Discussion

Discussion may initially be of limited value as a teaching method. Students may at first be attuned to receiving information passively, than to contributing to it by suggestions. Discussion presupposes that the participants have sufficient basic information on a topic to engage in relevant discussion, and that the material is "discussable", i.e. a matter on which a number of reasonable and valid views can be held. This in general tends to limit useful discussions to later stages in a course. However, they may be helpful in areas where working practices give an employee some discretion in his actions, e.g. times or degrees of thinning. They serve little or no purpose where techniques are precisely laid down, and any divergence from these would jeopardize the value of the work, e.g. in research procedures where results from various areas are being compared. Whilst their value cannot be overlooked, in the generally tight time-schedule of a technical course, use may be limited to selecting or planning procedures to be adopted in a group task.

8.5 Demonstrations

Demonstrations of the use of tools or instruments, or of working techniques, are an essential follow-up to classwork. In fact, they may be a primary part in teaching, and in this case the class should be held in a location where the demonstration can most conveniently be staged. If there is a considerable element of practical skill in a topic being taught, the initial teaching might well be carried out in the practice yard, or in the field, and detailed analysis of the activity and the necessary note-taking be referred to a subsequent classroom period. The use of skilled demonstrators, either highly trained workers or assistant instructors, may permit the instructor to continue a smooth flow of teaching and comment while a procedure is being observed.

Supervised practice is an essential follow-up of demonstrations, so techniques being introduced should, after an initial general demonstration, be broken into sufficiently small units to allow each component part to be practised thoroughly. This requires an adequate supply of equipment and sufficient supervisors to break the class into small practice groups, where the performance of each student can be observed. The heavy requirements of staff to carry out this type of training effectively is not always fully understood outside the immediate training organization.

8.6 Group work

Group work is valuable as an exercise in cooperation and in developing formal and informal patterns of leadership. However, it again has its drawbacks, as not all the members in a group may benefit equally from the exercise. The most able and energetic may gain a great deal. The less able or the indifferent may simply have a "free ride". Assessment of individual performance within a group activity is not easy, and the less able may gain from the general standard of performance of the more enterprising members.

The technique is of most value in the later stages of a topic, or a course, when the participants have a basis of information or experience which they can pool. It is of particular value when a task calls initially for the group to put forward constructive suggestions, followed up by a detailed study to translate these suggestions into useful activity. Tasks related to the preparation of a management plan, or the formulation of proposed activities in Community Forestry work, are often suitable.

8.7 Project work

An individual project can involve private reading, data collection, field observations or measurements; and activities such as specimen collection and examination, or raising plants. Spread over a substantial period of a course, it gives the students an opportunity to show initiative, persistence, and personal enthusiasm for the tasks they have undertaken.

One possibility is the detailed study of a tree species requiring the collection of background information, supplemented by actual observations and activities over a full year, and culminating in a written report. This is both a useful educational activity and a suitable method of gathering valuable supplementary information, perhaps not yet recorded in reference works.

8.8 Written instructions

The use of written instructions in setting out tasks to be completed, or problems to be solved, is a valuable teaching process. After leaving a training institution, a student will find that most of his directions for tasks to be accomplished, or techniques to be practised, will come as written instructions. It is essential to provide students with practice at reading and comprehending instructions in formal technical language. During such exercises, students should be encouraged to struggle with any problems of understanding or interpretation of the instructions. Instructional staff should only answer questions, or offer explanations, where it becomes apparent that the instructions are open to misinterpretation, or are too complex for them to be readily understood by particular students.

8.9 Assessments

Regular assessments of individual performance are an important part in the learning process, both for the student and the instructor. It is impracticable to lay down firm guidelines for their use, as circumstances vary considerably in different courses. Nevertheless, short "quiz" type assessments are very valuable and should be given at regular intervals during a course. They are particularly useful when one stage is, to some extent, dependent on the previous stage being properly understood.

For such assessments, objective type questions are easy to grade and students can get feedback from their results with the minimum delay. Where classes are large, there are also great advantages from the instructor's point of view, in using objective type questions in the main assessment or terminal test. This, however, deprives the students of practice in formulating ideas and putting them into their own words, which is a matter of great importance in training at this level.

Students, when learning in a language other than their mother tongue (and this happens in many countries where local languages or dialects exist), need all the practice they can get in expressing themselves freely and precisely in the official language. The use of letter grades in preference to numerical marks tends to smooth out some of the problems arising from this type of marking.

8.10 Conclusions

The type of teaching to be employed in any set of circumstances depends upon the level of the students, the stage of the course, and the nature of the topic. Flexibility and variety of approach is most easily arranged when wide-ranging courses are given broad allocations of time. Narrow courses within precise time schedules limit the possibilities of digressing or trying a new approach to a topic. An essential requirement is for the instructor to have sufficiently close contact with his class to sense if his material is being absorbed, and to stimulate his class to cross-check it against any prior knowledge they may have, or their general experience of the topic. A lesson plan, no matter how carefully prepared, should be suspended or even abandoned if the instructor can sense that it is not being properly absorbed. The ability to switch, when necessary, to a fresh approach to explain a topic which is proving difficult to understand, is a highly valuable skill in instruction.

9. LEARNING RESOURCES

Learning resources can vary from simple pieces of equipment to complex machines. Within the limited finances of most technical training programmes, and the nature and level of the material being taught, the simpler types of equipment tend to have many advantages.

9.1 Prepared diagrams

Diagrams are useful but must be used with care. They consist largely of two-dimensional symbols which a person from a culture accustomed to such things may find readily understandable, but which may be unintelligible to persons unused to expressing themselves in this way. An area outlined in green on a chalkboard may well symbolize a forest to

persons used to that convention, but be confusing to someone unacquainted with it. Logical colouring of diagrams, however, appears to assist understanding at most stages, and costs very little more than a single colour.

Diagrams should, whenever possible, be of the "build up" type, starting with the simplest concept or model, and adding information progressively as the description proceeds. Well produced overlays for an overhead projector are excellent for this purpose, but an instructor must balance the time taken to produce these against their ultimate usage. To justify the time taken in preparation, such aids must normally be used on a number of occasions. They are, therefore, best adapted to short courses repeated 3 or 4 times a year. If required only once a year, they are most valuable in areas of study where things do not change rapidly, e.g. some aspects of botany, entomology or forest utilization where the scope of teaching changes relatively slowly, rather than in silvicultural and management techniques where ideas or procedures may be outdated more rapidly, or where several alternative solutions may be acceptable.

9.2 Chalkboard diagrams

Skill in the production of neat chalk or crayon diagrams is a highly desirable attribute for an instructor. Such diagrams, built up before a student's eyes, with adequate explanation, take away much of the awe and mystery of more complex prepared diagrams, which may sometimes be difficult to comprehend and very difficult to transcribe into notes. The use of "logical colours" in all these diagrams is an aid to understanding.

9.3 Flip charts

For more complex situations, flip charts prepared in advance, especially where additions are indicated in distinctive colours, are relatively cheap and very helpful. If left in a classroom or a library resource centre for further study, they can enable students to work out the process and absorb it at their own speed.

9.4 Horizontal chalkboards

For tasks where there is a spatial element, e.g. the organization of groups in inventory or silvicultural treatment tasks, or for fire prevention, a "horizontal chalkboard" using models or counters suitably colour-coded to represent various tasks, is a more logical method of explaining procedures than a vertical board or diagram. The only limitation to this technique is that fewer students can normally see a horizontal layout than a vertical one. If this can be overcome, the more ready understanding of particular situations, and the ability to demonstrate how to move persons or items of equipment over an area, is of great instructional value.

9.5 Sand table or terrain model

A further development of the horizontal chalkboard is a sand table or terrain model. This is normally a static exhibit of strong construction, requiring a permanent space in circumstances where space is often at a premium. It involves greater work in preparation, but allows a number of solutions to any problem to be displayed at the same time.

9.6 Magnetic board

A magnetic board allows models or counters to be used in the vertical position and hence overcomes the viewing limitations of the horizontal chalkboard. The disadvantages are cost and the amount of time required to prepare the models. It is, however, possible to improvise a magnetic board using, for example, a metal cupboard.

9.7 Felt boards

Felt boards can be of particular value in teaching situations where a number of alternative solutions are possible and each one should be examined; for example, in discussing thinning or canopy opening operations. However, it takes time to prepare the various items required to illustrate a topic and the storage facilities must be both adequate and well-organized. If not, some of the illustrations tend to get lost, others become rather tattered or alternative uses are found for them. Felt boards are more suited for courses which are repeated frequently, rather than for courses held annually.

9.8 Overhead projector

The overhead projector can be a very useful aid to teaching, but to be really effective, the instructional staff require training in its use. This visual aid is particularly suitable for certain topics such as botany, entomology and soils, where illustrations can remain unaltered for a long period. With the use of a thermo-copier, it is relatively easy to transfer black and white drawings to transparency film which, with care, will last for years. It is also possible to prepare a series of transparencies, in permanent colours, illustrating various topics. Otherwise, the overhead projector can be used just like a chalkboard with non-permanent transparency marking pens. The difference is that the instructor remains seated facing the class and possibly can maintain better student control. Another technique is to fit a roll of transparency film, which makes it possible to give a series of illustrations and to refer back to the earlier ones, by simply rewinding the roller. Prepared transparencies can also be purchased with overlays and working parts which actually move. These can be of real value in connection with instruction concerning topics such as the maintenance of motor vehicles and machinery.

It should be noted that the screen must be fixed correctly above the projector, if the distortion of the image is to be avoided. Where the power supply is variable, a voltage stabilizer should be used, as the bulbs are very sensitive to voltage fluctuations.

9.9 Colour slides and film strips

A comprehensive and well-indexed collection of colour slides of field activities or operations, or of areas of a country which cannot easily be visited, can be of considerable value in supporting the instructions given. It must be remembered, however, that particularly in hot climates, not all classrooms can be adequately screened for this purpose, and if they can, they often become very uncomfortable. A good system of daylight back-projection onto a screen about 80 to 100 cm. square is valuable. Though this can sometimes be improvised, it is often difficult to get the right combination of intensity of light, short focus lens, and adequate screening round the picture, to give satisfactory viewing to a class. A well designed kit of matched projector and screen is a good investment.

Film strips, either purchased or made locally by the staff, can supplement slides where a specific short unit of instruction can conveniently be covered in this way. They normally have to be re-photographed from individual slides, as it is unusual to obtain a series of near perfect shots first time.

The task of planning and photographing a series of slides, or a film strip, as a teaching aid, can in itself be an important learning resource. It can stimulate valuable discussion on the precise point it is necessary to illustrate in each frame and this helps to reinforce correct procedures in the operation.

9.10 8mm films and film loops

Short 8mm films are of some value in initial training, such as demonstrating steps in planting or tree felling. Unfortunately, the time taken and the film consumed by amateurs to get an acceptable series of shots of a task, limits their use. They can usually only be justified when there are large classes and it is difficult to break these into sufficiently small groups for personal demonstrations in the field.

It is also possible to purchase film loops illustrating, for instance, maintenance tasks on vehicles and machinery, e.g. changing a wheel. A special type of projector, which is inexpensive, is required for projecting film loops.

9.11 16mm sound films

A 16mm sound projector, of a reliable and robust make, with good local servicing facilities is desirable. The number of films of direct teaching value on any particular topic within a country is likely to be very limited and would barely justify the cost of this equipment. Fortunately, there are usually a large number of films available of general interest which have good educational value and also provide a popular recreational facility in an institution. Some films of specific teaching value can usually be borrowed

from UN agencies through the local UNDP Representative. Films of a more general nature can usually be obtained on loan from various embassies or from cultural agencies.

9.12 Tape recorder

A tape recorder may be of value in recording instructions on tasks or field operations where the training is well-established, teaching material is highly formalized, and both staff and students are sufficiently educated to use it properly. Another possible use is in the initial stages of work-study, when practising timing. However, the dependence on aural clues, without visual clues, does not make for particularly accurate measurements.

Tape recorders can also be of value to staff for checking their teaching performance and in identifying, for subsequent correction, disturbing mannerisms in speech. Similarly, they can be used to help students train for public speaking.

9.13 Television, video recorders and video cameras

In areas where there is a well-established television network, a TV receiver may be of value, at least in a common-room or recreational area, for keeping students in touch with current national events. Occasional programmes may be of more direct teaching interest, but it is likely to be pure coincidence if these are shown at a time when they can fit in naturally to a teaching programme. A video recorder, to tape and play back such material at a more appropriate time, is of value but this normally requires the services of an assistant to record and care for tapes. A video camera can produce taped records much more cheaply than a conventional colour film camera, but cutting or editing such tapes is more difficult than with films.

Closed circuit television may be of value in enabling a large group to view a detailed operation in rather greater detail than if they were observing it normally. Regrettably, the cost of this equipment and skilled operators to use and maintain it, can only be justified in a large polytechnic-type institution where the expenses can be shared over several departments and a reasonably high degree of utilization of the equipment can be obtained.

These more expensive techniques are unlikely to find a place in the budget of a forestry school operating alone on limited funds.

9.14 Miscellaneous items

An adequate supply of 7 or 10 magnification binoculars, a loud hailer, and a supply of portable 2-way radios may all find a useful place in the teaching equipment, depending upon the needs and state of development of an institution.

The use of handouts and training manuals has been discussed in Section 6.11 above.

9.15 Library

A library is an essential feature of an educational institution and in most countries to which this manual will apply, it will have to depart from the accepted standards of accommodation and facilities which are found in more developed areas. Depending upon the standard of living accommodation available and the possibilities for study in a student's own quarters, a library may have to provide a much higher proportion of study places than might otherwise be required. It may be the only really suitable place for quiet study and up to 80% of the students may wish to use it at any particular time. The less comfortable the living accommodation, the greater the need for adequate space for study within the library.

The stock of books should also be generous. Students at this level often have neither the funds, nor the opportunities to purchase textbooks locally for their own use. Nor is there, in many developing countries, a tradition of students purchasing textbooks, using them carefully for a period and then reselling them at only a small loss, to their successors. Students, therefore, tend to be totally dependent on library resources for any material to supplement class teaching, or to widen their general knowledge.

Conditions in the library and the supply of books and periodicals should be such as to encourage reading. It is a highly desirable habit during training and it is likely to be the main means of keeping up to date with new developments after training. Also, it is a vital skill for interpreting written instructions in their subsequent duties.

The library should be provided with easily accessible card indices, by subject and author, and students should first be taught, and then encouraged, to use these to seek supplementary information on study topics for themselves.

If possible, a section of the library should be developed as a resource centre and should be the main repository of maps, charts, diagrams, etc., not in current use. Tables or frames of a convenient size to hold these items during study should be provided.

The library should also have a large general reading section to encourage reading of non-technical material. Only a person who can read sufficiently easily for pleasure is ever likely to tackle more serious reading for self-improvement. A number of international cultural agencies are usually able to assist in lending books to stock a general reading section.

The importance of a library as a learning resource and the high cost of books and other material and equipment housed in it justifies the employment of a professional librarian. This person should enjoy the same status and conditions of service as the teaching staff. The librarian's function should, in fact, be regarded more as a teacher than as a custodian of books.

In the early stages of the course, the librarian should play an active and significant part in teaching students how to make the fullest use of the resources available. Later, during individual study projects, the approach should be different, students being encouraged to locate information for themselves by showing how it should be done, rather than directly supplying information on a topic.

The librarian can also be made responsible for the audio-visual aids and for reproducing handouts. A further duty might be, if suitably qualified, to conduct remedial classes in the teaching language of the institution.

10. DURATION OF TRAINING

10.1 General considerations

Briefly, training should normally be as long as a country can afford in its current financial and personnel circumstances, also taking into account the level of technology being practised in the field at that time. A vital factor frequently overlooked by educational planners and teachers from more developed societies, is the very limited cultural base (judged in external terms) from which students start.

10.2 Level of entry in relation to the local community

Students in developing countries are often educationally well in advance of their parents and are, therefore, unable to receive from them the informal education common in developed countries. Whilst students may have a considerable amount of local culture or information, which some teachers may not always be fully able to exploit, they tend to lack many aspects of knowledge or experience which are accepted as normal elsewhere.

Skills of reading to seek out information, as distinct from memorizing for examinations, or the use of mathematics to solve everyday problems or for budgeting purposes, are frequently poorly developed in basic schooling and take time to build up during a course of technical education.

10.3 Level of basic education required

The duration of training to achieve specific objectives depends largely upon the level of basic education required at the entry point. However, the level required and the duration of training permitted by the administering agencies, tend to depend more on

general views held about education and comparability with other disciplines in a country than on any objective assessments of the requirements of a technical post in forestry.

Comparability with technical courses in other fields, such as agriculture, often limits a forestry course to a specific period, of which 2 years seems, at present, to be a widely accepted limit. Working back from the ultimate objectives of the course, it then becomes necessary to require a fairly high level of basic education initially, to enable candidates to reach the required final level within the prescribed period. In many countries, 12 years of basic education now appears to be the accepted norm.

Lower levels of basic education would in many cases be acceptable, if a longer period of technical training were acceptable. The final product might not be so well educated in a general sense, but might well be more technically competent and experienced in the student's particular field. The choice, therefore, depends upon the value placed locally on a fuller general education, with possibly more limited technical abilities, or more limited general education, but a longer technical course. A further factor influencing this decision is the possibility of trainees widening their basic education later, by continuing classes once they have entered full-time employment. This, unfortunately, is likely to be more difficult in rural areas where many forestry technicians will normally be stationed. Hence, it provides a strong argument in favour of high entry level initially.

10.4 Dangers of a too high educational threshold

Where a country insists on a full basic educational course up to university entrance standard, as a prerequisite to technical training, the technical course sometimes tends to draw in a proportion of "missed university" applicants looking for some alternative training. This is not necessarily a good basis for recruitment, as students may have failed university entry due to some deficiencies in teaching or learning over the last one or two years in school. If this is the case, it does not provide a solid foundation for further study. In fact, time is likely to be wasted in the early part of the forestry course providing a basic study programme to bring them up to the level they were presumed to have reached, and on which the rest of the course is to be built.

It may also tend to draw in a certain proportion of candidates who are not truly technically oriented, but are anxious to proceed later to some form of further education and see the forestry course as a means to an end. They are unlikely to remain in forestry, even if they graduate successfully.

10.5 Problems with a range of academic levels

There can also be problems with a wider range of academic levels in these circumstances. A few students may be at or near university entrance level, whilst the majority of the class are below this level. Teaching devised to develop the abilities in the lower range may cause boredom to the more able students and lead them to perform less well than they might. On the other hand, if encouraged, they can provide a stimulus to the less able students.

10.6 Deficiencies of a 2-year course

Technical training following a full 12-year basic education must, in most cases, be limited to 2 years' duration, both for economic reasons and in order to avoid overlapping with a 3-year university first degree course. Whilst 2 years may, in some cases, be adequate for training, a large part of the time must be used in acquiring new information and experience. Hence, there is a danger of a relatively small amount of the time available being devoted to using this information in situations closely resembling working conditions. Students are, therefore, inclined to go out deficient in experience in applying all the technical knowledge gained, unless the course is carefully planned to include work experience. This may mean that classwork should not exceed 55% of the total time available.

10.7 Additional problems in acquiring practical experience

Whilst it would be ideal for students to gain practical experience before commencing their training, it is not easy to persuade them to do this. The local concept of the benefits of education may be against students involving themselves in manual work. Therefore, students at this educational level are very likely to enter fresh from school and lack any understanding of either the requirements or nature of the course they are about to undertake. There are also distinct practical difficulties in arranging field training in some areas. The living conditions of the local people may make it difficult for trainees to find acceptable living accommodation in areas in which they are posted. Also, the wide social gap which sometimes exists between workers and educated persons may be hard to bridge.

10.8 Alternative entry level

A course of technical education commencing after 10 years' basic education may have distinct advantages. This assumes that the organizers have a clear understanding of the educational level of the intake, have formulated specific goals for the training, and are prepared to allow sufficient time to attain these goals. In countries where less importance is placed on completing a full academic programme of education, a technical institution is likely to attract a large number of suitable candidates at the 10-year educational level.

At this stage, it may also be easier for a student to integrate into a programme of pre-school practical work, especially if some care is taken in selecting the location for the work and in arranging satisfactory living conditions. A group of 2 to 4 students living and training together can provide mutual support and exchange of experience. A year spent in this way followed by an extension of the basic course to 3 years is more likely to equip a candidate to take over the responsibilities of a field appointment than 12 years' education followed by 2 years of technical training. However, it may be necessary to consider the implications in respect of government salary scales, which are often related to both technical qualifications and the level reached in basic education.

Another problem which may also arise if entry is allowed at the 10th year level is that of the exceptional students who are clearly capable of higher education. Unfortunately, they will not have the requisite educational level and may be required to undertake a further period of 2 years' general education to gain entry. In an area where there are many 12th grade students available, it may be extremely hard to obtain sponsorship to undertake these additional studies, no matter how technically competent the candidate has been. However, this problem is unlikely to arise in more than a small percentage of the students, say, 5-10% at the most, and therefore the bulk of the students will be correctly located at the technical level. Special arrangements should be made, if possible, for the top students, as experience has shown that university graduates with previous technician training can make very valuable contributions to the development of forestry.

The above proposal could work, provided there is an adequate career structure for technicians. This must recognize that a competent and experienced technician is often of greater value than a fresh graduate and the rewards be adjusted accordingly. Otherwise, the educational level of entry for forestry technicians may have to be comparable with other technical training, in order to gain recognition for salary purposes.

10.9 Job requirements

The duration of training must also take into account job requirements and any firm policy for continued training during service. In the initial stages of forestry development within a country, where the main field tasks centre on demarcation and protection of a forest estate, a relatively short course, of about one year, may be adequate. This should concentrate on surveying and the physical protection of forest areas.

As the situation develops, simple inventory techniques, logging skills and some silviculture must gain prominence in the course. Further developments usually call for more detailed studies of inventory techniques; a broader field of utilization and engineering studies, including road-making and simple construction; and a wider range of silvicultural

skills and management and administrative techniques. For this, a course of 2 years is the minimum requirement and many candidates would benefit from an even longer period of study to absorb the material offered.

10.10 Possibilities for specialization

In most countries technicians are, at least initially, expected to undertake a wide range of tasks and are unlikely to be able to specialize for several years. Where the employing agency is poorly staffed, it is of considerable importance to have technicians with broadly-based training, who can be posted wherever a need arises. Even where the range of technical tasks may initially be limited, training should be geared to widen these limits as quickly as possible, to exploit the full potential of the area.

As a country reaches an adequate level of technical staff, more attention can be paid to providing alternative programmes of study to fit candidates for specific vacancies within the employing agency. This may result in a reduction in the length of training for some tasks, but generally the time saved can be better used in improving the level of training in the chosen field.

A high degree of specialization is, however, undesirable initially, as it may deprive candidates of the wider understanding of the full relationship of forestry to the biological and social factors, which is necessary to pursue their specialization effectively. It may also condemn a candidate to a very narrow promotion channel. Specialized skills may best be imparted in refresher, or further training courses, to staff who have shown themselves competent over a wide range of tasks, and who have indicated a genuine interest in tackling a more specialized activity.

11. ENTRANCE QUALIFICATIONS

11.1 Level of general education

As suggested in Section 10.3 above, the level of general education for entry to a technical training course is more likely to be determined by the entrance requirements of the authorities for similar technical courses, rather than in relation to the specific requirements of a forestry course. Where substantial progress is being made in the field of secondary education, an entry point at Grade 12 seems to be the accepted level. The actual attainment in the Grade 12 assessment, however, normally lies in a band immediately below university entrance level. If possible, a procedure for accepting exceptional candidates who have not achieved this level, but who have shown in some other way a particular aptitude for forestry work, should be devised. This, however, may not be acceptable in certain countries where it may be hard to demonstrate the objectivity of the choice of a particular candidate.

Other measures may be necessary in areas where the school system may not be meeting the full requirements of government service and industry at the Grade 12 level. In such cases, it should be possible to devise a forestry course which can accept candidates at a lower level of general education, say, down to Grade 10. These courses will be longer than the usual technicians' course, in order that the required level of attainment, at least in technical operations, can be reached by the students.

11.2 Physical fitness

A reasonable standard of physical fitness is required, though this is hard to define in non-medical terms. Candidates should be free of any active disease, or injury, which would impair their ability to carry out any of the necessary physical tasks involved in the course. A reasonable record of resistance to common illnesses and some evidence of stamina, rather than great strength, is desirable. Any prior history of mental or emotional disturbances should generally be regarded as a serious disadvantage for the commencement of a strenuous course of training. Forestry work however is, in general, so varied that a wide variety of different degrees of fitness can be accommodated, and there is no particular need to lay down specific height, weight or size attainments, such as may be required for police or military service.

In areas where female candidates are accepted, the standard of fitness required must take into account whether or not females are going to be interchangeable with male candidates in all tasks. It is possible that they are more likely to gravitate into some less strenuous tasks associated with silviculture, mensuration or research. They should not be excluded by any attempt to set unreasonably high standards of fitness or strength that only a few could attain.

11.3 Aptitude and integrity of trainees

11.3.1 Assessment of aptitude

An aptitude for the work, and a willingness to persist in it, even in difficult circumstances, may best be judged by a period of pre-service training, rather than by a contrived 2 or 3-day test course before selection. Unless such a course is devised with considerable skill, and monitored by trained personnel, it may highlight the extrovert type, but may miss the more consistent performer who could ultimately be of greater value to an organization.

Any procedure for measuring a candidate's aptitude for training is complicated by the very wide range of skills a forestry technician may be expected to demonstrate. Simple tests of manipulative skills, such as may be used to screen candidates for machine-operator posts, cover only a very narrow band of the skills required. Complex tests of leadership and judgment, usually employed to screen military cadet candidates, are costly and difficult to apply with the limited staff available. With forestry too, it has to be remembered that devising relevant tests can be expensive in relation to the small number of candidates which most countries wish to train each year. Furthermore, it is difficult to place a relative value on the different aspects of skills which are shown.

11.3.2 Judgment of integrity

Integrity in this sense means not, for example, honesty in the handling of funds or property, which in any case would be very difficult to assess (unless a candidate had a criminal record, and this is rather unlikely). It refers to honesty or genuineness in the candidate's desire to enter and pursue effectively the set course of training and a subsequent career in forestry.

To attempt to judge a candidate's integrity in seeking training is extremely important, but is by no means easy to achieve. In an economy offering a relatively low proportion of the population safe and secure employment, as against self-employment in agriculture or rural crafts, there is often a very high desire to commence training for any apparently secure post, particularly in the public sector.

Forestry training institutions may, therefore, receive too many applications, some of which come from candidates who have little or no concept of the requirements of the training or subsequent employment, but who are willing to invest the cost of a postage stamp in submitting an application. As most candidates may be fresh from school and have had little opportunity to gather any knowledge of forestry activities, it is almost impossible to determine which ones are genuine applicants and which are simply job seekers. Until a forestry organization is reaching a stage of adequate staffing, however, it is very difficult to adopt any procedure other than direct entry to training, because of the need to build up the staff as quickly as possible.

In areas which are grossly understaffed, the general level of performance of field work may be so low that it will be counter-productive to introduce new candidates to such an unsatisfactory level of performance or organization. On the other hand, where an organization has reached, or is closely approaching full staffing, there should be adequate opportunity for placing new candidates in the field to gain work experience. Ideally, experienced staff should be selected to supervise their work and to comment objectively on their suitability for more formal training.

11.3.3 Pre-service training

The length of pre-service training is likely to be affected by the general school programme of the country. Candidates are normally selected as soon as the results of

the national scholastic examinations are known, in competition with other training institutions. It is administratively convenient, but by no means essential, for forestry institutions to follow the normal academic year of the country. If this is the case, a full year's pre-service experience is most likely to be adopted. If the training institution draws its candidates entirely from those with pre-service experience, it can commence its academic year at any season, and any length of pre-service training from 3 to 12 months or more can be adopted.

There are many advantages in arranging a course to end during a quiet season of the field operations. This enables the graduates to be appointed, to take up their duties, and to become reasonably acquainted with their new surroundings and tasks, before having to face a peak work requirement. If possible, the pre-service experience should cover the full range of seasons. This particularly applies if class teaching is to be closely linked to, or partly dependent upon, the field experience. Some candidates might benefit from a longer period of experience and should not be ruled out from further consideration, if not selected for training at the first opportunity.

11.3.4 Links with training institution

One possible drawback of a period of pre-service training is that the supervision may be weak and the programme of work inadequately planned. If this is the case, the candidates may fail to appreciate the value of the experience, or to make the fullest use of it. This can be overcome by establishing, right from the start, a direct link with the training institution which they will ultimately attend.

If possible, the candidates should attend a short introductory course in physical and manual skills at the institution. They can then be sent out in groups of 3 or 4, to selected training locations, possibly moving through two or three such locations during the period of training. The candidates should be required to submit detailed monthly reports on the work they have done and may be supplied with record sheets to collect data on rates of work and costs of operations. They should be encouraged to look closely at each task performed, and to use these sheets as a basis for management proposals in their formal training. A "correspondence course" situation, supervised by a number of instructors at the training institution, can help the candidates to make the most effective use of their time. The instructors should visit the students once or twice and accompany them to work. This will also enable the institution to weed out unsuitable candidates and should bring in students with relevant practical experience on which further training can be based.

This system, however, will only work if the general standards of performance in the field are sufficiently high. It is an extremely difficult task for instructors in an institution to rectify bad working techniques picked up in a poorly supervised situation.

12. SCHOOL BUILDINGS

12.1 Size in relation to staff requirements

The total establishment of technicians in a country must be determined by the application of agreed staff ratios to areas of plantation establishment and management; high forest management; industrial requirements; multiple-use forestry and ancillary activities such as are suggested in Appendix 4 dealing with the assessment of trained manpower for forestry and related industries. Where such a study indicates a short-fall in technical staff, either at the present or at some future time, a rate of build-up towards the target total must be decided, taking into account the annual increase in resources likely to be available to absorb qualified candidates into field posts, and an optimum size of class for efficient and economic teaching. To this must be added an annual allowance for deaths, retirals and resignations from the existing staff.

Perhaps the greatest problem lies in fluctuations of the economy over the time-scale when trainees are in the "pipeline", i.e. between pre-training practical experience and qualification. This in some cases may be 3 or 4 years. Fluctuations in the national economy leading to a reduction in the number of new posts created annually, or to a deferment in the filling of vacancies, plays havoc with a planned training programme. At such

a time, even the possibility of holding candidates over in lower grade field posts until vacancies arise at their correct grade, is limited.

During a period of increase in the establishment, the staff of an organization tends to be weighted towards the younger age groups, and a normal pattern of replacement, based on a percentage retirement and wastage is hard to define. A certain "frustration element" is likely to enter into the calculations after a few years. Some staff may resign in mid-career to seek other opportunities, if they find themselves one of a large group competing for relatively few vacancies in higher posts. If a "bonding system" applies to new entrants, departures during the period of bonding are likely to be very low, but this may be followed by a surge as soon as the bonding period is over. The surge effect tends to decrease with the length of the bonding period. It would seem that the incentive to make a change is decreased as length of service and salary level are increased, unless problems of limited promotion prospects arise.

In spite of these difficulties, it is necessary to establish some pattern of retirement and wastage for an organization, in order to plan the intake for training. Initially, the information on which this is based may not always be as accessible or as precise as one would wish. However, during a period of growth of an organization and within a relatively stable or modestly expanding economy, a replacement factor of 10-15% annually of the existing staff may be considered adequate. During periods of very rapid expansion of the economy, this rate may double, but few countries can sustain such boom conditions for long. Provided that detailed personnel records are maintained, it should be possible, at a later stage, regularly to analyze details of staff retirements and wastage, in order to provide more accurate forecasts of the replacement factor.

Nevertheless, even when more accurate information is available, a problem still remains in balancing the staff requirements of the organization with the training considerations of the institution concerned. From the organization's point of view, it is a question of providing sufficient trained technicians over a reasonable period of time, to meet any planned increases and the annual replacement factor. From the training angle, it is a matter of forming classes which are economic, can be handled by the staff available and are likely to be absorbed smoothly into employment on completion of their training. A class of about 20 is the minimum acceptable, if staff costs are to be kept within reasonable limits. Classes of 30 or, in exceptional cases, up to 40 can be taught by an experienced instructor, provided that a number of assistants are available to break the class into groups of about 8 students for practical exercises. The larger the class, the less direct contact between instructor and individual students, and the less possibility of giving detailed assistance to those who most need it.

When the requirements for trained staff are extensive, multiple classes taught in parallel streams are necessary. Large classes of 70 or 80 students cannot normally enjoy the close contact between student and instructor desirable for teaching at this level.

Up to the size limit of a single stream (say, 40 students), any rise and fall in numbers required is a relatively minor matter which can be dealt with by small adjustments in the number of assistants and in the supply of equipment. When the annual requirement exceeds the efficient level of one class, the decision to follow a double (or even treble) stream pattern of education involves considerably greater expenditure, and the commitment of more experienced staff as instructors. It also involves major problems in planning and executing practical exercises, especially those involving travel. This cannot be undertaken without some very serious consideration of trained manpower requirement forecasts or projections, to ensure that the double or treble streams will be required for a sufficient number of years to justify the cost. The use of less highly trained staff on certain tasks may reduce the need for fully trained technicians. Expansion to double or triple streaming for a limited number of years can only be justified, if there is a long-term programme of continuing education by refresher, or upgrading, courses to utilize the surplus capacity when multiple streams are no longer required.

In large countries with varying ecological zones, two or more smaller schools, concentrating on topics appropriate to the particular zone, may be more efficient than a large central organization trying to cover all variations of ecological conditions.

12.2 Purpose-built schools

There is a great need for properly designed schools for technical training in forestry but, unfortunately, their requirements have seldom been quantified. Hence, architects usually have little appreciation of the particular needs of this type of establishment. Furthermore, any suggestions which are offered during the design phase may be regarded as an instrusion into the sphere of their professional competence. They frequently offer a modified secondary school concept of building, resulting from familiarity with such designs, or scaled-down lecture theatre facilities rather than a design based on a thorough study of the particular needs of a technical course.

The World Bank recommends as suitable guidelines for space allocations the publication "Accommodation Standards for Educational Buildings" (revised 1977), published by the Building Research Establishment, Department of the Environment, London, England, U.K. Some relevant, but slightly modified figures, from the section "Colleges of Further Education" have been quoted in Appendix 5. The modifications are based on world-wide experience in teaching at forestry technical level.

Classrooms are important and must be of such a size that they permit, and encourage, student activity rather than passive learning. Small, individual desks are of limited value, other than for examinations. Chairs with a small writing area on one arm are even less useful at this level of teaching. Larger tables for one or two persons, but light enough to form into sets of two or more to allow groups to spread documents, drawings, maps or botanical specimens over a wide area, are the best. As group tasks should be a regular feature of training, the design and construction of furniture and the size of room should be related. The floor area should be sufficient to permit 8 groups to work simultaneously on joint tasks, in reasonable comfort, with sufficient space between groups to give some sense of privacy. A table-top area of $0.45m^2$ and a floor allowance of $2.5m^2$-$3m^2$ per person should meet these requirements.

Classes should be designed, as required for planned intake, in the range of 20 to 40 students. For laboratories, a higher space allocation of about $4.5m^2$ per person may be necessary to allow for side benches and adequate storage space. Provision should also be made for preparation rooms and equipment stores, directly accessible from the laboratory, at a level of about 15% of the teaching space in the laboratory.

Space allocations such as these may seem generous at the beginning, but it is not uncommon for an institution to be pressed to increase its intake at some stage in spite of careful forward planning, and these initial allocations may make it possible without too great inconvenience or disruption of the teaching programme.

A building design based on a repeated reinforced concrete pillar and beam module, of, say, 3m length and 8-9m span, is useful in that partition walls can be non-load-bearing. This means that they can be moved at intervals of perhaps 1m, if the requirements of the teaching change. In general, the length of the classrooms should not exceed 1.5 times the breadth, but there is some value in having moveable partitions between some pairs of rooms. This allows for the occasional use of double-size classrooms by guest lecturers, for securing adequate dispersal of candidates during examinations, or for certain tasks such as exhibitions, which require unusual amounts of space.

12.3 Shape and layout of academic and administrative buildings

The shape and layout of any particular group of buildings is very much dependent upon the site available and on the artistic or professional merits of the architect employed. Architects generally want freedom of expression and are not over-keen to accept suggestions from lay clients; therefore it is advisable to give a carefully thought-out and detailed brief. Important points to decide at an early stage are whether to favour a single or multi-storey building and aim at a compact layout, or accept some degree of dispersal to take advantage of particular site factors.

For a single stream institution with classes of up to 40 students, a single-storey layout is likely to prove to be the cheapest and most efficient. In this case, a T-shaped layout provides a very compact design. The classrooms, library/herbarium and laboratories can form the top of the T, with the administrative and storage accommodation located in the base. A circulation area is desirable at the junction of the two areas.

For a larger institution, still on a single-storey plan, an H-block layout or a rectangle enclosing an ornamental courtyard, may prove more suitable. The centre bar of the H can contain the library/resource centre and a herbarium/museum, whilst one side can be devoted to classrooms and the other to laboratories and a small assembly hall or auditorium. Office accommodation for staff can be incorporated in one of the wings.

Where high temperatures and humidity are experienced, it is most convenient to arrange rooms in a single line to allow ventilation from both sides. In cooler areas, the layout can be made more compact by having, say, classrooms on one side and offices and stores on the other side of a central corridor, in either an H or a T format. This, however, involves a wider roof span with greater problems of construction or the need for load-bearing partition walls, which limits the possibility of rearrangement later.

A double-storey design is probably best for a multi-stream institution, as it enables both teaching and administrative accommodation to be kept within a reasonable ground area. Office and storage accommodation and a library/resource centre can be located on the ground floor, and teaching accommodation and laboratories on the upper storey. In this case, except for the library area, a layout of rooms on either side of a central corridor is desirable to avoid an excessively long and narrow format. If teaching accommodation is confined to the upper floor, external verandahs or circulation spaces between classrooms are necessary to allow relaxation between classes.

Staff office accommodation always represents a problem. Individual offices for all staff members are costly and result, generally, in small and cramped cubicles in order to achieve a reasonable level of economy. Whilst the principal and certain senior staff may warrant individual offices, where they can discuss matters with assistants or students in privacy, 2 or 3 assistants sharing a more spacious office is not undesirable and can be beneficial. In the first place, not all are likely to be using it at one and the same time and when they are, some degree of inter-communication and discussion of activities can be established.

Adequate storage space, such as cupboards and filing cabinets in the offices, and small storerooms for easy access to teaching materials are essential. This helps to minimize delay and disruption to classes when additional supplies are required during teaching. The layout should also incorporate adequate general storage space, so that materials can be easily classified and issued with the minimum of delay. Office accomodation should also be provided for a storekeeper, in order that adequate records of stocks, issues and costs can be maintained.

The buildings should incorporate toilet and washroom facilities for both staff and students, so that a switch from practical work to class activities can easily be made.

12.4 Student dormitories and catering facilities

Careful consideration should be given to the layout and design of the student dormitories and associated catering facilities. As with the academic and administrative accommodation, single or multi-storey buildings can be used, depending upon the site and/or the size of the institution. Scattered, one-storey buildings are normal for smaller institutions or where there are amenity considerations. For larger institutions, two- or three-storey blocks are preferable, as they economize in space and reduce maintenance costs.

The student dormitories and catering facilities in the smaller institutions should form a block at a convenient distance from the classrooms and offices. Recreational facilities should also be included in this block and usually a sick-bay or first-aid room. This type of layout may not always be possible with the larger institutions.

12.5 Staff quarters and other buildings

The staff quarters should be included in the layout of school buildings ideally within walking distance of the academic and administrative block. Different types of houses will be required to meet the needs of both instructional and administrative staff. Details are given in Part II of the manual.

Other buildings which will have to be provided include various categories of workshop, tool stores, and possibly a small sawmill. When siting these buildings, great care must be taken to ensure that any noise arising will not distract students in class or administrative staff in their offices.

12.6 Landscaping of school grounds

When the layout of the school buildings is being considered, careful thought should be given to obtaining maximum educational benefits from the landscaping of the site. Possibilities may exist for retaining individual trees, or groups of trees, which can be utilized in teaching such subjects as forest botany and forest mensuration. Similarly, outcrops of rock can be useful, if geology is included in the curriculum, and examples of vegetation types. Space should also be left for planting specimen trees and for bringing in logs for timber measurement.

Other features to consider are groups or belts of trees for screening buildings, reducing noise and acting as dust filters. Likewise, amenity areas with trees, shrubs and plants should be planned to enhance the site. The establishment of a school garden may be another possibility, as this can be used to reduce food costs at the institution. It could also have an educational value in showing students how to produce their own vegetables. Space might also be available for fruit and nut trees and, in certain countries, fish farming could be introduced. To sum up, given space and time, it should be possible to obtain a wide range of educational benefits from the school grounds.

13. CONTROL OF TRAINING

This is more likely to be determined by the policy of a particular government than by an objective consideration of training needs and goals.

13.1 Centralized institutions

If a government tends to favour large centralized polytechnic institutions, it is almost impossible for forestry training to hold out as an individual organization. It tends to be absorbed into a large agricultural or biologically based institution. While there may be benefits in having this broad perspective on training, numerically the forestry sector is likely to represent only a minor part of the institution and both staff and students may feel that the special needs of their studies receive limited attention. Though they may gain in some respects from the ability to share common staff and services, they may lose in other ways.

This is particularly true in respect of providing the practical exercises which are required to make students competent performers in the skills, as distinct from "knowledgeable" in the various forestry subjects. Even where facilities are available in a forest site a few kilometres distant, the proportion of time spent in travelling in relation to the actual practice achieved may be disproportionate. Within such large institutions, individual departments can rarely control transport of their own and must rely on a pool of vehicles, which makes trips at short notice very difficult to arrange.

13.2 Departmental institutions

If the emphasis in training is placed on an ability to carry out a range of particular skills in order to tackle problems in actual working environments, i.e. to be adequately prepared to take over a field charge immediately on qualification, then there is a strong case for placing the training under the main employing body. Also, the school should be located in an area where facilities for realistic practical training are readily available.

If the training is controlled by the forest authority, it is likely to be more closely related to the particular requirements of the authority and to be more flexible to the changing emphasis and needs of the service. On the other hand, should the control be in the hands of a central educational organization, or a large inter-disciplinary institution, there will be a tendency to "straight-jacket" courses into specific time units to achieve comparability with other courses. In other words, the requirements of tidy educational administration may take precedence over the wider needs of the training.

Another aspect to be considered is that many forestry topics are "weather dependent" and this does not suit the long-term, pre-planned programmes of the large educational institutions. In smaller institutions, some syllabus and programme flexibility can be allowed to ensure that subjects are taught, and experience gained, when weather conditions are most suitable to the task.

13.3 Control of small institutions

One defect of a small institution may be that it is too self-oentred and that the training may go ahead to the satisfaction of the staff, but not necessarily of others. A good "advisory board" of experienced field staff, well acquainted with current needs and probable future trends of operations, and realistic in their assessment of students' and staff's capabilities, is therefore desirable to review curriculum content and suggest modifications. Their task should be to guide the general direction of the course, in order to meet the needs of the employers and to maintain a proper balance between the many topics clamouring for attention. Their function should not extend to the day-to-day running of the institution, which can only be planned and executed by the staff who are in daily contact with the students. In a situation where the standard of training is still low, it may be difficult to find field staff of a sufficient degree of maturity and experience, to form such an advisory board.

Budgets and major equipment purchases should be initiated by the institutionsl staff, but screened by the advisory board before being incorporated into the budget of the organization. Day-to-day allocations for expenditure on training needs should be agreed with the board, on a "per capita" basis, and a senior staff committee left to decide allocations between sections of the institute and day-to-day purchases.

13.4 Relationship with university education

Possibly the least satisfactory solution is to have technical training in forestry incorporated in a university programme. In the first place, university staff are trained to a high professional level and oriented normally to research rather than teaching; in the second, they usually lack knowledge and basic experience of the range of technical skills which the technician requires. In this environment, experienced forest technicians who could contribute substantially to the training, are usually relegated to a low, non-academic status and in consequence feel largely undervalued. The overall result is that the course tends to be a watered-down version of a degree course given to candidates below degree entry level and largely ignoring the specific requirements of technical skills. Also, the right of a technician to value and take pride in these skills is ignored.

University and technical training must, therefore, be recognized as being separate entities, with very different staff and training requirements. Nevertheless, they are complementary and close liaison should be maintained, where possible. Such liaison should have maximum use of existing training resources as a primary goal and a general improvement of the standards of training at all levels. In order to bring about improvement, it may be advantageous to establish a National Forestry Education Council, at which employers, educators and trainers, at all levels, can be represented. The forest technician schools, for instance, may be able to offer practical courses, such as the use of chainsaws, to university students during their vacations. Such courses, in the first instance, could lead to better understanding between professional and technical students. Ultimately, after the students graduate, they could bring about good working relationships in the field.

14. LOCATION OF SCHOOLS

14.1 Social factors

The location of an institution is normally influenced by the general development of a country. Where there is a marked trend towards urbanization and a high value placed upon the amenities of life in larger centres, it may be difficult to locate an institution in a rural area, even though this might provide the best environment and facilities for training. The problem lies not solely with the students, but more often with the staff or - more correctly - with their wives. In these circumstances, wives are often more reluctant to

give up the amenities of urban living and can often use the problems of shopping and the education of children in rural areas as reasons for staying in the centres of population. This inevitably leads to instability and a quick turnover of staff.

Where the process of urbanization has not yet advanced strongly, it is easier to locate a school in a rural area and provide satisfactory living standards for both students and staff. Overall, possibly the best location for a forestry school is on the outskirts of a small town which is in close proximity to large-scale forestry operations. Ideally, the town should have most of the facilities which modern living demands, such as supply of electricity and piped water, schools, shops and a hospital.

14.2 Level of development of forestry

The general development of forestry within the area or country is also a relevant factor. If there is still a large programme of surveying, inventory, or other field management activities requiring staff to spend long periods working in remote areas, it is desirable to mirror this in the students' training, so they know what to expect in their work situation. If forestry has progressed towards a more industrial atmosphere, with plantations feeding industries in close proximity to manufacturing communities, there may not be the same need for training in rural living. In this situation, the staff may be able to live in centres of population and travel, as required, to the field.

14.3 Source of student intake

Another consideration is the fact that in many countries there is likely to be a preponderance of town-bred students in the forestry institutions. This arises because the towns provide the best educational facilities, and students from these areas tend to do better in a competitive entrance process, if formal education plays a major role in it. In these cases, an introduction to rural living and experience of providing one's own entertainment and recreation is an essential feature in training. This can best be provided in relatively small institutions in a rural area.

14.4 Constraints on location in rural areas

One drawback of a small school in a rural area is that it may lack the services of good mechanics, carpenters, electricians, plumbers, etc. from the surrounding area. In these circumstances, the institution may be forced to make alternative arrangements from its own resources, often at considerable cost. A positive feature, however, is that it brings students into closer contact with the problems of maintenance of these services and this may be of value to them later when posted to remote stations.

15. TRAINING AND EMPLOYMENT OF TEACHING STAFF

15.1 Selection

Ideally, a candidate for an instructor's post in a technical institution should have a minimum of 2 years' experience in the field, after qualifying from a similar course. This may be increased to 5 years, if the employing organization is well developed and can provide a wide range of experience for a candidate over these years.

In cases where crash training programmes are required, the minimum period of field experience may have to be waived. It should be remembered that if this takes place, for the first year the new instructor will be at a great disadvantage, as it is difficult to exercise authority over a class who were his or her contemporaries only one year junior. The first year of service in these circumstances is, therefore, often unsatisfactory to both teacher and employer, and a direct posting from student to school staff should be avoided.

Selection should, whenever possible, be made from candidates who have volunteered for the work for genuine reasons of interest, not because it may appear to provide easy living conditions, or a short-cut to higher education. This should not rule out the selection of certain candidates who may appear to their former instructors, or to their supervisors, to have some special aptitude or qualities which would be of value in a training situation.

15.2 Induction

A candidate for a teaching post with limited field experience is best engaged as a field-work instructor and should only be given limited classroom responsibilities for at least a year. This enables the institution to assess if the person has any aptitude for the task, and is willing to accept the self-discipline of regular and consistent work which is required of a teacher. During this period, the head of section should give the new instructor some tuition in preparing and conducting demonstrations and in supervising groups of students. The criteria for assessing performance in field work should also be explained and the instructor required to practise on students engaged on practical tasks.

A candidate with a longer period of field service can pass through the stage of demonstrator and field instructor more quickly. Just sufficient time to gain some confidence in the work and to adjust his or her level of instruction to that of the students should be allowed. Thereafter, a limited programme of class teaching can be undertaken, in a familiar topic, under the guidance of an experienced staff member.

15.3 Further development

If a candidate shows aptitude for teaching, a decision must be reached as to whether his or her basic knowledge is sufficient for teaching duties to be undertaken, or whether further training is required. In areas where educational programmes are highly developed, a teacher may not be regarded as qualified unless in possession of a Bachelor's or even a Master's degree, though the latter may be of very little relevance to the work of a teacher at the technical level.

If such higher qualifications are required, a period of 4 to 5 years may have to be invested in the further education of a staff member required for a teaching post. Subsequently, there is likely to be a reluctance to move the instructor out of the training field, because of the investment. This, inevitably, limits the working experience of such staff and builds a degree of obsolescence into the training programme, unless periods of sabbatical leave, or further study in the field, can be granted.

Where education is controlled by the employing authority, and located in smaller institutions, it may be accepted that a period of work experience, or a short course of study in a country at a more advanced technological level, can provide adequate initial preparation. This involves a much shorter and less costly programme which is more relevant to field operations, and makes a later transfer from training to field duties less of a loss to the organization. It also allows more time for formal training in the techniques of instruction and use of the related training facilities.

15.4 Pedagogic training

It is most difficult to locate suitable educational establishments for training forestry instructors. A general teacher training programme at secondary school level is of limited value. The candidate is "odd man out" in his class and busy lecturers can seldom tailor his assignments or programmes to be of any real value to him, other than in some general principles of teaching. He must, therefore, take his chance in the general programme and derive what benefit he can from it, adapting newly-acquired knowledge and skills to his field of training.

Fortunately, one organization providing specific programmes for training instructors in forestry institutions does exist, at the Centre for Forestry Education Development, Los Baños, Philippines. In this centre, which for the time being caters only for candidates from Asia and the Southwest Pacific region, a six-months' programme provides for a period of study in educational science, backed up by further training in specialized professional areas that have been identified for individual course members. Work is also carried out on the preparation of a special teaching programme related to a selected topic. It is hoped that similar institutions will be established in other regions and that they will gain from the experience acquired from the pioneer work carried out at Los Baños. It should also be mentioned that in some of the more advanced countries there are courses for training technical teachers. However, the number of places available is limited and, again, the course curriculum may not be entirely related to the requirements of a forestry instructor.

If difficulties are found in locating suitable formal courses for training the instructors, a short-term solution is to arrange for a training team to visit the institution and give courses on teaching techniques. The team members should be experienced teachers and can probably be recruited from a local teacher training college or a technical institute. The course duration can be in the region of two to three weeks, with follow-up visits later, once the instructors have gained some teaching experience. Provided that the training team members are well-experienced and enthusiastic, it is surprising how much the new instructors can be motivated towards good teaching practices. Later on, this initial training can be supplemented by longer periods of study, as suitable courses are located or established, and as funds or fellowships are made available.

If the above measures are not possible, there remains "on-the-job" training. Such a programme can serve very well, provided that the workload of the supervisor makes time for training an assistant, and provided that there is adequate rapport between the senior and junior members.

Initial tasks can involve a review of class teaching on which the assistant's practical work classes are based. The assistant can be set specific tasks of studying recent library acquisitions, journals or internal circulars, to determine if the content of the training programme is fully up-to-date. He may then be given tasks of revising diagrams or illustrations used in class teaching and asked to suggest ways in which current ideas can be more skilfully presented. At the end of a course, he can assist the instructor in an overall review of the content and method of presentation of the course in the light of defined objectives and achievement targets.

In this way he can build up sufficient familiarity with a course to carry out teaching of a particular section himself. He should be allowed adequate time to draft a scheme of work for the section and prepare a series of outline lesson plans. Specific instruction should also be given in the use of teaching aids appropriate to the course. As a follow-up, he should be encouraged to produce revised or additional material for overhead projection, or to select a new collection of projector transparencies, if appropriate. In addition, he should review the existing facilities and equipment for practical exercises and suggest ways in which they could be more effectively used, identifying deficiencies for which further purchases are required.

Another aspect of the training given should be experience of planning camps or field exercise programmes to support particular sections of the classwork. Having prepared a plan, the assistant should play a prominent part in administrating and supervising the programme to verify the effectiveness of the plan.

Practice in drafting examination questions, in preparing model answers, and in grading examination scripts, under close scrutiny from the supervisor, is also an essential feature of instructor training.

Finally, it should be noted that to prepare a newcomer effectively to accept full responsibility for a course may take 1 to 2 years, depending upon the depth and range of experience gained in the field before assuming teaching duties.

15.5 Higher level educational training

Training in wider-ranging educational planning, management, and development may not be relevant to all teachers in technical institutions, some of whom may wish to return to normal field duties, or seek promotion in a specialized field, after a period of service as a teacher. This type of education is normally available at a university offering a professional programme in education. It is best taken after about 5 years' teaching experience, by anyone who wishes to continue teaching and aspires to a higher post in the institution.

Such courses would be a natural development of interregional centres for forestry educational development which could cooperate closely with an established university faculty of education, since the course would cover more general principles of planning, management and development, with only limited reference to specific forestry problems.

15.6 Inter-departmental or inter-country cooperation

Where cooperative programmes can be established, either between departments within a country employing technical instructors, or between countries with generally similar environmental conditions, these are likely to be of great value in preparing staff for teaching at the technical level. A reasonable diversity of candidates is not a great drawback, if emphasis is placed on principles and methods. One disadvantage is that not much attention can be given to detailed course content, but this is offset by the experience which is gained of a wider variety of approaches to teaching.

15.7 Build-up of experience

A feature which is often insufficiently rated by administrators is the value of the build-up of experience in the staff of a training institution. If this can be achieved to a satisfactory level, the existing staff can contribute greatly to the training of newcomers. The amalgam of well-tried procedures and the fresh ideas or experience of the newcomers can lead to a progressive improvement in the content and presentation of courses.

15.8 Conditions of employment

Specific conditions of employment will depend largely on whether the training institution is a large, semi-independent organization linked to a major polytechnic institution, or a small organization linked closely with, or even fully integrated into, the main employing agency. In the first case, the conditions of service and salary scales are likely to be influenced, if not controlled, by national agreements or by a pattern of remuneration common to all such institutions in the country. In a smaller departmental institution, where a fairly high degree of mobility of staff between training and field posts is expected, salary scales and conditions of service will be more closely linked to specific ranks or pay scales in field duties.

Additional increments, either on a temporary or permanent basis, may be required to compensate for the fact that most staff at residential institutions have certain extra-curricular responsibilities or duties, at abnormal times. Salary differentials between teaching and field posts must not, however, be so great as to hamper reasonable movement between teaching and practice, and lock into the system persons whose primary interest is the enhanced reward. Fringe benefits can be useful additions to the standard conditions of employment, as they may attract some good candidates for teaching posts. These benefits may include such items as good quality housing, pleasantly located within the school site, assistance with garden maintenance and reasonable access to transport for study or recreational purposes.

To retain staff who are particularly valuable to a training institution, it is important that facilities are available to create certain ad personam posts which have enhanced salary scales. These may be used to secure continuity of service of a particularly well qualified staff member, or to retain a person with a possible loss of career prospects whilst a suitable replacement is being trained.

15.9 Motivation, incentives and job satisfaction

Assuming the financial and domestic aspects of the post have been reasonably dealt with, personal motivation may spring from the good relationships between the staff member and the institution in general, and with his supervisors and colleagues.

In planning courses, within acceptable guidelines, instructors should be permitted considerable freedom of expression. They should be permitted to display initiative and skills in developing and applying new techniques in the classroom or with field instruction and should be encouraged to seek out positive new approaches to identified learning problems. Staff members, at all levels, should be given full credit in reports and such documents for any contributions they have made to the development of courses.

If their proposals require further research, or the purchase of additional equipment, before they can be fully implemented, reasonable support should be given. This may include allocations of time and resources to test the proposals and assistance in obtaining budgetary provision for any additional equipment which is considered essential.

Staff members should be enabled, and encouraged, to play a constructive part in the development of educational policy and practice within the training programme. They should be fully consulted on all new proposals and be invited to submit alternative or additional proposals where relevant. They should also be free to comment on the administrative procedures within the organization and to play a part in ensuring that these serve, rather than restrict, the main objectives of education. It has been found that monthly staff meetings provide a convenient forum for discussing new proposals and administrative matters.

The overall relationship of the institution to the departmental and national development programmes must be emphasized to all members of the staff. Channels should be provided for directing any staff suggestions which might contribute to the increased efficiency of the organization to appropriate levels at which they can be properly studied and implemented.

The status of the institution and personal pride at being selected as one of its staff may have a beneficial influence on an instructor's work. Staff members should know that success achieved in their tasks will be noted at the highest levels in the organization and may count favourably on their behalf, if they wish to move out to suitable field posts at a later date. Continuing contact with their former students in the field, and feedback on their performances, particularly their successes, is a valuable element in job satisfaction. Close contacts of this nature, including facilities to meet former students in their field posts and to discuss any problems of training, should be encouraged.

In general, a staff member should be encouraged to feel "part of" rather than "an employee of" the training institution, and to regard any contribution he makes to its improvement as a contribution to a group of which he is an integral part.

15.10 Cooperation with forest service staff

Close cooperation with forest service staff, or other potential employers, is essential for a number of reasons. In the first place, training must be regularly adapted to meet the changing needs of the forestry sector. A good flow of information from field workers about new developments is therefore required, even before the latest ideas and procedures have been formalized into departmental or company instructions. The instructors must be alert to any policy changes or emphasis in the direction of work, or to any problems arising, which a modification of the teaching programme might help to solve.

They should have a good understanding of all types of forestry work going on throughout the country and of the potential of both the current work techniques and the local staff for assisting in the development of the skills of their students. Recommendations on where students might be placed in relation to the students' own interests and capabilities, and knowledge of the nature and the availability of suitable tasks and supervisors, are valuable aids in making the best use of new recruits to an organization. This is particularly important in building up the confidence and skills of the less able students, and in stretching the capabilities of those who are competent but are unwilling to exert themselves fully.

Good relations with forest service staff can also assist with the location of field tasks suitable for providing useful training for students. Similarly, they can help to smooth over problems which may arise when a training group moves into a forest and carries out practical work, initially not always of the highest technical standard. In addition, information from field workers on current problems can give instructors some leads for personal study, or research programmes, which will enrich their courses and enhance their status as teachers.

Good relations will also lead to objective and honest feedback on the qualities of new graduates and help to assess the effectiveness of the training they have received. This gives useful verification of an instructor's personal assessment of the students' qualities and suitability for certain tasks. Finally, cooperation may also be required for an instructor to pursue his own interests or to make studies on forest operations, or to collect data for inclusion in the teaching programme.

15.11 Relations with secondary schools and the general public

Although a forestry institution should endeavour to maintain good relations with all secondary schools which approach it for information or assistance, it is normally impracticable to maintain an even flow of cooperation with all the schools in a country, hence a special relationship with certain schools is likely to develop. There may be schools which, because of their location, the background of their pupils, or the particular interests of their staff, have a close interest in forestry. This link should be fostered by a supply of information on training opportunities, talks, slide or film shows, displays or assisted visits to forest activities, whichever is appropriate. It is from these schools that some of the most committed candidates for entry to forestry institutions may come.

The link should start well down the school, at least 2 or 3 years below the level from which recruitment is made. This gives pupils a chance to consider at length the idea of forestry as a career, to find out more about it and its implications on their lives, and either to rule it out or to form a strong ambition to undertake it. Crash recruiting compaigns in the dull days between the main examinations and the end of the school year are of little value and may even be counterproductive. It is likely that they will draw in a mass of applicants who may have been impressed by the skilful presentation of the programme, but who have not given it sufficient consideration in relation to their own interests and inclinations.

Good relations with the general public should be fostered as far as academic commitments allow. Public relations exercises should be used to emphasize to students that they are training to be public servants, and must serve the public in any way they can, especially while benefiting from a publicly-sponsored and financed educational programme. Participation in community activities such as tree planting are valuable. Students must organize themselves to carry out the work efficiently in the public eye and this places them under a useful form of informal discipline. On the other hand, the public should be given the opportunity to see that the students are being endowed with correct attitudes to service and, if possible, to gain some minor advantages from the training provided.

Participation in agricultural shows, or government publicity activities to explain the services of the government to the people, are particularly helpful. The benefits of participation in such activities are not limited to the public. Preparation of clear, concise explanations, presentation of demonstrations and answering of questions and generally organizing an interesting and attractive presentation can involve hard constructive work and close cooperation amongst class members. The extent to which an institution can participate in such activities must be carefully balanced against any disruption that they may cause in the educational programme. Limitation of participation may, however, achieve some degree of competition amongst students to participate and so enhance the value of the experience.

16. TYPES OF COURSE

16.1 Need for different levels

Many countries recognize the need for at least two levels in their technician grades; a lower level, generally called a Forest Ranger, and a higher level, generally called a Forester, although in some countries these titles are reversed. The creation of separate ranks with particular establishments and salary scales presupposes that different functions and ranges of duties have been defined for the two grades. Whilst these may differ according to the particular needs of different areas or countries, the Forest Ranger would normally fulfil an executive role. His duties would include supervising and executing particular technical tasks involving such skills as surveying, mensuration, basic silvicultural techniques, and trying to secure an acceptable standard of skill and output amongst the labour force.

The higher technical level, on the other hand, would have a role involving more planning and decision-making in the technical sphere. In this case, the duties would include selecting areas for specific silvicultural operations; matching species to site conditions; specifying degrees of thinnings and other treatments in crops of certain ages, within defined limits, and checking and approving proposed road lines and the standards of construction.

The nature of the two functions would suggest that training for these two levels of work should be progressive, one following the other, with an interval of perhaps 3-5 years' service in the field. If the two levels of training are provided concurrently, there must be a distinct difference in the level of education for the candidates on either course. If both are drawn from a common pool of candidates, with the same number of years of education, it is doubtful if any basic educational examination system or selection process is sufficiently discriminating to sort out two groups of people into exclusive levels of training which will affect their entire lives.

There is a strong argument for providing a basic technical training programme for perhaps 2 years, and then deferring the selection procedure for training for the higher level until candidates have demonstrated by their daily work some aptitude for advancement to a higher post.

16.2 Lower technical courses

It is essential, in defining the contents of a lower technical course, to decide objectively the proper functions of this grade of staff in the field, and to design both the course content and methods of instruction to achieve these ends. A detailed study of work undertaken by this grade is likely to indicate the need for a high degree of skills and knowledge in a wide range of basic forest operations. A lower grade technician should be fully competent to carry out and demonstrate the full range of skilled tasks that his workers may be required to perform. He must be able to recognize a range of ecological conditions in which different procedures may be called for. He requires basic skills in surveying and mensuration to determine the area and condition of a crop and should be able to select from a number of standard alternatives the procedure most suited to the crop at that time. His skills will largely lie in the recognition or measurement of certain forest conditions and his ability to select and apply appropriate techniques to achieve the objects of management. He also requires the skills and practical experience necessary to guide competent workers in simple building or road construction tasks, and to follow accurately plans or diagrams defining such work. He should be thoroughly acquainted with all aspects of record keeping required of him and be competent at making brief and accurate reports on achievements, expenditures and labour issues. Also, he must be able to apply any rules covering the use of funds, or the use and care of stores and equipment in his charge.

As the technician at this level must have a practical approach, the course should be devised to permit students to gain as much experience in exercising these skills in the training situation as circumstances allow. It should also cover basic supervisory skills to enable the trainee to manage a work force effectively. After training, the technician should be given an introductory period of service in the field. During this time, his performance can be closely supervised to ensure that he has achieved the right level of competence, before he is given full charge of a specific area or range of duties.

16.3 Higher technical courses

Higher technical courses, if they follow a period of service in the lower technical level, may start with a short period of verifying or updating candidates' technical skills, though there should be little doubt about these if an adequate selection procedure has been employed. The course should then focus its attention on the supervisory, planning or general management skills required to coordinate the activities of a number of lower grade technicians. Techniques of identifying specific targets from long-range plans, and of budgeting both in terms of cash, materials and manpower to ensure the smooth working of a management programme should be taught.

Where detailed management plans already exist, these should be used as a basis for exercises in scheduling future annual work programmes. The cost of labour, materials and use of equipment should be calculated, using current charges. In addition, monthly schedules of work should be prepared, in which the resources available are balanced against the tasks required, within the framework of the seasons. Procedures should also be taught for reviewing and cross-checking reports from lower technical staff, and for verifying these reports against agreed work schedules or targets. A wide range of skills in planning harvesting patterns and road systems, in conformity with the terrain and to meet specific demands, is also necessary. Staff reporting is another essential area of

training and course members should be shown how to evaluate the performance of subordinate staff and prepare objective reports. The reporting procedures taught should include the use of job descriptions and associated rating scales to measure specific performances in the duties which have to be performed. The assessment of personal attributes, such as cooperation with colleagues, oral and written skills and approach to work, also requires attention. Some understanding of work study procedures and the general principles of worker health and safety must also be acquired by the trainees. In addition, explanations should be given of any specific regulations on these matters which may have to be observed at work.

The duration of such a course is likely to be 1 to 1½ years. In order to widen the experience of the technicians attending the course, it is useful if at least part of this time can be spent on a study tour, or work experience, in another country. Where such a course recruits candidates direct from schools, or with a minimum of work experience, at least 3 years should be allowed for training. The first two years should follow roughly the pattern of the lower technical training, though more emphasis is likely to be placed on academic achievement and somewhat less on acquiring a high level of manual skills. The additional year should concentrate on teaching the supervisory and planning functions. It is doubtful, however, if such a pattern of training, lacking as it does essential work experience against which to judge theoretical planning and management studies, will initially produce such satisfactory supervisory staff as a two-stage programme.

17. CONTINUING EDUCATION

17.1 Objectives

Continuing education should have two major objectives. One: to provide technical updating of staff where procedures have developed since initial training was given, and two: to renew the interest and enthusiasm of the staff for their work. The courses should be regarded as a major continuing function of a technical training institution and not as an "optional extra" to be pursued when there is nothing else to do. They should cover the working life span of all technical staff in the organization and prepare promising members of such staff for promotion.

17.2 Types of courses

Continuing education courses should be of several different types to meet the needs of the employing agency at various stages of its development. Courses of a specific technical nature are required when new techniques or procedures are introduced. These may include both field and administrative or financial procedures. These courses should be given to staff who will be required to implement the techniques initially. They should cover not only the technical details of the procedures but also general background information on why the changes are necessary and what benefits are likely to accrue from them. Emphasis should be given to leadership and instructional techniques, so that the students can, in turn, present the information to their workers and secure its willing acceptance. The need to take appropriate steps to overcome the general apathy to change, at the worker level, should be emphasized.

Courses of a more general updating nature should be offered to experienced staff who are required to convert from one type of work to another; e.g. from man-made to natural forest operations, or from savannah to high forest techniques. General refresher courses, covering in part recently introduced techniques, but more specifically changes in outlook or emphasis in the work of the organization, e.g. a move away from direct involvement in major forest operations towards promoting community forestry enterprises, should be available on a regular basis. Shorter courses may also be provided for career development or to prepare staff to introduce and implement new campaigns involving the general public or other government or private agencies.

17.3 Frequency of courses

The frequency with which any individual may be required to take part in continuing education depends upon a number of factors. These include the mobility of the individual between different types of work and the number of changes in procedures. However, the

attendance of individuals at courses should be regularly monitored by an active personnel group who should try to ensure that every staff member gets an opportunity to participate in the continuing education process at least once in every 4-5 years.

17.4 Duration of courses

The duration of any course must depend on the objectives of the course. Allowance must also be made for the fact that staff undertaking continuing education after a period of field service will need time to readjust to the learning situation. Very short, intensive courses are, therefore, likely to be less effective than those where students can proceed at a more leisurely pace and devote some time either to private study or the interchange of working experience with their colleagues. Bearing in mind the cost and disruption to normal work of bringing together the participants of a course, and the value of a general broadening of interests, a duration of perhaps one month is likely to increase its effectiveness.

For conversion or refresher courses, a duration of 3 to 6 weeks is normally adequate, though this should not rule out either shorter or longer courses, if these can be justified by specific objectives. In general, a period of about 8-10 weeks spent on continuing education over a 4-5 year cycle, representing an investment of 4-5% of a person's working time in this vital and usually rewarding activity, does not seem unreasonable.

17.5 Attitude change

A major objective of any continuing education programme must be to regenerate a student's interest in his work and to build up his confidence in the performance of his duties. Negative attitudes towards work may result from personal doubts about one's ability to cope with a task, or about the relevance and importance of the work in the national context. Seeking out and rectifying areas in which a person is deficient in knowledge requires considerable tact. Few people are anxious to highlight areas in which they are conscious of personal deficiencies. If these can be detected and a sympathetic programme devised to overcome the deficiencies, considerable personal satisfaction and a positive attitude change towards work normally results.

The continuing education programme should be presented at all times as an opportunity for self-improvement. It should never be suggested as a penalty for poor performance. The relevance of particular tasks in the national context may be clarified by talks and discussions. Every candidate leaving a continuing education programme should feel that his task is vital, in some way, to the overall strategy of his employers and that he is now better able to understand this task and contribute more effectively to it.

17.6 Promotion courses

Promotion courses may be justified, not necessarily to qualify a person for promotion, but to highlight the different scope of the work a technician may have to undertake if he is advanced to a higher level. The requirements of work planning and budgeting, plus the techniques of supervision, including checking and control at a higher level, may have to be presented to technical staff to ensure that when a technician is promoted he actually performs the new functions expected of him. Otherwise, there is a danger that he will try to continue with his previous tasks and this may interfere with the duties of those under his charge. Such courses should be available to potential promotion candidates before any firm decision on promotion is made. This enables assessments to be made of their performance on the course and the effect the training has had on their work in the field while waiting for a promotion opportunity to arise.

17.7 Extension education

All students in their initial training should receive a basic introduction to extension techniques. These introductory lectures should concentrate on effective communications with local community groups, the definition of the needs of target populations and how to determine the balance between official and community action to meet these needs. The required training is sometimes now absorbed into a wider course on Community Forestry. Such a course, whilst providing an understanding and appreciation of extension work and establishing an attitude favourable to cooperation or participation in it, may not be ade-

quate to prepare a person to play a major role in extension or community forestry activities. Further training may be provided by a period of service as an assistant in an extension branch, but even so, there is a need for more formal training in these techniques to be provided in continuing education.

Specific courses in extension techniques should be available to staff, either as they are posted to such duties, or as they move up to a position of responsibility in which they may have to promote or evaluate such activities within their territorial charges. A deeper study of sociological conditions and motivations in local populations should be the basis for more exacting case studies of previous or ongoing projects. The programme should also provide for participation in current extension activities.

17.8 Timing of continuing education

Continuing education should be, as its name implies, a continuing process running parallel to the main functions of an educational establishment. It should not be isolated from the mainstream of work and confined to periods such as vacations in the normal programme. In the first place, vacations are just as necessary for instructional staff as they are for students and it is logical to concentrate these in periods when there is a break in the programme of activity. If there is a heavy commitment to continuing education programmes, the staff will start their next main period of teaching without the rest and recuperation that a vacation implies.

Vacations for staff are also important for checking and maintaining equipment and pursuing private studies or field visits to ensure that course material is updated. There are also such mundane tasks as repainting and repairing teaching and living accommodation, as well as family needs. Apart from these human considerations, if a programme of continuing education is running parallel with the main educational programme, it allows topics which are weather dependent to be taken at the most suitable time of year. In addition, staff who are taking courses in both basic training and continuing education simultaneously are very likely to be able to share experiences or information with both groups. Thus, they can bring the best teaching methods or latest technical advances to the continuing stream, and conversely, many useful field observations from course members of the continuing stream can be passed on to the inexperienced students on the basic course.

18. STUDENT ACTIVITIES AND MORALE

18.1 Introduction

Whereas the prime objective of a forestry school at technical level must be to produce first-class technicians, it has to be remembered that these technicians can play a leading role in village and small town communities. The training programme should, therefore, provide opportunities for them to widen their knowledge on a broad front, to develop the skills of leadership in a community and to become fully aware of the role they can play in society. As part of this process, it is important that high student morale is maintained at the school, together with a good sense of self-discipline. They should feel proud to be forestry students and be very willing to work hard to achieve high standards. To this end, a number of activities should be encouraged. These are discussed below.

18.2 School insignia

At an early stage, a school badge and motto should be adopted. Staff and students should be encouraged to make suggestions and a vote can be taken to decide which design and motto is most popular. Once approved by the appropriate authority, the insignia can be used on notepaper, school publications and for sign boards. It can also be used to produce an official tie which can be sold through the student body, any profits being used to finance student activities. Similarly, school badges can be made for use on blazers and football shirts. School T-shirts can also be popular and sometimes a lapel badge is in demand.

18.3 Student association and societies

If at all possible, the students should be encouraged to form a non-political student association or union, with elected leaders. Positions such as president or chairman, secretary, treasurer and sports secretary are quite usual and a number of committees may be formed. The association should be required to keep proper minutes of all its meetings and usually these should be submitted to the school principal or director, for information purposes. He can, of course, raise any issues which might be contentious and it helps if regular meetings are held with the student leaders.

Apart from dealing with general student issues, the association should be responsible for promoting societies such as an amateur dramatic group, a music circle or a photography club. The school may also give assistance to these societies, either by providing facilities or financial aid.

18.4 Sports activities

Sports activities, as detailed in Part II, Section 13, should be given every encouragement and it may be necessary to provide financial assistance for the purchase of individual items of sports kit, e.g. football boots, which can be very expensive. If school teams are formed, they should be allowed to join local leagues and the school may have to assist with the provision of transport for any away matches. Benefactors of the school should be encouraged to support the teams and to donate shields and cups for competitions. In some schools, it may be the official policy to appoint instructors with special responsibilities for sports activities. Apart from coaching, they should try to allow the students to organize sporting events themselves, only taking direct action when things are not working properly.

18.5 School magazine

One means of publicizing the activities of an institution is to publish a magazine. Ideally, this should be produced by the students, but it is quite usual for one or more of the staff members to take part in an advisory, and sometimes executive, role. All members of the staff and students should be encouraged to submit non-political articles, either technical or general. An editorial panel is normally appointed to scrutinize the material submitted and select and edit appropriate articles. The school principal may wish to see a draft of the magazine before it is published, in order to check for any items which could cause official embarrassment. Local firms can be talked into placing advertisements in the magazine, at reasonable rates, which will help to subsidize the cost of production. Nowadays, with the cost of paper and printing rising, even a very modest printed publication can be expensive. Initially, therefore, a simple, duplicated edition should be produced on the equipment available at the institution. Later, if the magazine is popular, the presentation can be improved by using off-set printing. It takes a great deal of effort to produce a school magazine and good leadership and enthusiasm are vital. However, even if only one issue is published annually, the benefits to the institution in terms of publicity and establishing an identity are very significant.

18.6 Prizes

Most forestry schools, once established, provide prizes for various subjects and achievements, including the best project work submitted and the best all-round student. To encourage student activities and community involvement, a useful prize can be offered to the student who has shown the greatest sense of duty in this field.

18.7 Student counselling

Finally, the instructional staff should closely watch the activities of all the students and help them, if possible, to make a contribution to the life of the institution. Some may only make a limited contribution, but if the ethos is right the message should get through.

If students are found to have personal problems, these should be dealt with immediately, otherwise other students may be affected. The staff, in general, should try to promote the image of a caring community. Hopefully, this attitude will be carried by the students to the various communities in which they will eventually live.

19. ANNUAL EVENTS

19.1 Introduction

In this final section of Part I, attention is drawn to important events which will occur annually in the life of a forestry school and which require a great deal of preparatory work if they are to be carried out efficiently and successfully.

19.2 Budget preparation

This annual financial exercise, on which the next year's work programme will depend, must receive careful attention from all members of the staff concerned. It is, therefore, a good idea if relevant members of the staff are asked to note down, throughout the year, labour costs, food prices and any vehicles, tools, items of equipment or books which are likely to be required in the following financial year. Heads of sections, or the principal, can then compile a list of requirements, with the likely costs, immediately prior to the budget preparation period. Once the draft details of the budget have been prepared, senior members of the staff should form a committee, with the principal, to refine and complete the budget proposals.

19.3 Examinations

Examinations are normally held at the end of each term to check the individual progress of students. These also provide an opportunity to train both staff and students in examination procedures, before the final examination. Each instructor should be required to draft his own examination questions and present them to the head of his section, or to the principal, for approval. Great care should be taken with the wording of the questions, to avoid double meanings, very complicated mathematical questions and spelling mistakes which can confuse. The examination rooms should be prepared in good time for the scheduled examinations, with adequate seating, possibly numbered, and a good supply of paper, spare pens and other requisites. A clock should also be provided. It is customary on these occasions to remind the students about the examination rules; these should normally have been posted on the notice-board a few days earlier. Students should be allowed to raise any queries about the questions, before the examination starts.

The examiners should mark the examination papers without delay and the results should be posted as soon as possible. One reliable instructor is usually entrusted with the task of compiling the results which should be submitted to the principal for signature before they are posted. Any unusual results of individual students should be checked out in case any mistakes have arisen. The final marks should be carefully analyzed by the instructional staff to see what lessons can be learnt. Tidy copies should be filed for future reference purposes, e.g. final course results or student transcripts.

19.4 Presentation of diplomas and certificates

Diplomas and certificates will normally be presented at the end of the academic year. This is an occasion which can be treated as a low-key event, or it can become a highlight of the year. Most institutions prefer the latter and try to obtain maximum publicity from it.

To be really successful, the event calls for a great deal of preparation, particularly if exhibitions are to be staged. The guest speakers must be given plenty of notice about the event and reminded nearer the day. Students should be allowed to invite members of their family and friends, but a limit may have to be placed on the number permitted. The mass media should be invited to attend and as many national and local dignitaries as possible. The programme and invitations should be printed, if funds allow.

On the day, great care should be taken with the seating arrangements and the installation of a public-address system, if this is necessary. The catering arrangements should also be carefully thought out. Guest speakers' contributions should be publicly acknowledged during the ceremony. The principal should follow this up with a personal letter to each speaker the next day.

Over the years, it is possible for the event to assume a national character, particularly in small countries. This can have a very beneficial effect in respect of government support.

19.5 Sporting events

In some countries, forestry schools stage sporting events which can have great public appeal. These are useful occasions for gaining support from both government and the local communities. However, they should be organized with care to ensure that they do not cause serious disruption of the training programme.

PART II - PHYSICAL FACILITIES AND EQUIPMENT

1. INTRODUCTION

This part of the manual deals with the various buildings, workshops, stores, other physical facilities and associated equipment, which are considered necessary to meet training objectives. Obviously, not all these facilities will be required by every institution, nor will it be always possible to provide every item which is considered desirable. However, by presenting the complete range, it is hoped that the manual will give guidance to any organization faced with providing accommodation for a forestry school at the technical level. Existing forestry schools may also benefit, particularly if there are plans to extend their physical facilities.

2. CLASSROOMS

2.1 Basic concepts

Classrooms in a technical institution should be designed primarily as workrooms in which formal classes can be held, rather than the reverse. They must also take into account the wide variety of activities which may take place within them, of which passive listening to lectures and note-taking may be only of minor importance.

Though the classroom function may be of some importance at the commencement of the course, the possibilities for group activities and joint problem-solving are likely to increase during the course. The need for students to handle instruments, equipment, and specimens of many different types during the learning process, suggests a much more flexible layout than a formal lecture situation. A room should be laid out in such a way that a switch to group activities can be made with the minimum of disturbance. Working tables are in most cases much more practical than traditional desks. They should be sufficiently large to allow students to spread maps, plans, documents and specimens as required during their studies. The chairs should be adult-size, not secondary school size.

2.2 Space

A space allocation of $2.5m^2$ per place (up to $3m^2$ if funds permit) is adequate for the type of teaching envisaged. Though the cost per student place for buildings of generous proportions may seem high initially, it is a relatively minor item in the overall educational cost, when the life of a well constructed building is 30-50 years. Some may, in fact, serve considerably longer.

2.3 Lighting

Good natural lighting is highly desirable and should come, if possible, from two sides of a room. The orientation of the room is important in relation to the incidence of the sun's rays at different seasons of the year. In some cases, adequate shading can be provided by constructing a deep verandah on one side of a room, which can then serve as a circulation space for students between classes. It is not usually necessary, or economic, to provide verandahs on both sides of a room. However, "sun spoilers" built into the walls above the windows, or sun-screens on the windows themselves, may be necessary to avoid direct sunlight falling on the working tables at certain times of the year. If the building structure does not permit windows on two sides of a room, high intensity artificial lighting is necessary.

Windows should not extend to the end of the room where the chalkboard or projection screens are located. If this happens, there is usually some degree of reflection from the surface of the board or screen, which makes viewing difficult. The presence of a large area of windows, in relation to the total wall space available, limits the possi-

bility of fixing display boards in the room. A compromise between good natural lighting and the need for suitable display space must be found during the design stage.

2.4 Ventilation

Good ventilation, by means of louvred or opening casement windows, is necessary. This should be supplemented by ventilation spaces in the upper walls, especially in situations where high winds and heavy rainfall may force the closure of windows at times. It is essential to maintain cool conditions for study, particularly in the afternoons. Where necessary, large ceiling fans can be used to promote circulation of air and 3 or 4 of these fans, at a low speed, can maintain a satisfactory movement of air in an average-size classroom. Air conditioners create a totally foreign environment and should be discouraged, unless essential for the maintenance or use of some special equipment.

2.5 Furnishings

A good teaching table should be provided with cupboards or drawers for storing all the equipment an instructor is likely to need, e.g. chalks, drawing instruments, felt board materials, spare pencils, pens and paper. In general, to maintain the "work room" atmosphere, this table should be on the floor level, and not on a raised dais. This inhibits the free movement of work tables throughout the room, and causes the instructor to step up and down unnecessarily as he circulates amongst his class.

Adequate storage space for students' materials, either in shallow cupboards with sliding doors below the windows, or in shelves or racks at one end of the room, should be provided. This enables uncompleted tasks to be set aside and retrieved easily, as class sessions begin and end. Alternatively, a small teaching materials store, accessible from 2 adjoining classrooms, serves the same purpose and avoids the loss of floor area caused by cupboards or shelves.

2.6 Electrical installations

A classroom should have as many electrical sockets as found practicable. Sockets are normally required at both ends of the room to provide power for audio-visual aids such as overhead projectors or slide projectors. Additional sockets can be provided at either side of the room to supply reading lamps or light tables, if these are required. (See Section 6 below.)

2.7 Safety

The main entrance to a classroom should be of sufficient size to allow the room to be evacuated quickly in an emergency. The door should open outwards from the room and, wherever the basic design permits a second door, this should be provided in the diagonally opposite corner or side. A fire extinguisher should be installed within the room or in an easily accessible location outside it.

3. TEACHING LABORATORIES

3.1 Needs

The need for teaching laboratories depends upon the scope of the curriculum. In some cases the policy requirement is to provide a bridging course in basic studies, ostensibly to bring all students up to the level at which they can benefit from the remainder of the course. Too often, however, this is simply an admission of the inadequacies of the secondary school standards and it imposes on the technical curriculum matters which should properly be dealt with at the pre-entry level. Such courses are sometimes of little relevance to subsequent studies. Where they can be modified to serve the needs of the technical subjects, they can be very useful. In this instance, laboratories are required for their proper implementation.

3.2 Combined chemistry/soils laboratory

A basic chemistry laboratory, which can serve as a soils laboratory for later stages of the course, is desirable. This has much in common with a similar laboratory for the

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initial stages of an introductory university course in chemistry. In this case, however, space allocations can be made more generous to permit senior students to carry out soil studies simultaneously with the junior chemistry course.

3.2.1 Space allocations

A space allocation of $4.5m^2$ per student should be adequate to cover routine classes and to leave some bench space available for continuing demonstrations or experiments.

3.2.2 Storage and preparation facilities

An area behind the wall of the instructor's bench should be formed into two rooms, accessible from either side of the teaching bench and, if possible, connected by an internal door. One room should serve as a preparation room, in which exercises can be planned and prepared before being attempted in class. The second room should serve as a ready-use store, holding stocks of equipment in common use, which the instructor may not wish to leave unattended in the class. It should also house replacement bottles or packs of all consumable materials in general use which, if replenished at intervals, will ensure that classes are not delayed by unforeseen shortages.

The preparation room should be furnished with adequate cupboard space, both above and below bench level. Glass-fronted cupboards, above bench level, enable materials not frequently used to be stored and located more readily. A central bench should be installed, connected to water supplies and provided with one or more laboratory sinks, plus gas and electrical connections suitably protected against water. A proper laboratory tool kit, in a locked cabinet, should be provided and a comprehensive laboratory first-aid kit. A space allocation of 15% of the laboratory area should prove adequate. Depending on the complexity of studies to be undertaken, fume cupboards or cupboards for precision balances may be located on a bench at the rear of the laboratory.

3.2.3 Lighting

Though adequate natural lighting is desirable, as in classrooms, it is undesirable to have all the side wall space given over to windows. A reasonable proportion should be solid wall to protect balances, water de-ionisers and other items of equipment which may be in regular use. These walls are also a convenient location for small fire-extinguishers which should be of the inert chemical or gas type. To compensate for the loss of window space, a high level of intensity of artificial lighting, preferably using flourescent tubes, is required. Roof lights are seldom satisfactory in tropical areas where the sun may be directly overhead for part of the year.

3.2.4 Ventilation

Good natural ventilation by louvred windows or fixed louvres mounted high in the walls is desirable, but should be supplemented by extractor fans. The normal type of roof-fan mounted as in a classroom is not suitable in a laboratory, where it may disturb gas flames or the operation of balances.

2.3.5 Furnishings

Laboratory benches up to 6m long by 70cm wide and 80cm high are suitable for 6 students working in pairs. They should be fitted with laboratory sinks and tops at both ends and in the centre, if possible. Each working space should have convenient access to gas taps and electrical sockets suitably shielded against water. There should be drawer/cupboard facilities at both ends and at 1 or 2 points along the bench, if convenient. These cupboards should be free-standing from the structure of the bench, as this allows flexibility of location. Laboratory stools, of a type which can be stored conveniently under the benches, should be provided for students.

A large teaching bench, 3-4m long, raised on a low platform, with sink facilities at one or, preferably, both ends, and at least 2 twin gas taps and 2 twin electric sockets, is desirable. It should incorporate both drawers and cupboards for storing teaching equipment in regular use.

3.2.6 Services

In areas where a mains supply of gas is not available, liquid petroleum gas piped to benches from a pair of large cylinders mounted outside the laboratory, and connected by an automatic switch-over valve, is probably the best for general use. The gas pipes should run in an underfloor channel, covered by a concrete or wooden slab, depending upon the construction of the building, to twin laboratory gas taps at intervals of about 2m along the bench tops.

Electrical cables should run through metal conduits to suitable sockets provided against moisture.

All waste liquid should discharge first into diluting sinks outside the building, before being discharged into the main drainage system.

Large inert powder or foam fire extinguishers, an asbestos blanket and a properly equipped laboratory first-aid kit should be located near the instructor's bench, or in the preparation room if it is accessible at all times.

3.3 Biological laboratory

A biological laboratory which may share the same storage and preparation room as a chemistry/soils laboratory may be built in one block. In addition to basic botany and biological classes, it can also cater for practical exercises in entomology, pathology and wood utilization, if necessary. In many institutions, it may be more intensively used than the combined chemistry/soils laboratory, and therefore it should be adequately equipped for its multiple role.

3.3.1 Space allocations

Space allocations overall can be slightly less than for a chemistry/soils laboratory, as it is convenient to use narrower benches. An overall allocation of about $4m^3$ per student should be adequate.

3.3.2 Lighting and ventilation

Lighting and ventilation requirements are substantially similar to those of the chemistry/soils laboratory described above.

3.3.3 Furnishings

Laboratory benches can be of standard table height and reduced in width to 60cm. Free-standing drawer/cupboard units can be located below the benches.

3.3.4 Services

Gas outlets are not normally necessary on all benches. These can be provided at limited points on fixed side and rear benches. This allows greater flexibility in arranging the benches in the main part of the room.

Frequent electrical sockets, connected by cables in metal conduits, are required if microscopes or illuminated dissecting stages are to be used. The electrical connections to conduits in the floor can be flexible and detachable and the laboratory benches made free-standing, so that a certain degree of variation in their location is possible.

Sinks and water supplies can also be confined to fixed side and rear benches and to the instructor's bench. Balances, if required, should also be confined to these benches. The usual provision of fire extinguishers and first-aid kits should be made for this laboratory.

3.4 Safety

Laboratories should always have 2 large, outward-opening doors, at diagonally opposite corners, to allow quick evacuation of the room in emergencies. The "emergency door"

must be kept free of all obstructions and closed by a bar and lever device which will respond to pressure, in a hurried evacuation.

4. HERBARIUM

A herbarium for the storage of prepared plant specimens, with facilities for storage of timber specimens and mycological material, is desirable.

Preparation of material by students can best be done in the biological laboratory, so the herbarium itself need only provide sufficient space for a master collection of plants, plus duplicates of species in common use for class study. There is, of course, the need for a reasonable working area for a herbarium keeper, and possibly an assistant, to prepare or classify plants as necessary. The herbarium keeper is likely to be a member of the teaching staff and to have office accommodation elsewhere.

Drying ovens for preparing specimens are probably best located in the biological laboratory where they are more readily accessible to students. On the other hand, facilities for fumigating or preserving specimens are best located in a small workroom or cubicle attached to the herbarium. In certain climates, one or more dehumidifiers may be required to maintain a level of humidity sufficient to prevent deterioration of the collection.

4.1 Timber specimens

Where collections of timber specimens are maintained, suitable racks for display are normally required. A set of simple tools for preparing the specimens is also necessary. An industrial-type vacuum cleaner, to maintain a high level of cleanliness, is desirable if preparation work is carried out within the herbarium.

4.2 Lighting

Lighting can be by a limited area of windows high in the walls, and by artificial lights, to avoid direct sunlight falling on to the collection.

5. DISPLAY/STORAGE AREAS FOR OTHER COLLECTIONS

Depending upon the size of the institution, a suitable room may be required for the display or storage of other specimens used for teaching purposes. Examples are rock and soil samples, insect collections, taxidermic or skull collections and samples of timber defects.

5.1 Lighting and ventilation

Lighting and ventilation conditions similar to a herbarium or a biological laboratory are appropriate to this room.

5.2 Furnishings

Wall cabinets are required and, ideally, the section below table height should be wider than the upper part, to provide a narrow surface on which specimens can be laid whilst they are being stored or retrieved. A card index of the collection, giving details of the location of specimens in the various storage spaces, is necessary. One or more centre tables for preparing or examining specimens are required, but equipment for handling the materials should normally be kept in the appropriate laboratory.

6. DRAWING OFFICE

A drawing office requires a high allocation of space per student ($3.7-4.6m^2$), and therefore in every institution the question must be raised as to whether the utilization of this space for drawing tasks alone can justify the cost of its provision. If a high level of economy is required in the design of an institution, it may be necessary to use general classroom facilities for this subject.

6.1 Alternative solutions

If the basic layout of classrooms provides for 2 adjoining classrooms with a sliding partition between them, this can be opened to allow a class to use the 2 rooms simultaneously. Class members can congregate in one room to receive instructions, and then space themselves out over the two rooms for drawing practice, making use of all the table space available.

6.2 Additional equipment

If a classroom is to be used in this way for drawing purposes, wooden drawing boards raised at an angle on wedge-shaped blocks, with metal retaining bars at the lower edge, should be provided for each student. These are placed on the standard work tables. The cost of individual drafting tables is unlikely to be justified, except in institutions which offer particular options in surveying, engineering or management with a substantial content of drawing practice.

Portable "light tables" should be available in reasonable numbers, but it is not usually necessary to provide sufficient to meet the needs of all students at once. Arrangements may have to be made, however, to permit students access to the room after normal working hours to allow them to make use of these items. This avoids unnecessary expenditure on items used for a short part of the programme. Chests for storing maps or drawings in progress should be provided.

6.3 Lighting and ventilation

Good natural lighting should be supplemented in rooms used as drawing offices by high intensity overhead lighting. There will almost certainly be a need for this on dull days, or for any evening work. Whenever possible, individual desk lamps should be provided. Good ventilation, by ceiling fans or possibly extractor fans, is essential to keep working conditions satisfactory for students, and avoid any damage to work by perspiration. This is particularly important where artificial lighting may add to the heat in the room.

7. LIBRARIES

7.1 Ideal facilities

Because of space and cost restrictions, it is often difficult to incorporate in a library all the many desirable features one would like. The layout should, however, include an office for the librarian and a suitable working space for an assistant behind a counter, located adjacent to the entrance. A zone for reference books, with cabinets for both subject and author record cards, perhaps a micro-film reader and printer should be located where they can be closely supervised by the library staff. Racks for the display of current periodicals, before they are arranged in serial order, should also be located in this zone. An exhibition area may be provided, if space permits, to enable both instructional staff and students occasionally to stage exhibits on specialized subjects.

7.2 Stack area

The stack area should be reasonably compact, with the stacks running out at right angles to the walls with windows located between the stacks. There is a temptation to economize in space by making the area between the stacks rather narrow, but this inhibits free movement of users and should be avoided. A space of at least 1.20m between stacks should be allowed.

7.3 Reading facilities

Sufficient table space should be provided near the stacks to allow readers to sample books or to make short extracts from them. A zone should be reserved for the storage of maps, plans, charts, diagrams and other large items. The table space should be adequate for these to be studied without need of folding and risk of damage.

7.4 Storage of large flat items

Flat mapchests, or preferably, hanging map chests, should be provided to store the large flat items mentioned above and to allow easy location and retrieval. These may have to be locked and under the control of the library staff to meet security requirements in some areas.

7.5 Workroom

Where space permits, a small workroom for the labelling and repair of books is desirable. It keeps the issue and retrieval area of the library free from waste materials, and enables the staff to carry out the work without disturbance to the users of the library.

7.6 Study area

If the library is to be used as a study area for students, either a large extension beyond the stack area or a separate room adjoining it should be provided. Reading desks in this area should be arranged perhaps in a cruciform pattern with partitions between adjoining readers to minimize distraction, and to give the greatest sense of privacy possible, in relatively crowded circumstances.

7.7 Exhibition area

The exhibition area may simply consist of large-size noticeboards on which posters, charts, etc. can be displayed from time to time. If space permits, display cabinets and stands can also be provided.

7.8 Photograph collection

If a collection of colour transparencies or photographs has been assembled, these should be controlled by the librarian, and facilities for viewing sheets of slides and selecting photographs suitable for teaching purposes should be provided in the reference area of the library. A proper system for recording loans of such material must be maintained by the librarian.

7.9 Lighting and ventilation

A high intensity of lighting is required within a library. Good ventilation is also of great importance. Where humidity is high, a number of dehumidifiers appropriate to the volume of space should be located in the stack and reference areas to reduce humidity to an acceptable level at which there is no danger of the growth of mould on books.

Wet and dry bulb thermometers, or a recording thermo-hydrograph, are desirable to monitor humidity, if dehumidifiers are used. They can also be used to determine the most economical settings of the equipment.

7.10 Seating

Library chairs should have padded seats and wooden arms. The floor should be covered with a material which will reduce noise, such as thermoplastic tiles. Also, the legs of the chairs should be fitted with smooth studs to limit noise from chairs being moved by readers.

8. OFFICES FOR TEACHING STAFF

8.1 Principal

An office for the principal or director should be in the region of $20m^2$, to provide adequate space for his own requirements and for meetings with staff and groups of visitors. For these meetings, a table is required of about 2m long by 70cm wide. This can adjoin the main desk to form a T-shaped discussion area, or can be set back against a wall when not in use. A felt-covered noticeboard and a small, good quality chalkboard are useful

pieces of equipment which can be installed. A safe should also be installed to provide security for cash and for confidential documents such as examination question papers.

Adequate window space is needed, but not so much as to detract from the privacy of the room. Good overhead lighting and a flexible desk lamp are desirable. A desk-top fan may be required to ensure air circulation during meetings. A signal light, located outside the door and operated from a switch at the desk, is useful to indicate periods when the occupant does not wish to be disturbed. Two or three electrical sockets for the use of portable electric equipment should be provided.

8.2 Instructors

Senior instructors, such as the vice-principal or assistant director and heads of sections, may also require individual offices, in order that they may interview staff or students in private. An area of 15-20m^2 will be adequate, but if two senior members of the staff agree to share an office, it should be not less than 20m^2.

In the case of junior instructors, they can normally share offices of 20-25m^2 without much inconvenience. A reasonably full teaching schedule will ensure that the number of times the two instructors are in the office together is limited. If there are a number of field assistants and space is limited, three or four can be expected to share an office of about 20m^2, as their main duties are in the field.

In all cases, a felt-covered noticeboard and a chalkboard are desirable. Adequate natural and artificial lighting is necessary and at least 2 electrical sockets to serve each desk in the room. These should be so located as to avoid trailing wires on the floor, which can be particularly dangerous in a room with multiple occupation. Storage space is also essential for teaching aids and the desks which are supplied should have adequate drawer space. At least one drawer should be lockable, for safeguarding confidential papers.

9. OFFICES FOR ADMINISTRATIVE STAFF

9.1 General principles

As far as practicable, the administrative staff should be strictly limited, otherwise there is a tendency for this type of staff to proliferate, which frequently makes administration more cumbersome rather than more efficient. For small institutions, one competent clerk, with a typist/clerical assistant and a messenger has been found to be perfectly adequate. For larger organizations, a greater sub-division of tasks and a consequent increase in staffing may be necessary.

9.2 Layout

In general, an open-plan layout, with perhaps glass-walled cubicles for certain staff members, permits good supervision and a smooth flow of paper work. The senior member of the administrative staff, who may also perform the functions of an accountant, may be located in a glass-walled booth of about 12m^2 in one corner of the administrative office. Desks or tables should be provided nearby for a filing clerk, and a financial clerk, if the volume of financial work justifies this assistance. Initially, the financial clerk may be able to maintain the stores and equipment records, in addition to his normal duties. Later, the record-keeping may have to be undertaken by the storekeeper. In large institutions, a clerk dealing with personnel and students' records may also be necessary, but this work can often be handled by the filing clerk. A messenger/trainee clerk can often handle many miscellaneous tasks and look after the reproduction equipment. A space allocation of about 5m^2 per person should be adequate.

Desks in this office should be located sufficiently near each other to allow good oral communication and the easy transfer of files and documents. At the same time, it is important to allow sufficient space for low book racks or cupboards in which each employee can store the records or materials relevant to his or her task.

One or more noticeboards should be provided on which staff leave rosters, financial charts and general notices can be displayed.

9.3 Typing and reproduction facilities

If at all possible, there should be a separate typist's office. In small institutions, there will normally be only one typist who will also act as the receptionist and telephone operator. Where the volume of work justifies two typists, the senior typist can be entrusted with all important correspondence, including typing examination material under secure conditions. This will leave the junior typist to handle the routine typing, enquiries and telephone calls. Their room should have a small public area with a low counter. A wood and obscure glass screen can be used to cut off a section of the office, to allow the senior typist to work with some degree of privacy. There should also be a door providing direct communication to the administrative office. A space allocation of 12-15m^2 should be adequate.

In smaller institutions, space should be made available in the typist's office for either or both photocopying and duplicating machines, though these may be operated by an office messenger, or trainee clerk.

There should be adequate lighting and natural ventilation, and sufficient electrical sockets to allow a variety of office machines to be located and used conveniently in this room. Depending upon the complexity of the organization, an office varying from 12 to 30m^2 may be needed.

9.4 Print room

In larger institutions, it may be desirable to establish a separate print room. This could house an offset printer with associated plate-making equipment; ink and spirit duplicators; photocopiers and overhead projector transparency makers; collators and binders. Such a room should also provide desk space for the technician in charge, and storage space for stocks of materials and chemicals, and for print orders before distribution.

10. WORKSHOPS

10.1 Categories of workshop

Workshops can be divided into 3 categories: workshops used for instructional purposes in the training programme; those used for general maintenance of buildings and facilities; and those for vehicles. Though for convenience they may be located close, or even adjacent, to each other, they should be quite separate, to avoid friction between instructors and maintenance staff over borrowing of tools and equipment.

10.2 Students' workshop

A students' workshop should normally be located some distance from the main teaching block, preferably in a special "utilization" area, to avoid noise disrupting other classes. It should have all the necessary facilities to provide the practical skills required in courses such as Forest Utilization and Engineering. It should also provide "hobby" facilities for students interested in wood or metalwork. These may be made available after normal hours, or at weekends, to encourage an interest in woodwork, or in servicing small items of mechanical equipment, by selected groups of keen students. A reasonable number of grindstones should be available for sharpening axes and common cutting tools. It is often most convenient to locate these outside the main workshop, in a roofed area, with a concrete floor and open or wiremesh walls. A simple water supply is necessary for wetting stones when in use. An overall space allocation of 6-8m^2 per student place may be required.

The workshop should have as wide a span as a reasonably simple roof truss can cover, and as long as necessary for the size of class, and range of work, envisaged. It should provide a number of cupboards and shelves around the walls for storing tools. Space should be available for a number of wooden, general purpose work benches, standing some distance from the walls, so that they are accessible to students from both sides. These may be used mainly for manufacturing and fitting tool handles, and for hobby activities. There should be a large, unobstructed area in the centre for erecting filing vices, if large handsaws are still in use. When these are replaced by motor-saws, a number of

to establish and maintain, and can provide periods of very energetic exercise for reasonable numbers of students. For short periods of exercise after classes, they may be more used than a football field, and where the need justifies the provision of 2 or more of these courts, this should be arranged.

Tennis can provide good relaxation, but at a somewhat higher cost, for a more limited number of participants. The investment in posts and nets, wire mesh fencing for the courts, and the general maintenance of the surface is relatively high, as are the costs of racquets and balls. The provision of these facilities will depend upon the level of interest in the game in the particular area.

Hockey and cricket pitches are normally only justified in larger institutions, in areas where there is a particular popularity of these games. The relatively high cost of the equipment must be balanced against the probable interest in these sports.

Athletics facilities, particularly if they can be combined with the layout of a football field, are desirable. Running tracks and jumping pits are generally most useful and are not unduly expensive to maintain.

14. DORMITORIES

14.1 Arrangement of accommodation

Where possible, dormitories should provide room for 2 students. Single rooms are unduly expensive and may be made very cramped to achieve economy. Rooms for 4 students frequently involve the use of 2-tier beds and create an institutional, rather than a domestic atmosphere. An allocation of about $6m^2$ per person is desirable. A block of 10 to 20 rooms arranged back-to-back in pairs, each facing out onto a covered verandah, with toilet and washroom facilities at either end, provide a reasonably convenient arrangement in warm areas. Alternatively, pairs of rooms on either side of a central corridor are useful in areas of high rainfall or low temperatures. In large institutions, there is a case for building 2- or 3-storey blocks, unless there are special site or amenity factors in favour of scattered 1-storey buildings.

14.2 Furnishings

Rooms should be furnished with beds, desks or work tables, chairs and simple bookcases. Space is required for a large cupboard for hanging and storing clothes for each student. Part of the cupboard should be shelved for storing clothes and space provided for shoes. A small noticeboard for pinning reminders or photographs avoids damage to the wall surfaces. Floors should be easily cleaned. Heavy duty thermoplastic tiles throughout the block, except in the toilet/washroom area, are comfortable and reasonably durable. They create a much pleasanter atmosphere in the rooms than bare concrete.

14.3 Sanitary facilities

Washbasins, showers and toilets should be provided on a scale of 1 to 8 students, if possible, and 1 to 12 at a maximum. If these facilities are located at both ends of a residential block, it enables the accommodation to be split between male and female students with a greater degree of flexibility. Near the toilet facilities, an area for washing and ironing clothes is useful. There may also be facilities for making hot drinks in the late evening. If these facilities are not provided, students are liable to improvise them in their own rooms, creating a fire hazard and possibly overloading the electrical system.

14.4 Storage facilities

A dormitory block should provide at least one store room in which students can keep empty suitcases and trunks during term-time, to reduce congestion in their rooms. A small closet for storing brushes and cleaning materials is necessary, as is one or more dustbins for the disposal of litter. Space may also be provided for storing sports equipment.

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14.5 Lighting

Dormitories should be provided with good artificial lighting for the study tables and either bedlamps or suitable electrical sockets for lamps. At least one plug for a radio, or other small electrical appliance, should be provided in each room.

14.6 Safety

Dormitories should be provided with large foam-type fire extinguishers in accessible places. Central corridors and staircases should be sufficiently wide to allow quick evacuation of the residents in emergencies. In particular, corridors should be kept clear of boots and shoes, or other obstructions, which might cause people to trip and delay evacuation. In multi-storey buildings, 2 separate staircases should be provided in spite of the additional cost involved.

15. CATERING FACILITIES

15.1 General arrangements

A students' dining hall or cafeteria should ideally provide space for a small sitting-room in which students can assemble before meals. The room should provide a number of easy chairs or settees, and small tables for magazines or indoor games. Where available, a television set, or radio, may be located in this area. The recreation area may be separated from the main dining area by an open metal grille, or an ornamental screen, which can be folded back to increase the dining area on special occasions. The assembly of students in such an area before a meal is served is a much more refined procedure than queueing outside a dining hall. It is therefore valuable in training students in acceptable social behaviour. The space may also be used for quiet recreation after meals.

15.2 Dining hall

The main dining hall should provide tables for 8 to 10 students, to encourage them to mix and socialize in reasonable numbers. For economy and good hygiene, tables with plastic tops are most desirable. The floor should be of an easily cleaned material such as thermoplastic, or decorative ceramic tiles. Walls should be treated with washable paint and kept clean at all times. Curtains on the windows create a more relaxed domestic atmosphere in the room. Water coolers should be provided in warm climates.

15.3 Serving arrangements

A serving counter should be provided at one end, or along one side, of the dining hall and arranged so that students can collect their meals as quickly as possible. If this is not taken into account in the planning stage, the hall will acquire an undesirable institutional atmosphere and those at the end of the queue are likely to have cold food. In some cases, adequate table space behind the counter is necessary for laying out compartmented plastic or metal trays which also serve as dishes, for pre-serving meals. If this procedure is not followed, sufficient space must be allowed at the serving counter for helpers to dispense 3 or 4 items of the meal onto the plates, as the students move along.

15.4 Food preparation areas

The cooking and food preparation areas should be screened from the serving area by a partial wall, which will allow reasonable access between the two, but cut off the dining hall from the noise and activity of the kitchen. A large scullery should be located near the serving counter to avoid transporting utensils with left-over food through the kitchen. Access to this may be by a hatch at one side of the serving counter. The scullery requires large sinks and a plentiful supply of hot water for washing dishes. It also requires adequate plate racks so that dishes or trays can dry in the air and not require drying by cloths. The cookers and other items of equipment used for the final preparation of the food should be in an area giving easy access to the serving counter and be supplied with adequate facilities for washing food and utensils. The preliminary preparation of food, such as peeling and cleaning raw vegetables, should be isolated from the final food preparation area.

15.5 Storage facilities

A walk-in cold room may permit meat, bread and certain other commodities to be purchased in bulk at intervals of a week or more, and so economize in cost and transport. In addition to this, one or more catering-type refrigerators are required and, in hot climates, water coolers. Stores for vegetables and dry goods should be located near the entrance to the kitchen area, to avoid carrying unprepared goods through the final food preparation area. The kitchen should be provided with toilets and washrooms for the staff, and there should be facilities for them to change from normal clothing into suitable working clothes, before they commence to handle food.

16. RECREATION HALL

In most schools, a recreation hall for more active pursuits, such as table tennis or badminton, is desirable. This should be a large hall with a roof free of obstructions. In many institutions, it may also have to serve as an assembly hall. In this case it should have a stage and, if possible, small rooms or waiting areas on either side, with easy access to the stage. If it has to serve both as a recreation and an assembly hall, adequate storage space will be required for stacking chairs, table tennis tables and other sports equipment, when not in use. If possible, a small separate room for storing a film projector, screen, stand and related equipment should be provided. In some cases, it may be possible to adapt it as a film projection room and instal a permanent screen in the main hall.

Toilet facilities of a standard suitable for guests should be incorporated into the design.

17. QUARTERS FOR STAFF

17.1 General principles

Though the initial costs are high, and rents charged may not meet routine upkeep costs, it is desirable that a high proportion of the teaching staff of a residential institution should be housed on the campus. This ensures that they are more freely available to participate in extra-curricular activities. Casual social contacts between students and staff sharing common facilities lead to better mutual understanding and generally, a higher standard of student conduct.

17.2 Grades of accommodation

There is a tendency to grade housing according to the status of the occupant, rather than his particular family needs, and this can cause problems. Therefore, there should be some flexibility in allocation, or overlap, between status and house size to make the best use of the housing stock, and to meet particular domestic needs.

A number of three- or four-bedroomed houses are normally required for family groups, and a certain number of two-bedroomed houses for more junior staff with younger families. Staff houses should normally provide a living room with a dining annex, as well as the customary kitchen and toilet and bathroom facilities. Where appropriate, the kitchen must be designed to accommodate modern equipment such as an electric oven or refrigerator. It is beneficial to have a small study, preferably with direct access to the outside. This gives the occupant freedom to work without the distraction of other family activities. It also permits students or other staff members to pay a visit without disturbing the family.

Simple car-ports or garages are normally regarded as essential features in such houses. Whether or not accommodation for servants should be provided depends largely upon the customs of the particular country, and on the possibilities of finding accommodation for servants either in or near the campus.

17.3 Location of quarters

Quarters for staff should, whenever possible, be located within walking distance of the occupants' main place of work. This avoids the distractions resulting from staff vehicles circulating and parking in the main teaching or administrative area. Generally speaking, the use of cars within the campus should be discouraged. It is customary, but not essential, to locate houses for teaching staff in one area.

17.4 Quarters for non-teaching staff

The extent to which administrative, clerical and ancillary staff should be housed depends upon the possibility of finding suitable accommodation for them within a reasonable distance of the school site. Certain persons who may be required to work unusual hours are normally housed within the school compound. These include medical personnel, storekeepers, cooks, drivers, and some maintenance workers.

17.5 Standards of housing

The standards of housing offered will normally be influenced by comparable housing standards outside the school compound. A house should, however, have a useful life of 30 to 50 years. Consequently, during the initial construction period, it is necessary to anticipate future trends in housing improvements, at least for the next 10 years. This will result in a standard which is rather better than normal at the time, but it will probably still be acceptable 20 years later. Subsequent refurbishings may then extend its useful life for another 20 years or more.

Unless there is a strong feeling locally for each house to have its own garden or compound, the residential accommodation can be developed into an attractive open-plan layout, which is both practical and economical to maintain. Housing for junior grades is often better located in compact groups, or rows, to reduce the cost of services such as water, electricity and sewage.

17.6 Bachelors' accommodation and mess

Depending upon the size of the teaching and administrative staff, there may be a case for a certain number of small bachelor quarters linked to a common dining room/sitting room. A limited number of guest rooms can be incorporated into the layout. Small houses will be adequate, each consisting of a combined sitting room/study, one bedroom, a bathroom and toilet, and a small store. Facilities for preparing coffee or light snacks may be provided, but main meals can be supplied, on payment, in the common dining room.

17.7 Furnishings

The extent to which furnishings, including cookers and refrigerators, are supplied in staff quarters of the various grades, depends largely upon the normal arrangements for the supply of these items to public servants within a particular country.

For more senior staff, there are often advantages in acquiring such items on a personal basis as this may avoid a heavy outlay when retirement comes round. For junior staff, at least some assistance with furnishing and the provision of a cooker and refrigerator may be necessary for them to achieve a reasonable standard of living on a modest salary. A system of charging a reasonable rent for furniture and equipment supplied is often the best arrangement. This leaves each person free to select and pay for what he considers to be his needs.

18. CLINIC/FIRST-AID ROOM

Depending upon the size of the institution and the accessibility of proper medical facilities, a clinic, or at least an adequately equipped first-aid room, is highly desirable. In remote areas a well-stocked clinic, staffed by a trained nurse or para-medical person who can treat everyday complaints and issue drugs in common use, is definitedly needed. When the availability of proper medical centres nearby makes this unnecessary, at

least a first-aid room should be provided. This should be adequately equipped to deal with accidents and other emergencies, and manned by an employee trained in first-aid procedures.

19. PRACTICE YARD AND UTILIZATION TRAINING AREA

19.1 Location

Depending upon the range of training which is provided, a practice yard may be incorporated in a general utilization training area. To reduce the amount of time lost by classes moving between this area and the main teaching block, these facilities must be located reasonably close to each other. Noise from the practice yard/utilization area can be reduced by surrounding it with a tall hedge. Outside the hedge, scattered trees with dense crowns will further help to screen noise.

19.2 Facilities

In addition to a replaceable selection of logs in both vertical and horizontal positions for sawing or axe-work demonstrations, the yard may include an open-sided workshop for tool maintenance. This may replace some of the facilities suggested in the students' workshop mentioned in 10.2 above.

A combined practice yard/utilization training area may contain a small circular saw bench. This can be used for elementary instruction in sawmilling, but an important subsidiary function may be to demonstrate to students, using material from the school forest, how logs can be damaged through bad pruning; by mechanical damage to the bark, and by the breaking of branches. Students can also see the value of pruning at different ages by the amount of knot-free timber available.

Timber from the saw bench should discharge into an open dipping tank, before being used for exercises in stacking. A simple covered stacking shed, with permanent bases for the stacks, should be located sufficiently close to allow easy manual handling of the timber output from the saw bench. When dried, the timber may be restacked elsewhere prior to sale, after having been used for exercises in mensuration.

Where appropriate, the utilization area may contain concrete tanks or steel drums for sap displacement treatment of timber, and for hot and cold impregnation treatment. This treatment area must be carefully screened to reduce the possibility of accidental fire spreading throughout the yard.

19.3 Charcoal production

A steel charcoal kiln may be located within the area if space is sufficient both for the kiln itself and for reasonable stocks of wood during drying. Where permanent brick kilns are commonly used, this type of kiln may be installed for demonstration and practice purposes. The resulting charcoal can be supplied to the kitchen for cooking purposes and/or sold to the staff members at concessionary rates.

19.4 Exhibition/demonstration area

Various exhibits of simple joinery products such as roof trusses and door and window frames can be maintained in this area. A "grave yard" for tests of treated and untreated timbers can be useful. The exhibits can also perform a general public relations function and should be manned by student guides when visitors come to the institution.

19.5 Access

Good access by road to this area is required, but the traffic should be diverted away from the main teaching and administrative areas to avoid noise. Adequate turning spaces for vehicles should be provided.

20. SCHOOL FOREST

This topic has already been discussed in Part I, Section 7. It is sufficient to emphasize here that this should contain small but adequate areas of crops of all ages, for demonstration and ab initio training.

When an institution is founded on a "green field" site, it is necessary to allocate sufficient land to achieve this purpose, over a period of, say, 30 to 40 years. Initially, this may involve relatively large areas of land standing unused for forestry purposes. Therefore, to limit criticism of what may appear to be a waste of valuable land, it may be advisable to establish temporary short-term crops on those areas which are not required for tree planting for, say, 20 or more years.

The forest should have good access roads which can also serve for demonstration and instruction in road maintenance and culvert construction.

21. FOREST NURSERY

21.1 Size

A necessary adjunct to a school forest is a forest nursery. Depending on the number of students and the requirements of the surrounding forests, this should be sufficiently large to provide a realistic view of nursery production. In addition, there must be sufficient space to allow students to have individual seed beds and for staff members to carry out research work. From experience, it has been found that a nursery of between 0.5ha and 1ha is normally adequate, over 1ha being too much to handle.

21.2 Layout

In a nursery used for instructional purposes, all paths and roads should be wider than normal to accommodate groups of students following demonstrations, or carring out practical work. The layout of water supplies may also be more intensive than normal, to provide practice in laying and maintaining water pipes. Facilities for compost making and soil storage should be provided.

21.3 Working shed

Where plants are raised in polythene pots, a large open-sided shed for storing and mixing soil ingredients and filling pots should be provided. A number of large bins, of several cubic metres capacity, should be arranged at one end to hold the ingredients of the soil mixture. These can be recharged by a tractor and a trailer from outside the shed.

Near this, a large concrete mixing floor should be laid, if hand-mixing is carried out. If a mechanical mixer is available, the concrete floor area can be reduced. Workers filling pots can be seated on either side of a long table running down the centre of the shed. A steady supply of soil from the mixing area should be arranged. Filled pots can be packed into boxes and transported on narrow trolleys to the bed space in the nursery.

21.4 Nursery office and store

The nursery should incorporate an office and stores constructed in local materials likely to be found near a field nursery. It should, however, provide perhaps slightly "idealized" accommodation to indicate the full range of facilities that might be required in a large nursery. The office accommodation, for instance, should provide for a nursery officer in overall charge, and for a foreman and storekeeper. Facilities for maintaining all necessary records are essential. In the tool store, racks and shelves should be erected to hold all the equipment which is in use, and a simple work bench for maintaining tools is required. A store for holding materials is also necessary. This should be divided into two unequal sections. In the larger section, all major stocks of polythene tube and fertilizers, etc. should be held, whilst the smaller one can be used to store seeds, insecticides and other chemicals. Appropriate measures should be taken to secure the stores, particularly the one containing chemicals.

A well-drained tool washing area should be provided outside the tool store, to enable tools to be cleaned before they are returned to the storekeeper. Simple, but adequate, toilet and washing facilities should be provided for staff and workers, particularly if any of them spend their lunch break at the nursery. The nursery should have its own first-aid box for treating minor injuries which may not justify an immediate visit to the clinic or first-aid room. Another requirement is a selection of tools for the routine maintenance of wheelbarrows, trolleys, sprayers and pipe fittings, and these should be kept in the tool store.

22. METEOROLOGICAL STATION

Ideally, a forestry school should maintain a meteorological station both to maintain current climatological records in support of field operations and to teach appropriate procedures for reading instruments and recording data. The equipment used should be of the same type as is used in government meteorological stations within the country. This enables the records to be incorporated in the national climatological data. The layout of the instruments should also correspond to the approved local pattern and a security fence is essential.

Initially, the station may start with a few basic instruments, including a standard rain gauge, a Stevenson Screen containing maximum and minimum thermometers as well as wet and dry bulb thermometers, a simple evaporimeter, a weather-vane and a cup anemometer to enable wind speeds to be calculated. Later on, as more funds become available and the skill of the staff and students in handling instruments increases, more expensive and intricate items can be purchased. These might include a sunshine recorder, recording rain gauge, recording thermo-hydrograph, evaporation tank, total radiation integrator and soil thermometers.

Readings, of course, have to be taken throughout the year and this can present difficulties in the vacations. As a solution, it is often possible to train one or more of the maintenance staff to be permanent observers. They can be used to train students in taking observations during term-time and also be responsible for continuing the readings during the holiday periods.

23. EQUIPMENT

23.1 Teaching equipment

All classrooms should be equipped with a number of essential items of equipment such as a chalkboard for writing or displaying notes and diagrams. Ideally, the chalkboard should be of the roller type with a prepared graph section. This model enables the instructor to refer back to diagrams or notes presented in the early part of a teaching session. A screen is also necessary, if films and slides are to be used. The most convenient type is a spring-loaded roller screen, installed above the chalkboard. The screen can quickly be brought into position and then released when it is no longer required. Similarly, if overhead projectors are used, an angled screen will be required, as mentioned in Part I, Section 9.8. Finally, a clock is an essential item, which should be hung at the rear of the classroom for the convenience of the instructor.

Some of the equipment used should be permanently allocated to each classroom, e.g. chalkboard. Other expensive items, like a 16mm film projector, can be shared. Appendix 6 gives a list of equipment which should be considered.

23.2 Office equipment

23.2.1 Principal's and instructors' offices

An instructor's office should be furnished primarily as an office, but should contain additional equipment to make it an efficient work-room for him to cope with his particular duties. In the case of the principal and senior instructors, provision must also be made for interviewing staff and students and for group meetings.

The range of furniture and equipment suggested is given in Appendix 7.

23.2.2 Administrative office

An administrative office should be adequately equipped for the number of staff sharing it, with specialized items such as filing cabinets, and a safe, located near the person who is responsible for their use. In hot climates, air conditioning may be considered necessary, or otherwise, the use of ceiling fans.

A suggested list of furnishings and equipment is given in Appendix 7.

23.2.3 Typists' office

An office for typists should contain the necessary equipment for the main function of typing. It may, however, provide reception facilities for visitors to the main office complex and contain a telephone exchange or radio telephone. In addition, it is usual for any document reproduction equipment to be installed in the typists' office.

A suggested list of furnishings and equipment is given in Appendix 7.

23.3 Laboratory equipment

A detailed list of laboratory equipment can only be produced once the full scope of teaching in the physical and biological sciences has been decided. There may be considerable differences between countries in the objectives and scope of the topics dealt with in the physical sciences, but there is more likely to be a closer agreement on the requirements of the biological sciences.

Some suggestions on suitable items are given in Appendix 8, but it is emphasized that detailed "shopping lists" for any particular institution should only be prepared once the requirements of the curriculum are known. It is preferable to be short supplied and forced to use some improvisation in the first year than to order a large quantity of expensive equipment only to find later that some of it is unnecessary.

23.4 Herbarium

The basic equipment for a herbarium can be more clearly defined and a suggested list of standard items is given in Appendix 9.

23.5 Library

The range of equipment required for a library will depend upon a number of factors, including the size of the institution, the importance of the library in its teaching role, and the use made of it by staff for reference or research purposes.

Inevitably, cost factors may prove the greatest constraint in developing a good library and resource centre, but within reason, the fuller the equipment, the greater the service it can provide to both students and staff.

Suggested items of equipment for a major library are given in Appendix 10. These may have to be scaled down, if funds are limited, or the full range can be acquired over a period of years. A list of reference books is given in Appendix 11.

23.6 Workshop equipment

A list of desirable workshop equipment could be very lengthy and if acquired without careful consideration would involve considerable expenditure. It is therefore more realistic to start with a limited range of items, such as are indicated in Appendix 12. Additional items can then be acquired as the requirements of the various courses, the schedule of practical exercises and the range of maintenance services required are defined more precisely. A more comprehensive list of appropriate items can be found in the International Labour Organization's "Equipment Planning Guide for Vocational and Technical Training and Education Programmes No.17, Forestry (1981)".

In funding a new institution, it is better to spread the equipment allocation over the first 2 to 3 years of operation. It is also a good idea to allow some degree of flexibility in the allocation of funds to help relate the equipment supply, both in the range of

equipment and numbers of items, to the emerging needs of the programme. The alternative is to have a lengthy preparatory period for establishing the programme, but even this is unlikely to foresee precisely all the needs.

23.7 Field equipment

A very comprehensive list of suitable field equipment can be found in the ILO publication mentioned in paragraph 23.6 above. Additional items of importance are outlined in Appendix 13. Again, it would be unwise to commit an institution to purchasing a large amount of equipment in the initial stages, as the full range and numbers of items required may only emerge once the training programme is in operation.

23.8 Camp equipment

The definitive list of camp equipment required for any institution will depend upon the extent to which camping plays a part in the training programme. It will also depend upon the general views of what a camp should be. In certain areas, this is distinctly spartan, whilst in others, particularly in the eastern hemisphere, it may be quite luxurious. The suggested list of equipment in Appendix 13 aims to fall between these two extremes and to provide a moderately comfortable standard of camping.

23.9 Catering equipment

Good standards of catering are required at a forestry school, as the students are likely to be young, extremely fit, and with very healthy appetites. The person in charge of the kitchen must, therefore, be encouraged to select the right kind of equipment which will help to produce well-cooked meals and allow them to be served properly.

The main items requiring close attention are pots and pans and the cooking stoves. The former should be of a heavy duty pattern and sufficiently large to cope with the numbers being fed. Similarly, if electric or gas ovens are chosen, they should be large-size catering models, with not too many gadgets, as these are liable to go wrong. In making the choice of equipment for cooking and baking purposes, it should be remembered that although modern ovens are quick and easy to clean, they are usually very expensive. Likewise, the cost of electricity or gas can be very high in developing countries. An alternative is to use wood or charcoal cooking stoves, possibly located in an outside kitchen. Although much slower and more messy, they make use of local fuel supplies. Probably a combination of the two provides the best situation, as the charcoal stoves can be used when there are power cuts or bottled gas is in short supply.

23.10 Fire-fighting equipment

A number of items of fire-fighting equipment have been mentioned earlier in connection with some of the recommended facilities. To be safe, it is suggested that when the final plans for a forestry school have been agreed, a review should be made of the provisions for fire-fighting and emergency evacuation of staff and students. Whereas fires can start anywhere, the kitchen, laboratories and workshops are likely to be the most hazardous. Here, large-size inert powder or foam fire extinguishers must be provided together with an asbestos blanket. Extinguishers should also be obtained for the classrooms, offices, dormitories and staff quarters. For these facilities, it may be possible to locate the appliances in central positions to serve groups of buildings.

All exits from buildings should be kept clear of obstructions and fire exit doors must be clearly indicated. Both staff and students should be trained to use fire-fighting equipment. Such equipment should be checked annually to make sure it is effective. Fire drills should be held once a term to ensure that everyone knows what to do in case of a fire.

If there is an existing fire service, either public or private, in the neighbourhood, it will probably be worthwhile contacting the Chief Fire Officer to seek his advice about the school's fire precautions. He may also be able to arrange for his staff to give demonstrations of different fire-fighting techniques.

24. DESIGN AND SUPERVISION OF BUILDING PROJECTS

It has been stated that architects, in general, are not very well informed about the special requirements of buildings to be used for technical training in forestry. Therefore, assuming that the staff of a new forestry school have been appointed before the buildings are constructed, it is essential that they take a great interest in the building project.

If it can be arranged, any staff suggestions should be considered at the design stage and the principal should try to make sure that a set of the draft plans is sent to him for scrutiny. With a certain amount of tact, patience and persuasion, it should be possible to eliminate the worst design features and ensure that at least some of the ideas of the school staff are incorporated into the final design.

If the staff are appointed after building construction has commenced, there will still be opportunities to change things, particularly if a close watch is kept on the site. Normally, a clerk of works will be appointed and good relations should quickly be established with him. He can be a very good ally, pointing out problems which have arisen and generally keeping the school well-informed of developments on the site. It may even be worthwhile for the principal to appoint a staff member as the "site liaison officer". He should be well-acquainted with the plans and be free to spend a lot of time watching the building operations and working with the site supervisors. If things are going wrong, e.g. incorrect siting of buildings, poor workmanship or a need to change the design of a room, the matter should be reported to the principal. He can then try to sort things out locally, but if these efforts fail, the issue should be raised immediately with higher authority. It may result in unpleasant interviews or enquiries, but the principal has a duty to look after the long-term interests of the school. On completion of the buildings, no one will be interested or have any sympathy if he complains about design faults, when it is known that they might have been eliminated through earlier action. It will be a very satisfying moment when the school buildings are finally opened and the staff are able to feel that they have made significant contributions to a design which works.

APPENDIX 1

ASSESSMENT OF KNOWLEDGE/SKILLS REQUIRED BY FOREST TECHNICIANS TO PERFORM THEIR DUTIES

NAME: ..... AGE: .....

RANK: ..... NUMBER OF YEARS

STATION: ..... IN ORGANIZATION: .....

IN PRESENT RANK: .....

SUBJECT	Little or no knowledge/skills required	Some knowledge/skills required	Relatively good knowledge/skills required	Very good knowledge/skills required	Specialist knowledge skills required
1. National language					
2. International language					
3. Basic mathematics					
4. Biology					
5. Forest Botany					
6. Geology/Soils					
7. Use of hand tools					
8. Use of chain saws					
9. Preparation of land					
10. Planting					
11. Weeding					
12. Pruning/Thinning					
13. Felling					
14. Extraction of timber					
15. Measurement of plantations/forest areas					
16. Measurement of timber					
17. Nursery work					
18. Road construction					
19. Building construction					
20. Water supplies					
21. Work study					
22. Surveying					
23. Supervisory duties					
24. Communication and extension					
25. Office administration					
26. Report-writing					
27. Bee-keeping					
28. Maintenance of vehicles					
29. First aid					
30. Community forestry					

APPENDIX 2

2.0 CORE CURRICULUM

The curriculum for any particular school must be devised to meet the specific needs the school is aiming to fulfil. It is, in fact, dangerous to try to adopt, or even modify, the curriculum of any other institutions without first examining critically the precise needs of the country.

The suggestions for a core curriculum are, therefore, given more as an indication of how this might be prepared than for the specific topics mentioned within. Subjects have been given traditional or rather generalized titles. Sub-division of these major blocks of work can easily be done when the circumstances warrant it. The emphasis within the subject will vary from country to country or from area to area within a country.

Educators must, however, be aware of the dangers of a very wide selection of relatively short topics which may fail to form any recognizable pattern in their students' minds, and the difficulties students may have in using knowledge gained in one subject, without guidance, to support work in another.

The two curricula, based on a 2-year diploma course, have obvious limitations and concentrate on providing a sound basic education in technical matters. A suggested curriculum for a further 1-year course to prepare a candidate with some years of field service is also given, but this is of value only as a general guide. The authorities sponsoring such a course must, in every case, be able to define more specifically what they require of members in this higher grade. It is only then that the training institution can devise a course to meet these requirements.

No particular system of course numbering is recommended. This varies considerably from place to place, and it is most logical to adopt a numbering system, should this be necessary, which corresponds to those in use in universities or similar technical institutions in the country.

The alternative 2-year curriculum has been suggested to meet the situation where the authorities require a series of courses in basic studies, not directly related to forestry in order to maintain some degree of uniformity with training in other disciplines. Such courses, where they are required, weigh heavily on the limited time available and undoubtedly affect the technical competence of the eventual trainees, although they may have some general education benefits.

It is desirable to leave a certain number of hours teaching or practice unallocated within each subject to allow for public holidays, and for unforeseen disruptions in the teaching programme.

2.1 CORE CURRICULUM: Two-Year Diploma Course (excluding Basic Studies Courses)

6 terms of 10 weeks each with 2 weeks of practical exercises and 2 weeks vacation after the first, second, fourth and fifth terms, and 8 weeks field work and 6 weeks vacation after the third term (or any alternative distribution of practical exercises/field work to suit local conditions).

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(Appendix 2, cont.)

YEAR 1

TERM 1.1

BOTANY I	50 hrs.	Plant morphology.
SILVICULTURE I	70 hrs.	Seed production; collection; treatment; and nursery practice.
UTILIZATION I	70 hrs.	Care and use of common hand-tools and working techniques in forest operations.
SURVEYING I	70 hrs.	Common surveying instruments and techniques; preparation of simple plans and calculations of area.
FOREST SOILS	60 hrs.	Development and structure of forest soils, nutrient status and soil descriptions.
FIRST AID/HEALTH AND SAFETY IN WORK	30 hrs.	Simple first-aid procedures; safe working procedures; diet, etc.

Term followed by 2 weeks practical exercises mainly in Silviculture and Utilization but with some practice in Surveying and Soils.

TERM 1.2

BOTANY II	50 hrs.	Plant physiology with special relations to trees.
SILVICULTURE II	70 hrs.	Plantation establishment and maintenance techniques.
UTILIZATION II	70 hrs.	Forest operations, harvesting and extraction techniques.
SURVEYING II	70 hrs.	Study of scales; enlargement and reduction of scales; use of topographic maps; simple photogrammetry.
FOREST MENSURATION I	60 hrs.	Measurement of forest produce and individual trees.
INTRODUCTORY STATISTICS	30 hrs.	Basic introduction to statistics for foresters.

Term followed by 2 weeks practical exercises in Silviculture, Mensuration and Utilization.

TERM 1.3

DENDROLOGY	70 hrs.	Study of forest species and forest types.
SILVICULTURE III	70 hrs.	Silviculture of indigenous forests and regeneration systems.
MENSURATION II	70 hrs.	Measurement of forests; sampling and inventory techniques.
UTILIZATION III	70 hrs.	Wood technology; requirements and processes of forest industries.
POLICY AND LAW	40 hrs.	Review of forest policy in relation to national objectives and fundamentals of local forest laws and legal procedures.
FOREST INFLUENCES	30 hrs.	Effects of trees on climate, water, soil, with reference to management of water yields, etc.

Term followed by 8 weeks field exercises in silviculture, sampling and inventory techniques, tour and visits to forest industries.

(Appendix 2, cont.)

YEAR 2

TERM 2.1

FOREST ECOLOGY	70 hrs.	Recognition and classification of plant communities; succession; forest structure, etc.
SILVICULTURE IV	60 hrs.	Silvicultural techniques in arid, semi-arid and mountainous areas.
AGROFORESTRY	60 hrs.	Management of forests in conjunction with agricultural requirements.
FOREST ECONOMICS	50 hrs.	Economics of forest operations; production, conversion and marketing of forest products.
FOREST ENGINEERING	70 hrs.	Road alignment and construction; culverts; bridges, etc.
TECHNICAL REPORT-WRITING	40 hrs.	Content and format of technical reports.

Term followed by 2 weeks of practical exercises in Ecology, Agroforestry or forestry in semi-arid or mountainous areas, and road alignment and construction.

TERM 2.2

FOREST MANAGEMENT	70 hrs.	Forest management techniques; inventory control; data collection and presentation techniques.
FOREST EXTENSION AND COMMUNITY FORESTRY	100 hrs.	Extension techniques; investigation, definition and implementation of community projects.
FOREST ENGINEERING	70 hrs.	Simple building construction and water supplies.
FOREST TREE IMPROVEMENT	60 hrs.	Genetic principles and implementation of tree improvement programmes.
ENTOMOLOGY	50 hrs.	Anatomy, physiology and classification of insects; study of some important orders of insects; prevention and control of insect damage.

Term followed by 2 weeks of practical exercises in Community Forestry and Engineering.

TERM 2.3

FOREST MANAGEMENT	70 hrs.	Collection and analysis of data; application of management systems; preparation of management plans.
ADMINISTRATION	100 hrs.	Structure and organization of government and ministries and forest organization; channels and methods of communication; stores and financial procedures; personnel management.
SILVICULTURAL RESEARCH	70 hrs.	Organization and administration of research projects; arboretum; species trials; crop performance trials; collection and analysis of data.
PATHOLOGY	50 hrs.	Important tree diseases and their causes; recognition; prevention; treatment.
WORK STUDY	50 hrs.	Work measurement; day work; task work; piece work; setting and achieving targets.

(Appendix 2, cont.)

2.2 CORE CURRICULUM: Two-Year Diploma Course (including Basic Studies Courses)

6 terms of 10 weeks each with 2 weeks practical exercises and 2 weeks vacation after the first, second, fourth and fifth terms and 8 weeks field work and 6 weeks vacation after the third term (or any alternative distribution of practical exercises/field work to suit local conditions).

YEAR 1

TERM 1.1

BOTANY I	50 hrs.	Plant morphology.
CHEMISTRY	60 hrs.	Introduction; measurements and concepts; weight relationships; structure; bonding; gases; solutions; equilibrium; organic chemistry.
MATHEMATICS	60 hrs.	Forest calculations and basic statistics.
SILVICULTURE I	60 hrs.	Seed production and collection; nursery practice.
UTILIZATION I	50 hrs.	Care and use of common forest tools and working techniques.
FOREST SOILS	40 hrs.	Development and structure of forest soils.
LANGUAGE STUDIES	30 hrs.	Improvement studies in use of official language; correspondence.

Term followed by 2 weeks of practical exercises in silviculture and use of common forest tools.

TERM 1.2

BOTANY II	50 hrs.	Plant physiology.
PHYSICS	60 hrs.	Vectors and balances; motion; work; energy; power; gases; angular motion; vibratory motion; heat; mass; density; light; electro-statics.
SILVICULTURE II	70 hrs.	Plantation establishment and maintenance techniques.
UTILIZATION II	70 hrs.	Forest operations, harvesting and extraction techniques.
LANGUAGE STUDIES	30 hrs.	Technical report-writing.
FOREST SOILS	40 hrs.	Soil nutrients and relations to plants; field soil descriptions.
FIRST AID AND HEALTH AND SAFETY	30 hrs.	Simple first-aid procedures; safe working procedures; diet, etc.

Term followed by 2 weeks practical exercises in plantation establishment and maintenance techniques and harvesting techniques.

TERM 1.3

DENDROLOGY	60 hrs.	Study of species and composition of forest types.
SILVICULTURE III	60 hrs.	Silviculture of indigenous forests and regeneration systems.
UTILIZATION III	60 hrs.	Wood technology; requirements and processes of forest industries.

(Appendix 2, cont.)

(Term 1.3)

SURVEYING I	70 hrs.	Common surveying instruments and techniques; preparation of plans and calculation of area.
FOREST MENSURATION I	60 hrs.	Measurement of forest produce and individual trees.
POLICY AND LAW	40 hrs.	Review of forest policy in relation to national objectives and fundamentals of local forest laws and legal procedures.

Term followed by 8 weeks of field exercises in silviculture and mensuration, and visits to forest industries.

YEAR 2

TERM 2.1

FOREST ECOLOGY	50 hrs.	Recognition and classification of plant communities, succession, forest structure, etc.
FOREST INDUSTRIES	30 hrs.	Effect of trees on climate, water, soil, with reference to management of water yields.
SILVICULTURE IV	50 hrs.	Silviculture techniques in arid, semi-arid and mountainous areas.
AGROFORESTRY	40 hrs.	Management of forests in conjunction with agricultural requirements.
FOREST ECONOMICS	40 hrs.	Economics of forest operations; production, conversion and marketing of forest products.
FOREST MENSURATION II	70 hrs.	Measurement of forests; sampling and inventory techniques.
FOREST ENGINEERING I	70 hrs.	Road alignment and construction; culverts, bridges, etc.

Term followed by 2 weeks of practical exercises in ecology, inventory techniques and agroforestry or forestry in arid and semi-arid areas as appropriate.

TERM 2.2

FOREST MANAGEMENT	70 hrs.	Forest management techniques; inventory control; data collection and presentation techniques.
FOREST EXTENSION AND COMMUNITY FORESTRY	100 hrs.	Extension techniques, investigation, definition and implementation of community projects.
FOREST ENGINEERING	70 hrs.	Simple building construction and water supplies.
FOREST TREE IMPROVEMENT	60 hrs.	Genetic principles and implementation of tree improvement programmes.
ENTOMOLOGY	50 hrs.	Anatomy, physiology and classification of insects; study of some important orders of insects; prevention and control of insect damage.

Term followed by 2 weeks of practical exercises in Community Forestry and Engineering.

TERM 2.3

FOREST MANAGEMENT	70 hrs.	Collection and analysis of data; application of management systems; preparation of management plans.

(Appendix 2, cont.)

(Term 2.3)

ADMINISTRATION	100 hrs.	Structure and organization of government and ministries and forest organization; channels and methods of communication; stores and financial procedures; personnel management.
SILVICULTURAL RESEARCH	70 hrs.	Organization and administration of research projects; arboretum; species trials; crop performance trials; collection and analysis of data.
PATHOLOGY	50 hrs.	Important tree diseases and their causes; recognition; prevention and treatment.
WORK STUDY	50 hrs.	Work measurement; day work; task work; piece work; setting and achieving targets.

2.3 CORE CURRICULUM: One-Year Senior Technicians' Course (following service in the field as a Junior Technician)

3 terms of 10 weeks each with 2 weeks of tours or practical exercises and 2 weeks vacation after the first and second terms and 6 weeks tour or field study programme after the third term.

TERM 1

SILVICULTURE	70 hrs.	Review of recent developments in techniques in plantations and natural forest silviculture; organization and planning of silvicultural operations; records.
UTILIZATION	70 hrs.	Review of recent developments in working techniques and extraction methods; new and developing forest industries; requirements of material; planning operations to meet requirements of industry;
SURVEYING	70 hrs.	Review of standard procedures; improved instruments; costs; operating procedures, etc. Introduction to precise surveying and levelling.
MENSURATION	70 hrs.	Review of recent developments in techniques and equipment; planning and organizing inventories to achieve standards of accuracy.
HEALTH AND SAFETY/ ERGONOMICS AND WORK EFFICIENCY	40 hrs.	Review of recent developments; review of work practices to improve efficiency.
PRIVATE STUDY	30 hrs.	Reading or initial investigation of a topic for private investigation and report.

Term followed by 2 weeks study tour of selected forest areas to see examples of recent developments studied in class.

TERM 2

ADVANCED SILVICULTURE	70 hrs.	Review of existing silvicultural techniques in certain selected areas. Evaluation of results in relation to cost and personnel requirements; study of possible variations in objectives or techniques; study of possible amended procedures for monitoring success.
SILVICULTURE RESEARCH	70 hrs.	Planning and lay-out of experiments; assessment techniques; checking and verification of data; maintenance of records; formulation of proposals for additional research.

(Appendix 2, cont.)

(Term 2)

FOREST MANAGEMENT	70 hrs	Detailed study of selected ongoing management plans; review of proposals and achievements to date; presentation of data in tabular and graphic forms; review of staffing, finance and equipment in relation to objectives; revision of at least one selected plan.
ADVANCED UTILIZATION AND ENGINEERING	70 hrs.	Review of new equipment available; evaluation of any possible cost benefits in purchasing it. Preparation of training programmes for staff in new techniques/tools; efficiency/productivity tests to quantify benefits.
PRIVATE STUDY	70 hrs.	Reading; field study; collection of data on a specific topic of relevance to the student's work.

Term followed by 2 weeks detailed field study of major silvicultural, management, utilization or research area, to gain experience in new techniques.

TERM 3

ADMINISTRATION	100 hrs.	Review of processes of administration within the organization; review of administrative procedures outside the public sector; critical examination of any apparent weaknesses; proposals for improved procedures. Study of improved budgeting techniques and expenditure control; presentation of data in tabular and graphic form. Case studies in stores and personnel problems; assessment of performance and personnel report-writing.
EXTENSION/COMMUNITY FORESTRY	100 hrs.	Case studies of some existing projects; evaluation of results in relation to costs; definition of problems; formulation of alternative targets or methods of approach.

OPTIONAL COURSES

PUBLIC RELATIONS	40 hrs.	Public relations techniques for public organizations.
OR		
LEGAL PROCEDURES		Presentation of documents, etc. for legal action.
MAPPING AND PRESENTATION OF DATA	40 hrs.	Map production; visual presentation of data.
OR		
USE OF OFFICE MACHINES AND EQUIPMENT		Familiarization with office machines in current use.
PRIVATE STUDY	70 hrs.	Reading, field study; collection of data on a specific topic of relevance to the student's work. Continuation of previous term's work. Continuation of previous term's work or new topic.

Term followed by 6 weeks field study programme. 3-4 weeks tailored to students' particular interests in technical matters with at least 2 weeks study of administrative procedures in regional or central offices.

APPENDIX 3

COURSE : SILVICULTURE - C.100

SECTION: PLANTATIONS - C.111

COURSE OBJECTIVES

To teach the standard procedures adopted in establishing and tending plantations of softwoods and other fast-growing species within the country.

ACHIEVEMENT TARGETS

After completing the course a student should be able to:

(1) Verify that a site is suitable for the species and objectives of the plantation;
(2) prepare the site for planting;
(3) carry out the lining-out, hole digging and planting operations required;
(4) carry out all weeding and tending operations prescribed, including pruning;
(5) calculate the number of trees to be marked at each thinning by the method prescribed;
(6) select trees to be thinned on proper silvicultural grounds and carry out the thinning.

CLASSWORK

Ref.	TOPIC	Hours
111.0	Plantations	4
	Introduction; reasons for establishment.	
1.1	Choice of site; objects; available sites; transport.	
1.2	Choice of species; objects of plantations; site factors.	
2.0	Preparations for Planting	5
2.1	Water control; clearing in grassland, forest, swamps.	
2.2	Preparation of ground; spot and strip hoeing; strip ploughing; clean hoeing; complete ploughing; disc harrowing.	
2.3	Spacing; silvicultural and economic considerations.	
2.4	Lining-out on flat sites; on steep hills.	
3.0	Planting Operations	2
3.1	Lifting, transporting and distributing plants; time of planting; methods; stock check; survivor count; beating up; use of insecticides.	
4.0	Weed Control	2
	Objects of weed control.	
4.1	Methods; clean hoeing; harrowing; strip and spot hoeing; slashing and trampling; chemical weed control; use of cover crops; climber cutting.	

(Appendix 3, cont.)

Ref.	TOPIC	Hours
5.0	Pruning	2
	Definition and objects of pruning.	
5.1	Types of pruning; rodent/climber pruning; access; 1st and 2nd high prunings; method; season; pruning schedules for softwoods; pruning hardwoods.	
6.0	Thinning	6
	Definition and objects; silvicultural and mechanical thinning.	
6.1	Basic ideas; classification of trees; principles; degree of thinning; cycle; dangers of over- or underthinning; yield.	
6.2	Selection of thinnings in plantations; small plot method; calculations; selection and marking in the field; selection for 2nd and 3rd thinnings, stock check before 3rd thinning; rate of work; felling.	
7.0	Eucalyptus Pole, Fuelwood and Timber Plantations	2
	Economic considerations.	
7.1	Choice of site; ground preparation; spacing; weeding; pruning and thinning; eucalyptus timber crops.	
8.0	Hardwood Plantations	1
	Past efforts.	
	Unallocated	3

DEMONSTRATIONS AND PRACTICAL EXERCISES

Ref.	TOPIC	Hours
2.1	Clearing before planting	2
2.2	Lining-out on flat sites and steep slopes	6
4.1	Weed control, methods of weeding	2
5.1	Pruning, demonstration	4
6.2	Selection of thinnings by small plot method	4

FULL-DAY PRACTICAL EXERCISES

Ref.	TOPIC	Days
2.1	Clearing in grassland	4
2.2	Preparation of ground, ploughing	
2.4	Lining-out on flat sites and steep slopes	10
3.1	Planting, stock-checking	
4.1	Weed control, climber cutting	
5.1	All types of pruning	3
6.1	Thinning selection	
7.1	Eucalyptus planting	

APPENDIX 4

METHODOLOGY FOR ASSESSING TRAINED MANPOWER REQUIREMENTS FOR FORESTRY AND RELATED INDUSTRIES

Manpower planning may be described as a systematic attempt aimed at maintaining and improving the ability of an organization to achieve its stated objectives through the development of strategies designed to enhance the contribution of manpower at all times and in the foreseeable future. It is of vital importance for the formulation of sensible education and training policies. It is also a valuable management tool for career development, promotion, setting forth a realistic recruitment policy and establishing sound labour relations.

The quantitative aspect of manpower planning has three main components: (1) determination of the numbers of trained people actually employed, (2) assessment of trained manpower requirements in the light of clearly defined development targets for the sector and (3) translation of requirements into educational and training needs.

Determining the demand for trained manpower is the most difficult as well as the most important step. The needs can be estimated fairly accurately over time, given certain basic data. However, the actual demand, especially in the public forestry sector, which, in developing countries, is always the largest employer of trained forestry manpower, depends also on other factors, mainly financial ones. Ultimately, it is finance which determines what is possible rather than desirable for effective operation.

The particular characteristics of forestry and forest industries that influence manpower needs of this sector have been fully described by Professor S.D. Richardson 1/ in his original work in this field. These special features can be summarized as follows:

1. Forestry is involved in several sectors of the economy, notably the industrial and service sectors, as well as the rural sector.

2. Forestry shows a wide range of capital/labour ratios, from labour-intensive forest establishment and management to capital-intensive industries, such as modern paper mills and automated fibreboard plants.

3. The essential feature of forestry is its long-term nature. This gives it a relatively poor competitive status for finance in the absence of quick returns. Also, forests are not movable assets in that their location is determined by the physical and biological environment. These features increase the difficulties of finding and applying any really universal norms for manpower requirements for forest production.

4. In contrast to agriculture, where rising labour-force numbers frequently limit the production structure adopted, forestry can usually operate according to economic criteria and capital output ratios. In these conditions, manpower requirements can be linked to productivity per unit area or per forest product unit, provided the necessary basic data are available.

5. The changing nature and concepts of forestry production in the world are having significant effects on the present-day role and training of foresters, as well as on the structure of forestry administrations.

1/ Richardson, S.D.: "Manpower and Training Requirements in Forestry Development Planning". FAO, Rome.

(Appendix 4, cont.)

6. Forestry education and training covers many aspects, e.g. wildlife management, erosion control, inventory and surveying, sawmill engineering, produce processing, as well as tree crop production. This creates a difficulty in attempting to translate numerical manpower requirements into a meaningful occupational classification, and the need for flexibility in forestry training programmes.

Classification of forestry operations

Because of the diversity of forestry activities, some broad classification is necessary as a preliminary step in making an assessment of manpower requirements. Details of such a classification may well vary from country to country, depending on the range of their forestry and related operations.

A widely used classification is that evolved by H.A. Hilmi precisely for this purpose. This has the following groupings:

i) Plantations: covering a) establishment of new forest plantations and related operations; b) management of existing plantations.

ii) Natural forests: management for production only. It is considered that management costs on extensive areas of variable tropical forests would not be justified except for identifiable benefits (see under multiple-use forestry below).

iii) Industrial wood supply: felling, logging and transport operations to supply all major forest industries, but also including fuelwood production and bamboo production.

iv) Forest industries: usually sub-divided into a) sawmilling; b) wood-based panel industries; c) wood pulp industry, depending on what exists or is planned.

v) Multiple-use forestry: including the needs of torrent control, soil and water conservation in mountain areas; protection against encroachment, fire, pests and diseases; forestry aspects of shifting cultivation (agroforestry); nature reserves, national parks, recreation, game reserves and wildlife management 1/.

vi) Ancillary activities: covering a variety of activities not readily quantifiable in terms of manpower requirements; e.g. forest administration, servicing and planning; research, development and extension; education and training; other operations not covered above in items i) - v).

Having established a suitable breakdown of the overall pattern of forestry operations in any one country, the next step is to quantify, as far as possible, each in appropriate units of area, volume or weight. Essential for this purpose as a means of estimating manpower requirements is the existence of a forestry development plan which should establish production targets for 15-20 years ahead. The more realistic and detailed the plan, the more accurate the manpower estimates are likely to be.

Method for estimating trained manpower requirements for forestry

Where there is wide diversity and intensity of manual operations to cater for in manpower planning work of this kind, the logical approach is to determine first the workforce requirements - or labour norms - for each forestry operation, and then to apply practicable supervision ratios to assess the numbers of trained personnel needed at each level. This, together with the inclusion of labour productivity factors, was the basis of the forestry manpower methodology evolved by Richardson. Unfortunately, few countries have yet accumulated the time series of statistical data needed, so simpler methods have had to be employed meantime.

1/ A new methodology is now being developed for assessing trained manpower requirements for wildlife and national parks management.

(Appendix 4, cont.)

To fill the gap, Hilmi devised a series of empirical norms for technical-level personnel, based on forest area or forest products. The numbers of professional personnel were estimated by applying empirical ratios to the numbers of technical personnel. These norms and supervision ratios are reproduced in full below. They are based largely on data drawn from countries of the Asian region and considered to be workable averages for broad manpower planning purposes. In the present context, however, their use is mainly illustrative, so that the figures given should be revised where necessary by and for each individual country in the light of experience and to accommodate technological advances and changing socio-economic conditions.

Proposed work norms for forestry technicians 1/

a) Plantations

i) Establishment of new plantations (including related operations):
1 technician per 200 ha.

ii) Management of existing plantations:
1 technician per 1,000 ha.

b) Natural forests

Take the total number of technicians estimated for all five norms of item c) below (industrial wood supply) and multiply this number by the percentage of industrial wood production from natural forests. This proportion is taken as indicating the level of management intensity required, as well as being the factor from which to derive the numbers of technicians needed.

c) Industrial wood supply (felling, logging and transport)

i) For log production (sawlogs, logs for plywood, veneer, sleepers):
1 technician per 10,000 m^3 of roundwood removals per annum. 2/

ii) For production of other industrial wood (pulpwood, poles, pitprops, for production of boards, etc.):
1 technician per 30,000 m^3 of roundwood removals per annum.

iii) Fuelwood production:
1 technician per 100,000 m^3 per year of industrial fuelwood. 3/

1 technician per 1,000,000 m^3 per year of non-industrial fuelwood.
(The figure may be as low as 500,000 m^3 in some localities.) 4/

1/ "Needs and Problems of Forestry Education in Asia". FAO/APFC, 8th Session, Seoul, Republic of Korea.

2/ A higher figure of 15,000 m^3 per technician was adopted, for example, in the case of Malaysia and the Philippines because of considerably higher stocking per unit area of forests as well as higher volume outturn per tree.

3/ Industrial fuelwood consists of fuelwood used in industries of all kinds, steamboats, railway locomotives, factories, power stations, charcoal kilns, etc. and, generally, fuelwood used for urban consumption or disposed of commercially - and requiring stricter supervision and control - as opposed to 4/ below.

4/ Non-industrial fuelwood, generally of non-commercial nature or for rural consumption. For example, villages situated close to forests, whether classified as reserve or unclassed public forests, have direct and free access to local forest products, particularly fuelwood, to which the villagers help themselves. This now requires little or no supervision and control, but such control is expected to increase considerably in the future.

(Appendix 4, cont.)

iv) Bamboo production
1 technician per 30,000 metric tons per annum. 1/

d) Forest industries

i) Sawmilling:
1 technician per 25,000 m^3 annual input.

ii) Wood-based panel industries:
1 technician per 12,500 m^3 annual input.

iii) Pulp industry:
1 technician per 3,500 metric tons annual output.

e) Multiple-use forestry

Subjective estimates based on the importance to the country of the fields indicated in the classification of forestry operations, item v). In a later manpower study of the same region, Lantican 2/ used a ratio of 1 professional + 3 technicians for every 40,000 ha. of multiple-use forest. Where agroforestry is a significant feature, special provision may be needed for forestry extension manpower on a population basis similar to that used for agricultural extension work.

f) Ancillary activities

Add 15 percent of the estimated total personnel employed under a) to e) for development and extension, research, education and training.

Table 1.- Forestry Personnel - Summary of Supervision Ratios

Activity	Ratio Professional/Technical
a) Plantations	
i) Establishment	1 : 7
ii) Management	1 : 6
b) Natural forests	
Management for production	1 : 8
c) Industrial and wood supply	
All types	1 : 8
d) Forest industries	
i) Sawmilling	1 : 5
ii) Wood-based panel industries	1 : 3
iii) Pulp industry	1 : 3
e) Multiple-use forestry	1 : 4
f) Ancillary activities	1 : 3

1/ Bamboos are managed both in plantations and natural forests. In view of their increasing importance in the rural economy and as raw material for pulp and paper mills in the region, more and more skilled personnel will be required.

2/ Lantican, D.M. (1978): "Reappraisal of Forestry Education and Training Needs in Selected Countries in Asia and the Far East". FAO, Rome.

(Appendix 4, cont.)

Forestry manpower training levels

Planning of trained personnel for forestry development is concerned mainly with three levels in the operational field of forestry and forest industries: vocational, technical and professional. A wide diversity of employee nomenclature is used which, because it often relates more to duties and rank, may confuse the issues for the manpower planner. Richardson, therefore, in giving the following definitions, makes it clear that the terms refer primarily to levels of training rather than to types of training or kinds of employment, as recommended by the FAO Advisory Committee on Forestry Education.

Vocational: Personnel concerned mainly with the direction of manual labour; they may have received a formal training of less than six months, or may have been promoted from the labour force and given ad hoc short-course training. Such personnel hold a variety of ranks and designations in forestry services.

Technical: Formal full-time training is usually for two years, but may range from one to three years, in a recognized technical institution at below university level. Technicians should be capable of organizing and supervising work in forests and industrial plants and carrying out the instructions of professional foresters, administrators, plant overseers and research officers. They carry a wide range of designations and duties. Depite these differences in the extent and depth of training and in the variety of work performed, the usual practice in manpower planning work is to treat technicians as a single category. In some countries, however, there are two distinct technical training levels. For broad planning purposes in such cases, the total estimates of technicians required can be split according to the ratio of 25% "senior" and 75% "junior" levels. This, of course, should be modified to meet the actual availability and utilization patterns found in any one country.

Professional: University graduates who have completed a minimum of three years' full-time study, or its equivalent, in forestry or related disciplines. This includes holders of degrees in pure science and in specialist fields, who may be employed in forestry and its industries, e.g. zoologists, botanists, chemists, economists, civil engineers, etc. The denominations of professionals in the forest services are as varied as those for technical personnel. They characterize personnel that should be capable of policy-making or planning, as a whole or in part, the working of a forest area and, at the highest level, of the national forests of a country or of a specific forest or wood-using industry; and after proper specialization if necessary, planning and research of all kinds for the promotion of forestry and on methods employed by the lumber and wood-using industries.

Forestry staffing ratios

As will be seen from the supervision ratios quoted, Hilmi covers only the professional and technical categories. Lantican, in his later study of the same region, includes a vocational group (forest guards) in his data for actual forestry manpower employed in 1977, and a fourth group, skilled labourers, in his estimated requirements. The comparative staffing ratios calculated from the figures given in his paper, for each of the six countries involved, are shown in the following table.

Table 2 - Asia/Pacific Region: Comparative forestry staffing ratios in 1977 1/

Categories	a) Actual Ratios			b) Estimated Ratios			
	P	T	V	P	T	V	Sk. Lab.
Burma	1	1.98	2.55	1	2.33	6.37	6.62
Indonesia	1	1.95	2.83	1	2.96	5.05	7.41
Malaysia	1	6.84	9.43	1	2.56	3.76	6.41
Philippines	1	1.76	1.26	1	3.10	2.77	7.74
Sri Lanka	1	7.09	13.22	1	1.93	2.87	4.82
Thailand	1	3.25	0.13	1	2.78	3.62	6.94
	1	2.43	1.94	1	2.84	4.61	7.09

1/ Derived from D.M. Lantican. a) refers to actual manpower employed,
b) refers to estimated manpower employed.

(Appendix 4, cont.)

Such national or sectoral ratios, even those derived from estimated requirements, are only a reflection of the trained forestry manpower situation and structure in each country and provide no explanation of the wide variations shown. The ratios in b) above are particularly useful as general guidelines for the manpower planner, but obviously none should be used without thorough preliminary investigation as to their suitability.

To illustrate the more detailed breakdown of such country-wide ratios, an analysis of the estimated manpower requirements for forestry development in Nigeria 1/ in 1985 shows the following staffing ratios for the various groups of forestry operations. These compare with an overall ratio in the forestry public sector for 1975 of: 1 professional: 0,84 senior technical, 2.05 junior technical, 6.72 vocational personnel actually employed.

Table 3 - Nigeria: Forestry staffing ratios from estimated requirements for 1985

Sub-sector	Prof.	Sen. Techn.	Jr. Techn.	Voc.
Forest management	1	1.86	5.29	11.31
Logging (low variant)	1	1.00	3.03	6.12
Plantations (low variant)	1	0.77	2.32	13.03
Forest industries	1	4.67	14.00	4.67
Wildlife	1	0.60	1.00	10.00
Research, training	1	1.50	1.00	1.00
Planning, coordination	1	1.50	2.00	2.00
Overall	1	1.43	3.27	8.11

Forest industries personnel. An important point for the manpower planner to bear in mind and check when considering the needs of forest industries is that only a fraction of the professional and technical personnel employed may be graduates of forestry training institutions as such. Much of the work is more related to mechanical engineering and industrial processing than to forestry. Accordingly, in the Nigerian Country Profile Study, for example, it was assumed that only 10-15 percent of the estimated manpower needs in forest industries would require any formal forestry training. The bulk of the trained personnel would come from Engineering Faculties and trade schools.

Forestry extension personnel. In many developing countries, agrisilviculture is a feature of the tropical forest areas. Where these operations are fully controlled by forestry departments, the system has proved economically and socially beneficial because of the better rates of return and the employment creation effects. Where agrisilviculture is important, special extension personnel should be provided to train and assist farmers/workers in the purpose and methods of agrisilviculture or agroforestry.

Trained manpower needs for this type of forestry extension work can be estimated using similar criteria and ratios to those for agricultural extension work in the same country. In the case of Nigeria 1/, the basis adopted was one technical (agroforestry) assistant to 1,000 agroforestry farmers, and an overall staffing ratio of 1 professional: 2 senior technicians, 5 junior technicians, 6 vocational personnel. The location of such forestry extension personnel within the organizational structure of extension services is a matter for careful consideration if the most effective impact is to be achieved.

1/ Nigeria: Country Profile Study - Agricultural Manpower Planning, Training and Utilization. - Technical Report. UNDP/FAO (AG:DP/NIR/73/001). FAO, Rome, 1978.

(Appendix 4, cont.)

Forestry personnel wastage rates

In manpower planning an essential factor to be measured is the annual staff wastage rate. This covers losses from deaths, retirements and transfers. In addition, allowance must be made for staff turnover due to factors such as unsatisfactory conditions of service, lack of career opportunities within the service, and attractive employment opportunities elsewhere. Where full employment exists, particularly for highly trained personnel during the early years of development, forestry often fares badly in competition with many other occupations offering higher salaries and better amenities. In the absence of locally discernible time trends, the following graduated series of wastage factors may be used as percentages of projected annual employment intake to allow for replacements.

Table 4 - Staff wastage: rate of annual replacement needed (percentages)

Level/Period	First 5 years	Second 5 years	Third/fourth 5 years
Professional	25	20	15
Technical	20	20	15
Vocational	15	10	10

Special wastage factors may apply to female personnel. In general, wastage rates among women will tend to be higher than for men. Much will depend on attitudes to unmarried women occupying certain posts, and on conditions of service for married women, such as transfers with the husband, maternity leave, and so on.

To avoid high unit training costs, it is essential to monitor the situation closely and to obtain accurate data on the nature and extent of annual losses of trained personnel in the forestry sector.

Technological change in forestry

Where trained manpower requirements are based primarily on production criteria, as in the case of forestry and its industries, the effects of technological changes on training needs are likely to be much greater than where manpower is directly related to rural population or human factors. This is something which both the manpower and educational planners have to try to foresee. For example, many governments are putting more emphasis on total rural development, on reforestation of denuded lands, especially watersheds, on wildlife management and on local processing of timber into finished products. These and many related changes are being reflected in forestry education and training programmes, particularly in such fields as forest economics, extension, engineering, and development planning, as well as in the broadening range of trained manpower now needed in the forestry sector.

APPENDIX 5

Accommodation Standards for Educational Buildings
(Revised Edition, April 1977)

Building Research Establishment,
Department of the Environment, London, England

STANDARDS FOR COLLEGES OF FURTHER EDUCATION

	Usable area per working space
Teaching rooms with demonstration	2.50 m^2
Drawing offices (using A1 or smaller boards)	3.70 m^2
Drawing offices (using A0 or larger boards)	4.60 m^2
Laboratories: non-advanced science and engineering	4.60 m^2
Workshops: crafts requiring work benches and smaller-scale machines and equipment	5.60 m^2

Storage and Service Rooms:

Drawing offices	10% addition
Non-advanced science lab.	15% "
Workshops	15% "

A more detailed set of World Bank "Guidelines on the Construction of Educational Buildings", issued in February 1967, may still be available in some countries. This gives extremely precise suggestions and layouts for use at the detailed design stage of buildings.

The cost estimates, however, are now only of historic interest.

APPENDIX 6

6.0 TEACHING EQUIPMENT

A classroom should normally be equipped with as many of the following items as circumstances, space and finance allow:

A CHALKBOARD with a set of suitable drawing instruments

CHALKBOARD CLEANERS and DUSTERS

A FELT-BOARD and/or a MAGNETIC BOARD, as preferred. (This should, if possible, be suspended from an overhead track to allow it to be moved to different points along the wall as required.)

HOOKS for hanging flip-charts

A PROJECTOR SCREEN: either a "pull down" screen fixed centrally or a rigid screen running on an overhead track shared with the felt-board/magnetic board

WALL-BOARDS or NOTICE-BOARDS, felt-covered, at convenient places around the room

A WALL CLOCK

WASTE PAPER BINS, one or more

STUDENTS' TABLES and CHAIRS.

Depending on available funds and the degree of utilization, the following items may be shared between two or more classrooms:

An OVERHEAD PROJECTOR

A SLIDE PROJECTOR with, if possible, back projection facilities

A 16 mm SOUND PROJECTOR

An EPIDIASCOPE.

Where these items are installed on mobile trolleys, they can be moved reasonably conveniently between classrooms on the same floor as required.

Items which may be located in a specific room but used on loan in other rooms, if required, are:

SCIENTIFIC CALCULATORS

PRINTING/ADDING/LISTING MACHINES

INTERVAL TIMERS

STOP WATCHES.

The teaching desk in each classroom should be equipped with drawers or cupboards holding:

WHITE and COLOURED CHALKS

WRITING PAPERS of various types and sizes

SPARE PENCILS, PENS, ERASERS, PENCIL SHARPENERS, etc.

FILES for teaching notes and hand-outs in current use.

(Appendix 6, cont.)

A classroom which also serves as a drawing office should have facilities for storing:

DRAWING BOARDS and STANDS for each student
Sets of DRAWING INSTRUMENTS and SCALES
LIGHT TABLES and adjustable DESK LAMPS.

APPENDIX 7

7.0 OFFICE EQUIPMENT

7.1 INSTRUCTOR'S OFFICE

OFFICE DESK, standard, with cupboard and drawers

DESK CHAIR, preferably on castors

VISITORS' CHAIRS, two or more

TELEPHONE EXTENSION and/or an INTERCOM TERMINAL as appropriate

DESK FURNISHINGS, such as letter trays, pen trays, paper punch, stapler, pencil sharpener, desk lamp, etc.

BLOTTING PAD

WASTE PAPER BIN

WALL CLOCK

SIDE TABLE, suitable for extending the desk during meetings

FILING CABINET, of an appropriate size

BOOK SHELVES

CUPBOARD for stationery

ROOF or DESK FAN, if climatic conditions warrant it

TAPE WRITER

CALCULATOR and/or an ADDING LISTING MACHINE, as appropriate

PORTABLE TYPEWRITER.

A senior instructor's office might also have the following items if space and funds permit:

COFFEE TABLE

ARMCHAIRS, 2 or 3.

7.2 PRINCIPAL'S OFFICE

The principal's office should contain the equipment set out in 7.1 Instructor's office, but a larger desk may be required, with more drawers. Additional equipment might include the following items if space permits:

LARGE TABLE, 4-6 persons, for holding staff meetings

CHAIRS, 4-6

COFFEE TABLE, for entertaining visitors

ARMCHAIRS, 2 or 3

SAFE, for the secure storage of important documents.

(Appendix 7, cont.)

7.3 ADMINISTRATIVE OFFICE

DESKS, standard, with cupboards and drawers for staff, as required

DESK CHAIRS, preferably on castors, for each desk

VISITORS' CHAIRS, one or more per desk

ACCESS TO a TELEPHONE EXTENSION, usually shared, and/or an INTERCOM TERMINAL

DESK FURNISHINGS, as in 7.1

BLOTTING PADS

WASTE PAPER BINS, as required

WALL CLOCK

SIDE TABLES, possibly linking desks to permit the easy flow of documents

CUPBOARDS, shared, for stationery and documents

FILING CABINETS, shared

BOOK SHELVES, as required

FANS, roof or desk, if conditions warrant it

CALCULATORS or ADDING-LISTING MACHINES as appropriate

SAFE, at least one, for cash and/or documents.

7.4 TYPISTS' OFFICE

TYPIST'S DESK, for each typist, or a combined receptionist/typist's desk

TYPISTS' CHAIRS

TYPEWRITERS, as required (at least one with a long carriage)

TELEPHONE EXTENSION or INTERCOM TERMINAL (It is probable that the telephone exchange or intercom control unit will be located in this room.)

PAPER RACKS

CUPBOARDS, for stationery and documents

DESK FURNISHINGS, as in 7.1

WASTE PAPER BINS

WALL CLOCK

FANS, roof or desk, if conditions warrant it

WAX STENCIL DUPLICATOR

SPIRIT DUPLICATOR (for some teaching requirements)

PHOTOCOPIER (preferably with facilities to produce overhead projector transparencies).

In large institutions, these reproduction facilities may be located in a separate Print Room and be augmented by an OFFSET PRINTING MACHINE and equipment to produce aluminium plates, if substantial amounts of teaching material are required to be produced locally.

APPENDIX 8

8.0 LABORATORY EQUIPMENT

8.1 BOTANICAL/BIOLOGICAL EQUIPMENT

MICROSCOPES for students
MICROSCOPE SLIDES
COVER SLIPS
HAND MICROTOMES
STAINS
DISSECTING STANDS
HAND LENSES
DISSECTING INSTRUMENTS, set of
MICRO-PROJECTOR and SCREEN
PREPARED SLIDES, set of
SLIDE BOXES
PLANT PRESSES
PITH
PETRI DISHES.

8.2 SOIL EQUIPMENT

SOIL SIEVES, sets of
PESTLES and MORTARS
GAS JARS
GLASS TUBING
pH TESTING KITS
pH METERS
SOIL TEST KITS
SOIL MOISTURE METERS
TENSIOMETERS
BALANCES
DRYING OVEN
SOIL AUGERS
WATER DE-IONISERS.

(Appendix 8, cont.)

8.3 CHEMISTRY (BASIC STUDIES COURSE)

BALANCES (direct reading)
BUNSEN BURNERS
TRIPOD STANDS
GAUZES
PIPE CLAY TRIANGLES
TONGS
REAGENT BOTTLES (various sizes and types)
GLASS RODS
GLASS TUBES (various bores)
GLASS TUBE CUTTERS
FILES
BEAKERS (Soda and hard glass)
FLASKS (various types)
PIPETTES and RACKS
BURETTES and STANDS
TEST TUBES and STANDS
TEST TUBE HOLDERS
FILTER FUNNELS and STANDS
FILTER PAPERS
GAS JARS and COVERS
EVAPORATING BASINS
CRUCIBLES and LIDS
STANDARD REAGENTS
RUBBER TUBING
CLIPS
THERMOMETERS
CLEANING CLOTHS
FIRST-AID BOX
FIRE EXTINGUISHERS
FIRE BLANKET.

APPENDIX 9

9.0 HERBARIUM EQUIPMENT

A small herbarium for teaching and reference purposes in a training institutions should have the following furniture and equipment:

WORK TABLES for examining and preparing specimens

CHAIRS, as required for the work tables provided

SHELVES or CUPBOARDS for storing specimens

FUMIGATING FACILITIES for specimens

HAND LENSES

LENSES on flexible stands or dissecting stands

Sets of BOTANICAL INSTRUMENTS (SCISSORS, SCALPELS, NEEDLES, TWEEZERS, etc.)

MOUNTING SHEETS

GLUE

SPECIMEN LABELS

SPECIMEN FILE JACKETS, with labels

HAND PRESSES

DRYING OVENS (either in the herbarium or in an adjacent lab.)

DESKS and CHAIRS for staff

CUPBOARDS for storing materials and equipment

DEHUMIDIFIERS (if necessary)

CLEANING EQUIPMENT (e.g. an industrial vacuum cleaner).

If timber specimens are to be prepared and examined in the room, the following items may be required:

WORK BENCH

SAWS, KNIVES, CHISELS, PLANES, RASPS, etc.

APPENDIX 10

10.0 LIBRARY EQUIPMENT

10.1 LIBRARIAN'S OFFICE AND ISSUE DESK

DESKS as required
DESK CHAIRS
VISITORS' CHAIRS
TELEPHONE EXTENSION and/or INTERCOM TERMINAL as appropriate
DESK FURNISHINGS, as at 7.1
BLOTTING PADS
WASTE PAPER BIN
WALL CLOCK
FILING CABINET
BOOK SHELVES for reference books and catalogues
FAN, roof or desk, if climatic conditions warrant it
ISSUE DESK or counter
RACKS for storing borrower's cards
PHOTOCOPIER (in a large library).

10.2 REFERENCE AREA

FILING CABINETS for subject and authors' index cards
SHELVES for reference books
RACKS for displaying recent publications
READING TABLES
CHAIRS
MICRO-FILM READER and COPIER (if required)
MICRO-FILM STORAGE CABINET
CABINETS for storing coloured transparencies and photographs suitably indexed
VIEWERS for reviewing sheets of coloured transparencies.

10.3 STACK

BOOK SHELVES, preferably with shelves of adjustable height
READING TABLES
CHAIRS
CHESTS for maps or posters
TABLES or SLOPING RACKS for studying maps or posters
DEHUMIDIFIER (if conditions required this)
HUMIDITY RECORDER.

(Appendix 10, cont.)

10.4 GENERAL READING AREA

READING DESKS
CHAIRS
READING LAMPS.

10.5 EXHIBITION AREA

NOTICEBOARDS, large size
DISPLAY CABINETS
STANDS.

10.6 WORK ROOM

WORK TABLE
CHAIRS or STOOLS
CUPBOARD for storing materials
SCISSORS, KNIVES, etc.
TAPE, INKS, etc. for laoelling books
REGISTER OF ACQUISITIONS
LABELS and STAMP for identifying ownership
POCKETS FOR CARDS
TYPEWRITER.

APPENDIX 11

BOOKS FOR TECHNICAL FORESTRY SCHOOL LIBRARIES

The function of a library in a technical training institution is, firstly, to support the courses offered and, secondly, to provide wider reference material for teaching staff or for students who have the interest and aptitude to explore beyond the strict limits of their course.

A choice of books must be closely related to the courses offered and to their content. Firm recommendations are, therefore, extremely difficult to make, as the range of courses will vary considerably from institution to institution. Moreover, there are very few texts specifically aimed at technical-level students. They tend to fall between the level of higher secondary education texts, which are very general, and academic texts for university-level courses, which often are strong on theory and scientific discussions, but cannot deal with specific techniques which are of greater interest to a technician. Texts, especially at the university level, are now extremely expensive and a library can absorb a very considerable part of the equipment/supplies budget, if not managed with great care. Initially, what may be of the greatest value are multiple copies of a few texts on which instructors can base parts of their courses.

A list of books which may be of use as references to staff, and in some cases for reading by students, is given below. A range of publishers' catalogues can usually be consulted in a major university or public library to obtain information on supplementary material. A selection of standard periodicals may also prove a useful guide to literature, as lists of texts cited in some of the articles may indicate material it might be useful to acquire.

11.1 ADMINISTRATION AND MANAGEMENT

Anon. 1979 Business management for sawmill operators. Proceedings of the Business Management Clinic for Sawmill Operators, Portland, Oregon, U.S.A. Miller Freeman Publications Inc., San Francisco, CA, U.S.A.

Adeyoju, K.S. 1976 A study on forest administration problems in six selected African countries. FO:MISC/76/21. FAO, Rome.

Betts, P.W. 1980 Supervisory studies. MacDonald & Evans Ltd., London.

Currie, R.M. 1964 Work Study. Pitman & Sons Ltd., London.

FAO 1983 Report of the FAO/SIDA Consultation on Forest Administration for Development. FO:GCP/INT/295/SWE. Rome.

Flippo, E.B. 1979 Principles of personnel management. McGraw-Hill Kogakusha Ltd., Tokyo.

Fraser, J.M. 1967 Psychology: General/industrial/social. Pitman Paperbacks, London.

Graham, H.T. 1980 Human resources management. MacDonald & Evans Ltd., London.

Macklin, R.R. 1983 The logging business management handbook. Miller Freeman Publications Inc., San Francisco, CA, U.S.A.

Palin, D. 1980 Management of development forestry - A comparative study of public forestry administrations in the Asia-Pacific region. GCP/RAS 46 (SWE). FAO, Rome.

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Sjödahl, L. 1966 Elementary industrial psychology. Logmans, Green and Co. Ltd., London.

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UN 1979 Handbook on the improvement of administrative management in public administration. ST/ESA/SER. E/19. UN Department of Technical Cooperation for Development, New York.

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Worrell, A.C. 1970 Principles of forest policy. McGraw-Hill, Maidenhead, Berks., U.K.

11.2 AGROFORESTRY

Davies, J.W. 1975 Mulching effects on plant climate and yield. WMO Report No. 388.

Eckholm, E.P. 1976 Losing ground. Environmental stress and world food prospects. W.W. Norton, New York.

FAO 1978 China: Forestry support for agriculture. FAO Forestry Paper No. 12. Rome.

FAO 1982 Village forestry development in the Republic of Korea. A case study. FAO Forestry for Local Community Development Programme. GCP/INT/347/SWE. Rome.

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Filius, A.M. 1981 Economic aspects of agroforestry. In: Wiersum, K.F. (ed.) "Viewpoints on agroforestry". Agricultural University Wageningen, Netherlands.

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Howes, K.M.W. and Rummery, R.A. (eds.) 1982 Integrating agriculture and forestry. CSIRO, Division of Land Resource Management, Perth, Australia.

Klee, G.A. (ed.) 1980 World systems of traditional resource management. Edward Arnold Publishers Ltd., London.

Maghembe, J.A. and Redhead, J.F. 1980 Agroforestry: preliminary results of intercropping Acacia, Eucalyptus and Leucaena with maize and beans. Division of Forestry, University of Dar es Salaam, Morogoro, Tanzania.

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Nair, P.K.R. 1980 Agroforestry species: A crop sheets manual. ICRAF, Nairobi, Kenya.

National Academy of Sciences. 1977 Leucaena. Promising forage and tree crop for the tropics. NAS, Washington, D.C.

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Arnold, H.F. 1980 Trees in urban design. Van Nostrand Reinhold Co. Ltd., Wokingham, Berks., U.K.

Bridgeman, P. 1979 Trees for town and country. A practical guide to planting and care. David & Charles, Newton Abbot, U.K.

Clouston, B. and Stansfield, K. (eds.) 1981 Trees in towns: Maintenance and management. Architectural Press, London.

Hudak, J. 1980 Trees for every purpose. McGraw-Hill Book Co., London.

James, N.D.G. 1982 The arboriculturalist's companion. Basil Blackwell, Oxford, U.K.

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Bower, F.O. 1969 Botany of the living plant. Hafner Publications, New York.

Brimble, L.J.F. 1980 Intermediate botany. MacMillan Press Ltd., Tokyo.

Burnett, J.H. 1976 Fundamentals of mycology. Edward Arnold Publishers Ltd., London.

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Cutting, C.V. and Luckwill, C.C. 1970 Physiology of tree crops. Academic Press Ltd., London.

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FAO 1978 Forest influences, FAO Forestry Series No. 9. Forestry and Forest Products Studies No. 15. Rome.

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APPENDIX 12

12.0 WORKSHOP EQUIPMENT

12.1 STUDENTS' WORKSHOP

12.1.1 FOR MAKING AND FITTING TOOL HANDLES

WORK BENCHES, preferably wooden, fitted with carpenters' vices
RIP SAWS
CROSS-CUT SAWS
TENON SAWS
SPOKESHAVES
RASPS or SURFORM PLANES
CARPENTER'S CHISELS (Various sizes)
CARPENTER'S MALLETS
CLAW HAMMERS
WOOD and METAL WEDGES, small.

12.1.2 FOR MAINTENANCE OF HAND SAWS

FILING VICES
FILES, flat, single cut
DEPTH GAUGES/RAKER GAUGES
SETTING GAUGES
SETTING ANVIL and HAMMER
WIRE BRUSH
SETTING PLIERS for bow saws and hand saws.

12.1.3 FOR MAINTENANCE OF POWER SAWS

MECHANICS TOOLS, set of, for servicing motors
FILING CLAMPS
FILING GUIDES
FILES, round and flat
RIVETING SET
CENTRE PUNCH
BALLPEIN HAMMER.

(Appendix 12, cont.)

12.1.4 FOR SHARPENING CUTTING TOOLS

GRIND STONES
WHET STONES
AXE GAUGES
FILES.

12.1.5 FOR WATER SUPPLIES

PIPE FITTING VICE
PIPE FITTING DIES
PIPE WRENCHES
HACKSAWS
FILES.

12.2 MAINTENANCE WORKSHOP

12.2.1 FOR WOODWORK, etc.

WORK BENCHES with carpenter's vices
CARPENTER'S TOOL KIT
BANDSAW, small
UNIVERSAL WOODWORKING MACHINE
TURNING LATHE, small
DISC SANDER, portable
GLUE POT and HEATER
CLAMPS
PAINT BRUSHES.

12.2.2 FOR METAL WORK

METAL WORK BENCHES with engineer's vices
MECHANIC'S TOOL KIT in lockable cabinet
HACKSAWS
METAL SHEARS
PIPE BENDER
WELDING EQUIPMENT, gas and electric
SAFETY EQUIPMENT (GLOVES: EYESHIELDS, etc.)
PORTABLE DRILL and STAND
SMALL TURNING LATHE
GRIND STONES (electric).

(Appendix 12, cont.)

12.2.3 FOR BUILDING CONSTRUCTION

MASON'S LINES
PLUMB BOBS
MASON'S LEVELS
MASON'S AXE
STEEL TROWELS
STEEL FLOATS
MORTAR PANS.

12.3 VEHICLE WORKSHOP

WORK BENCHES as required
ENGINEERS' VICES
VEHICLE MAINTENANCE TOOLS, comprehensive set of, in a secure metal cabinet
ELECTRIC GRINDER
PORTABLE ELECTRIC DRILL with vertical stand
DRILLS, sets of
DIE STOCK SET
SCREW EXTRACTORS
PUNCH SET
JACK (screw or hydraulic type)
TROLLEY JACK
PARTS TRAY
COMPRESSOR
SPRAY GUNS (for oil; air; paint)
TYRE PUMP with pressure gauge
WELDING PLANT, electric (if not available in maintenance workshop)
WELDING PLANT, gas (- do. -)
BATTERY CHARGER
ACID CARBOYS
HYGROMETER
SPARK PLUG CLEANER
ELECTRONIC ENGINE TUNER.

APPENDIX 13

13.0 FIELD EQUIPMENT

13.1 NURSERY EQUIPMENT

PICKS
SPADES
DIGGING FORKS
SHOVELS (round and square mouthed)
GARDEN LINE
CARPENTER'S TOOLS for making frames and shades
WATERING CANS (fine and coarse roses)
WATER HOSE
JETS FOR HOSE, variable
SPRINKLERS
SPRAYERS, hand or backpack (insecticide and herbicide)
HAND FORKS
TROWELS
SECATEURS
HEDGE TRIMMERS
KNIVES
SIEVES
SPRING BALANCE for weighing insecticides and herbicides)
CONCRETE (SOIL) MIXER
SOIL SHREDDER
WHEEL BARROWS
TROLLEYS
PLANT BOXES.

13.2 FELLING AND CLEARING EQUIPMENT

FELLING AXES
SPLITTING AXES
CROSSCUT SAWS (Raker tooth/Peg tooth)
BOW SAWS with spare blades
POWER SAWS
POCKET WEDGES
COMPOSITE WEDGES
BREAKING BARS
TREE PUSHERS

(Appendix 13, cont.)

(13.2)

PORTABLE WINCHES
BUSH KNIVES (Machetes)
SHARPENING STONES, Hand
LOGGER'S TAPES
DIAMETER TAPES
CALIPERS
EXTRACTION SULKIES
HANG-UP SULKIES
SAFETY HELMETS with visors and ear protectors, if appropriate
FIRST-AID KITS.

13.3 PLANTATION AND SILVICULTURAL OPERATIONS

PICK AXES
HOES
MATTOCKS (various types)
WEEDING HOOKS
SLASHERS
SPRAYERS, Backpack
PLANTING TROWELS
PLANT BOXES
PRUNING SAWS
LADDERS (rope and aluminium)
HATCHETS.

13.4 FIRE PREVENTION EQUIPMENT

BACK-PACK PUMPS
WATER TRAILERS
MOTOR PUMPS with hoses and jets
FIRE BEATERS
FIRE SHOVELS
FIRE RAKES
FIRE BRUSHES
FIRE AXES
FIRE MATTOCKS (Polaskis)
WATER CARRIERS
DRAG TORCHES
FIRST-AID KIT.

(Appendix 13, cont.)

13.5 SURVEY/MENSURATION EQUIPMENT

PRISMATIC COMPASSES and TRIPODS
HAND COMPASSES (various types)
STEEL MEASURING ROPES
THEODOLITES
PLANE TABLES (with alidades and plumb bobs)
STEEL MEASURING TAPES
FIBREGLASS or PLASTIC TAPES
RANGING RODS
SURVEYOR'S ARROWS
OPTICAL SQUARES
CLINOMETERS (degree and percent)
ABNEY LEVELS and TARGETS
ALTIMETERS (Barometric)
PRECISE LEVELS
LEVELLING STAFFS
FIELD BOOKS
HYPSOMETERS
HAGA ALTIMETERS and TARGETS
BLUME LEISS ALTIMETERS and TARGETS
RELASCOPES (simple)
RELASCOPES (Spiegel)
DIAMETER TAPES
CALIPERS
BARK GAUGES
INCREMENT BORERS
CLIP BOARDS.

13.6 ENGINEERING EQUIPMENT

SURVEY and FELLING EQUIPMENT from appropriate lists
PICKS
SHOVELS
CROWBARS
GRUBBING AXES
WHEEL BARROWS
MASON'S LEVELS
HAND WINCH.

(Appendix 13, cont.)

13.7 DRAWING OFFICE EQUIPMENT

DRAWING and TRACING PAPERS of various types and sizes
LEAD HOLDERS and LEADS
ERASERS
DRAWING INSTRUMENTS, sets of, in boxes
SCALE RULES
CIRCULAR PROTRACTORS
SET SQUARES (45° and 60°)
PARALLEL RULES
PROPORTIONAL DIVIDERS
PANTOGRAPHS
PRICKERS
AREA GRIDS
DOT COUNTERS
PLANIMETERS
DRAWING BOARDS
DRAWING BOARD CLIPS
T-SQUARES.

13.8 CAMPING EQUIPMENT

TENTS, Staff, complete with groundsheets
TENTS, Students, complete with groundsheets
COOK'S and STORE TENTS
MESS TENT
CAMP BEDS
CAMP BED MATRESSES
SLEEPING BAGS
MOSQUITO NETS
HOLDALLS
LAMPS (kerosene or L.P.G.)
WATER CARRIERS
WATER FILTERS
METAL GRILL for cooking fire or camp stove
COOK'S BOX containing POTS, PANS, COOKING UTENSILS, KNIVES, SPOONS, etc.
BASINS/BUCKETS for washing up
PLASTIC PLATES and MUGS
CUTLERY
BOXES for transporting plates, cutlery, etc.
BATH SCREENS
PORTABLE TOILETS

(Appendix 13, cont.)

(13.8)

PICKS/HOES
SPADES
FIRST-AID KIT
MEDICINE CHEST.

13.9 TRANSPORT

4-WHEEL DRIVE BAGGAGE LORRY
4-WHEEL DRIVE LORRY converted for passenger-carrying
BUS
4-WHEEL DRIVE STATION WAGON
4-WHEEL DRIVE PICK-UP
LIGHT TRUCK, for food supplies and general duties
STATION WAGONS for staff use
MOTOR-CYCLES for use within campus.