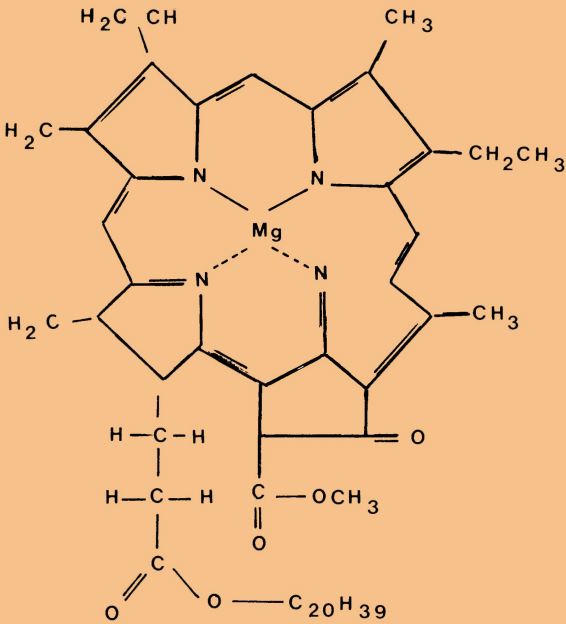


M. Welman



Careers in Botany



CAREERS IN BOTANY

prepared by

The South African Association of Botanists

1984

Hierdie boekie is ook in Afrikaans verkrygbaar

We gratefully acknowledge the assistance of Mrs Linda Davis who designed the cover; of Professor C. E. J. Botha, University of Fort Hare, who provided the micrographs; the University of Natal Publicity Office who provided the photograph for Figure 3; and especially the cooperation of the Botany Department of the University of Pretoria who translated the manuscript into Afrikaans. We are also extremely grateful to the staff of the University of Natal Press for their help and advice and for setting the type.

Careers in Botany is published by The South African Association of Botanists, Private Bag X101, Pretoria, 0001.

A Career in Botany

THE DIVERSITY WITHIN THE SCIENCE OF BOTANY

The science of botany includes many disciplines and the plant kingdom is large and very varied. Careers in botany, therefore, are equally varied.

Botany is the science of the study of plants and the traditional definition 'plant' includes an enormous range of living organisms ranging from bacteria to flowering plants, algae and fungi, mosses and ferns and gymnosperms, although some scientists consider these diverse kinds of organisms to belong to several distinct kingdoms of living things. Most botany departments, however, include aspects of each of these groups in their general courses. In addition, many universities also have separate departments specialising in micro-organisms (microbiology) or disease-causing organisms in plants (plant pathology).

The science of botany includes the fields of morphology, anatomy, physiology, ecology and taxonomy. Each of these could be applied to all or some of the groups of plants. Specialisation within each discipline is also possible. A career in botany can, therefore, include a survey of the distribution of plants in a given area, or details of the fine structure of parts of a leaf, or experiments to determine how plants convert simple chemical compounds into complex compounds in metabolic processes – and many more.

In your initial training you will be exposed to the scope of each field of botanical study and to the range of plants. By your senior years, some specialisation will begin and you will have discovered where your interests lie. You may choose anatomical and morphological studies. These could begin with simple observations with the naked eye or aided by a hand lens, and graduate to light

microscope studies, but more searching critical investigations are possible with the aid of scanning and transmission electron microscopes. These studies have application in wood identification, and the wood industry as a whole; comparative studies of plants; investigations of the fine structure and form of tiny unicellular plankton, some of which were barely seen – let alone studied in detail – before the invention of electron microscopy; studies of anatomical details of specially adapted plants; or details of fine structure of cells with a view to understanding their functions. Developmental anatomy involves a systematic study of a plant from juvenile to adult phases or detailed investigations of nutritive tissue, to give one example, or development of pollen grains for another. The illustrations in Figures 1 and 2 will show some of the details visible with the light and electron microscope.

Others may find themselves drawn towards physiological studies. This covers a wide range of topics: the control of growth and development, the factors inducing flowering and fruit set, nutrient uptake, water regulation and the biochemical processes whereby organic compounds are manufactured from inorganic materials for most plants are autotrophic and do not require organic nutrients. They are therefore not dependent on other organisms for nourishment. Physiological studies have a responsible role in agriculture where aspects such as drought tolerance, crop yield, nutrition, quality of protein content of food crops, the physiology of germination and of seed storage and the post-harvest physiology of fruit and vegetable crops are studied. In view of present and projected food requirements on a world-wide scale, the role of physiologists is an extremely important one. Physiology is an experimental science requiring clarity of thought, curiosity, technical skill and a chemical background. A course in chemistry is very often required for senior students in plant physiology.

A very popular field of botany is ecology, which is the study of plants in relation to their environment and may involve detailed studies of species in relation to their environment, or studies of the structure of complex communities, or – combined with physiology – the science of ecophysiology.

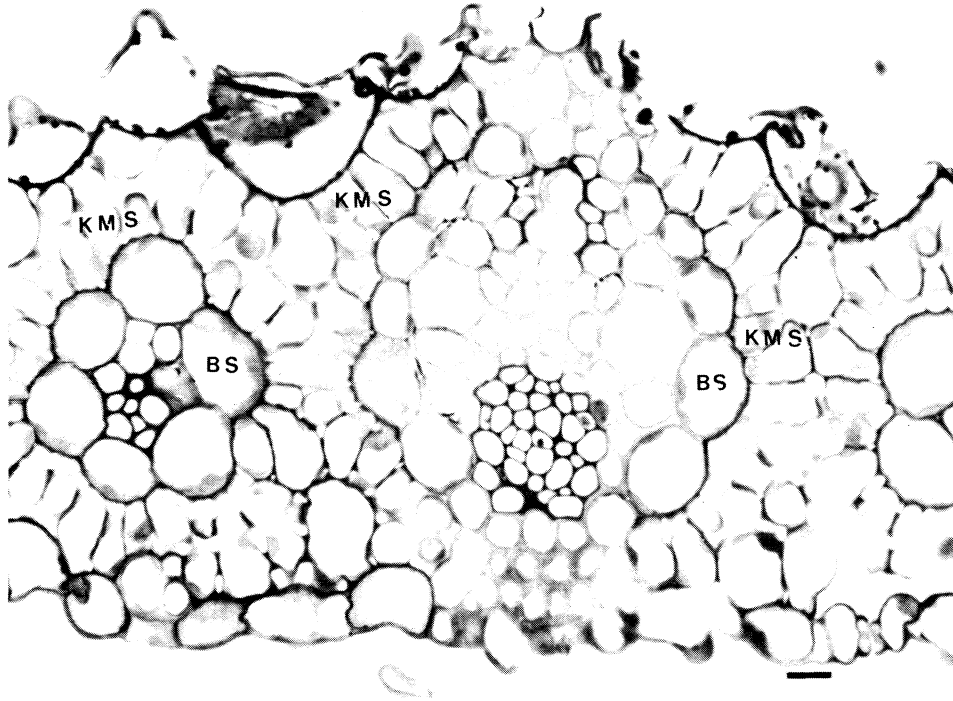


Figure 1. A cross section of a portion of a leaf of *Themeda triandra* (rooigras) showing two vascular bundles surrounded by their bundle sheath (BS) and Kranz Mestome sheath (KMS). Scale = 10 μ m

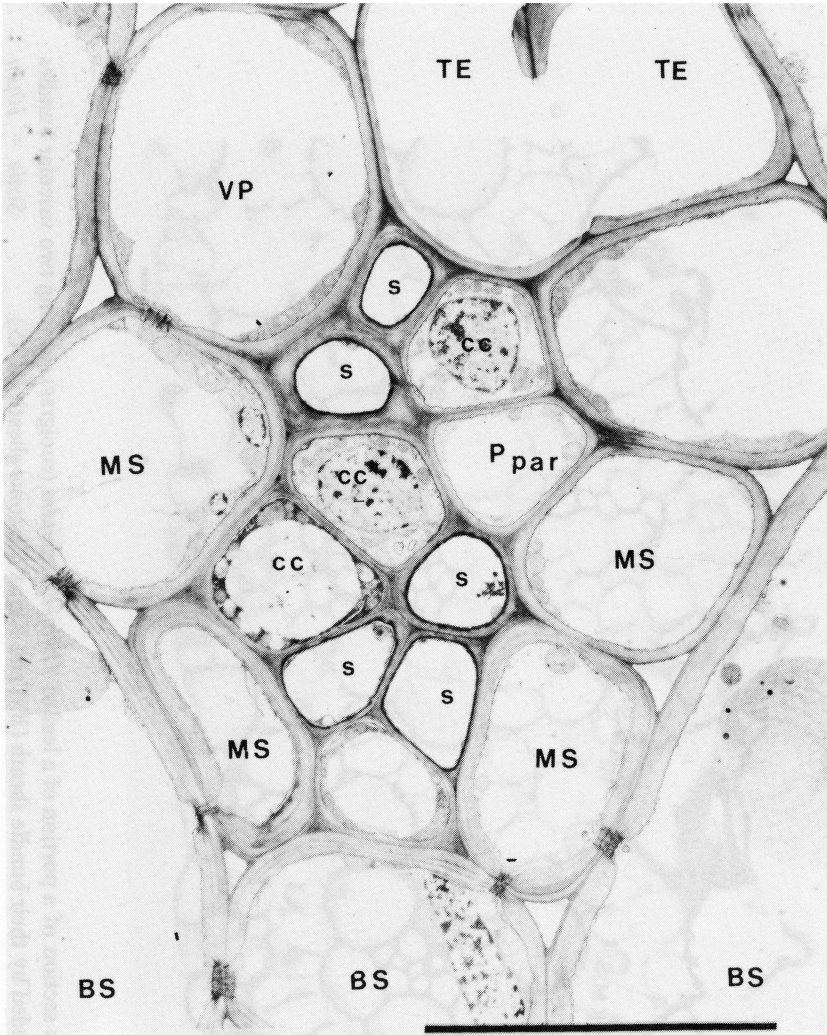


Figure 2. A detail of a single vascular bundle of a leaf of *Saccharum officinarum* (sugarcane) showing bundle sheath cells (BS), mesophyll sheath (MS) adjacent to the phloem sieve tubes (s), companion cells (cc) and phloem parenchyma (P.par), as well as vascular parenchyma (VP) and tracheary elements (TE).

Scale = 10 μ m

Effective use of our natural resources and adequate protection of our heritage require adequate knowledge of our natural vegetation. This may involve preliminary identification, description and mapping, special studies of relationships and the use of simple or highly sophisticated analytical techniques to study vegetation. Quantitative ecology requires some knowledge of mathematics and biometrics is incorporated into most undergraduate programmes.

Basic to all botanical research is taxonomy, that branch of botany which is concerned with establishing the relationships between plants, with classifying them into natural groups, with providing names and adequate keys to their identification and, most recently, with studying plant populations in the field in the study of biosystematics.

The taxonomist undertakes studies of groups of plants, provides an acceptable classification, applies appropriate and legitimate names, and presents his findings in the form of revisions, monographs and floras, which become the reference for all botanical studies. In order to determine natural relationships, a taxonomist may study all parts and all aspects of the plant and taxonomy is therefore a synthetic science collating data from many disciplines.

This synthetic nature, plus the unique richness of the South African flora, provide ample scope for basic taxonomic research in South Africa.

The most recent development in taxonomy, biosystematics, includes studies of the chromosomes of plants, traces the way populations of plants reproduce, and how pollination is effected. Such studies are important in the understanding of how a species lives and survives and is a field which has hardly been touched in this country.

In addition to these basic fields of study, more specialised areas include embryology (the study of embryos), palynology (the study of pollen grains), genetics (the study of the mechanisms of inheritance) and hydrobiology.

The role of botanists in the modern industrial world is an important one. They have been involved in much of the biotechnology associated with agriculture, including production of

new forms of animal feed, are intimately involved in the pharmaceutical industry and the essential oil industry, and make significant contributions to the welfare and quality of life by their contributions to solving problems of industrial wastes and effluents in our limited and valuable water supplies.

A career in botany begins with a training at the undergraduate level leading to a B.Sc. in botany, usually with one other major. Further studies leading to an Honours degree, a Master's degree and a Doctorate are possible. Any of these could be combined with a professional teacher's qualification.

CAREERS IN BOTANY

A training in botany can lead to a career in teaching or research, either applied or pure.

Careers in Teaching Botany

Never before has mankind been so aware of his responsibility for his environment, for the conservation and preservation of his natural heritage. The conservation of our unique flora depends largely upon an extensive education programme which begins in the schools and a teacher of botany or biology is challenged with the responsibility of instilling into young people, an enthusiasm for the natural environment, a sense of responsibility for its conservation and of nurturing scientific enquiring minds.

Teaching is a demanding but stimulating career and teaching of botany or biology is particularly interesting as it combines both theoretical and practical instruction.

The demand for qualified teachers of biology is constant and training may be obtained through a training college offering specialist courses in biology or through a university which offers a basic academic training which is followed by one year of professional qualification.

A degree in botany with zoology as second major subject is the most frequent choice of prospective school teachers, but courses in geography and chemistry are useful ancillaries. Your choice of subjects will in part be determined by the requirements laid down



Figure 3. Preparation of material for tissue culture must be undertaken in the absolutely clean environment of a laminar-flow bench.

by provincial education departments and student advisers will be available at universities and training colleges to assist you on registration.

Teaching of botany at university and training college as well as at school level offers opportunity for a stimulating and varied career and, at university level, it is combined with opportunities for research in your chosen field.

Careers in Botanical Research

Research in botany offers opportunities as varied as the range of disciplines. It may be pure research or applied research and conducted at universities, in research units associated with universities or institutes devoted to a specific discipline. Industry also offers many opportunities.

A major employer of botanists is the government Department of Agriculture and Fisheries which includes several institutes offering career opportunities at the technical level or professional level. The Botanical Research Institute in Pretoria is the major unit and includes four sections:

1. Herbarium and information services
 2. Flora research
 3. Botanical survey
 4. Economic botany and botanic gardens.
1. Herbarium and information services

The Botanical Research Institute maintains six herbaria in different parts of the country.

An herbarium preserves examples of the flora and provides an information service to the public and to other institutions. Botanists are employed as professional officers in charge of sections of the main herbarium at Pretoria or to staff regional herbaria. They are responsible for the care of their collection for the identification of material relevant to their section and for the provision of identification services to the public. In collaboration with the Botanical Survey Section, the data from herbarium collections is being computerised to provide an efficient service.

2. Flora research

This section is responsible for the production of the *Flora of Southern Africa*, a complete account of the plants of South Africa, South West Africa, Lesotho and Swaziland. Several taxonomists are engaged in this project and contributions from botanists employed at universities are collated with the main contributions.

Within this section is included the Laboratory for Anatomical and Cytogenetic studies. These studies are of immense assistance in classification and identification and current projects are concentrated on the grasses – a taxonomically difficult and complex family. Botanical artists are employed by the Institute to prepare illustrations for the *Flowering Plants of Africa*, a serial publication produced by the Institute, in addition to other scientific documents.

An important member of the Flora Research Section is the South African Liaison Officer at Kew. His function is to solve taxonomic queries sent to him by the Botanical Research Institute and other Botanical Institutes in South Africa.

3. Botanical survey

The function of this section is to study the vegetation of South Africa and its ecological relationships. Ecologists employed by this section will carry out the three main aspects of the work namely:

- (i) the identification, description and mapping of vegetation types;
- (ii) the study of ecological relationships between different types of vegetation;
- (iii) the development of various techniques for ecological studies of vegetation.

4. Economic botany

This recently established section employs professional officers with responsibilities for:

- (i) the exploration of the indigenous flora of South Africa for plants of economic potential;
- (ii) botanical research aimed at control of undesirable plants such as weeds, drug plants and poisonous plants;

- (iii) botanical research in fields of survival studies and ethnobotany. This section provides an information service to the public and to institutions such as the Veterinary Research Institute at Onderstepoort.

Another potential employer is the Plant Protection Research Institute. Officers with a special training in applied mycology (the study of fungi, especially of infection by fungi) and plant pathology are employed at this institute and usually have a basic degree in botany with special training, at senior levels, in mycology and plant pathology.

The National Botanic Gardens with headquarters at Kirstenbosch and regional gardens in many parts of the country, employ botanists as directors of regional gardens, or as staff of the herbaria especially the Compton Herbarium at Kirstenbosch, and as educational officers at the larger centres.

Botanic research, particularly in the field of ecology, is often carried out under the auspices of a provincial department of Nature Conservation or Parks Board. Such botanists may be stationed at the headquarters or be seconded to nature reserves within the province, with responsibility for ecological surveys of vegetation, grazing studies and management studies. These posts are highly sought after as they offer ideal opportunities for field studies. Most departments encourage their staff to undertake research for a higher degree.

A degree in botany with ecology as a major component would probably be the most appropriate course.

Museums

A recent survey established that seven per cent of professional botanists are employed on the staff of museums. It would appear therefore that limited numbers of posts might be available for people interested in this particular field.

Many university botany departments house collections of plant specimens in private herbaria. Some of these are valuable collections with libraries of rare volumes of taxonomic interest and are large

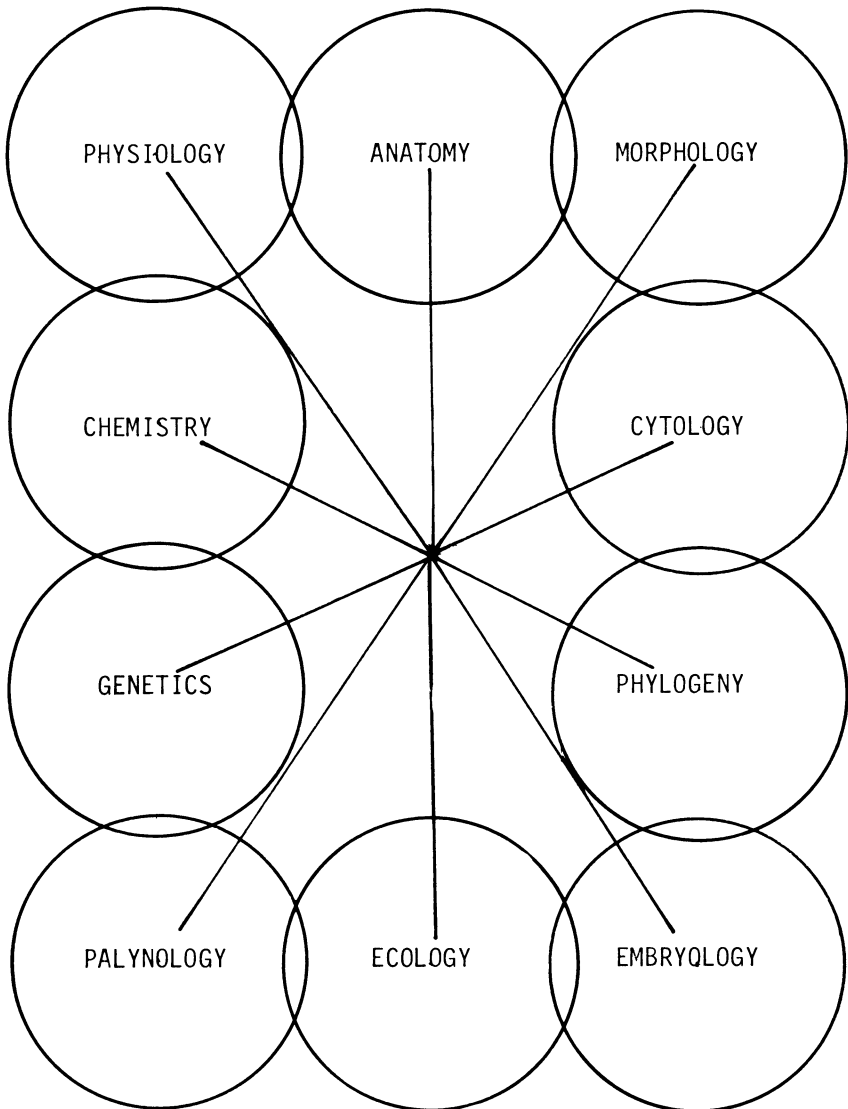


Figure 4. Taxonomic data from all these diverse fields of study are integrated into systematic studies of plants.

enough to warrant the employment of full-time curators and other staff.

The Bolus Herbarium, University of Cape Town, is the largest of these and valuable collections are also to be found in the H.G.W.J. Schweickerdt Herbarium at the University of Pretoria, at the University of Natal and the Moss Herbarium at the University of the Witwatersrand. A few posts for taxonomists and for technical assistants are available at these institutions but direct approaches to the Curators would establish whether vacancies exist at present.

Palaeontological Research

This highly specialised field of study offers opportunities for botanists and geologists with a particular interest in fossil fauna and flora. A degree combining botany and geology would be an admirable basic training and postgraduate training would be undertaken at a specialised institute such as the Bernard Price Institute for Palaeontological Research at the University of the Witwatersrand. Palaeontological Research is conducted at that institute, at the Geological Survey section of the Ministry of Mineral and Energy Affairs and at the Botanical Research Institute in Pretoria.

South Africa's fossil flora is rich, ancient and varied and of particular interest in academic studies of the origins of flowering plants and commercially in the search for fossil fuels.

Special Research Units

Many universities and some other bodies house special research units which employ botanists. These include:

- The Institute for Freshwater Studies at Rhodes University
- The Institute for Environmental Studies at the University of the Orange Free State
- The Seaweed Research Laboratory at the University of Cape Town
- The Palynology Unit at the University of the Orange Free State

The Research Unit for Growth Substance Control of Plant Development at the University of Natal in Pietermaritzburg
 The Photosynthetic and Nitrogen Metabolism Unit at the University of the Witwatersrand
 The Margaretha Mes Institute for Seed Research at the University of Pretoria
 Saasveld Forestry Research Institute at George
 PU-NTC Institute for Ecological Research at the Potchefstroom University for Christian Higher Education

The Water Research Institute at the C.S.I.R. in Pretoria includes botanical studies of freshwater algae as well as other scientific disciplines.

The Oceanographic Research Institute in Durban has also employed botanists as professional officers.

In addition, applied research is carried out in large chemical firms producing fertilizers or pharmaceutical products and in the research laboratories of:

The Banana Control Board
 The Citrus Board
 The Deciduous Fruit Board
 The Sugar Milling Research Institute
 The Tobacco Research Institute
 The Wattle Research Institute
 The Wheat Board

TRAINING

If a career in botany appeals to you, you will probably wish to embark on a B.Sc. degree in the first instance. University entrance in the Faculty of Science requires a matriculation exemption with mathematics and a science subject.

Training is three years for B.Sc. with the option of proceeding to an Honours degree (one year) and possibly research towards higher degrees.

Provincial departments of education stipulate regulations for

acceptable courses and a higher education diploma of one year is a professional qualification for a high school teacher.

In-service training, after a basic science degree, is often offered in Research Institutes and in industry and you may find a degree with botany enables you to enter related fields such as forestry, agriculture, veterinary medicine and pharmacology.

The opportunities are wide, the remuneration varies according to qualifications and the careers offer an opportunity to combine indoor laboratory work with outdoor fieldwork which has great attraction to many.

Professional natural scientists are invited to apply for official registration in much the same way as engineers and medical doctors register with their relevant councils.

The South African Association of Botanists represents professional botanists but membership of the Association is not obligatory. This Association holds an annual congress in different centres each year and local branches promote interest in botany. A newsletter *Forum Botanicum* is sent to every member and the association is also responsible for the editing of the *South African Journal of Botany* which is the national journal for this science. Student membership of this society is encouraged and further particulars are obtainable from:

The Honorary Secretary
South African Association of Botanists
P. Bag X101
Pretoria
0001

