

WRITING AND PRESENTING SCIENTIFIC PAPERS AND TECHNICAL REPORTS

A MANUAL FOR AGRICULTURAL SCIENTISTS
AND TECHNOLOGISTS

by

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CONTENTS

	<u>page</u>
PREFACE	2
INTRODUCTION – COMMUNICATION	3
PART 1 – WRITING	4
The purposes of writing	4
Characteristics of scientific and technical writing	5
Preparing and planning a report or paper	6
Writing the first draft	7
The structure and contents of papers and reports	8
Revision to produce the second draft	10
Producing the final draft	11
Submission of copy	11
What editors want	12
Semantics – the meaning and use of words	13
Syntax – the formation of sentences	15
Composition – building a theme	16
Punctuation	18
Abbreviations	20
Names	21
Numbers	21
Tables and figures	21
PART 2 – PRESENTING	23
The Presentation Plan	23
Visual aids	23
Preparing the presentation	25
Presenting the paper	26
The PowerPoint presentation of 20 slides	28

PREFACE

This manual has grown out of seminars presented to groups of agricultural scientists and technologists who are required to write and present reports and to offer papers as a normal part of their duties. The success of the seminars encouraged me to offer them as a manual, with the objective of helping scientists and technologists improve the crucially important written and verbal communication of their work. The contribution made by Alistair Donovan is gratefully acknowledged.

Being a manual, a laconic style of writing is used because it is considered most suitable for communicating scientific and technical information.

INTRODUCTION – COMMUNICATION

Effective research and technology are as much dependent on good communication as they are on good scientific or technical skills.

Communication skills are needed to ensure that a reader or listener receives clearly and understands unambiguously the message or mental impression that the writer or speaker wishes to convey.

Communication consists of two *processes*:

- converting thought into words by a writer or speaker,
- converting words into understanding by a reader or listener,

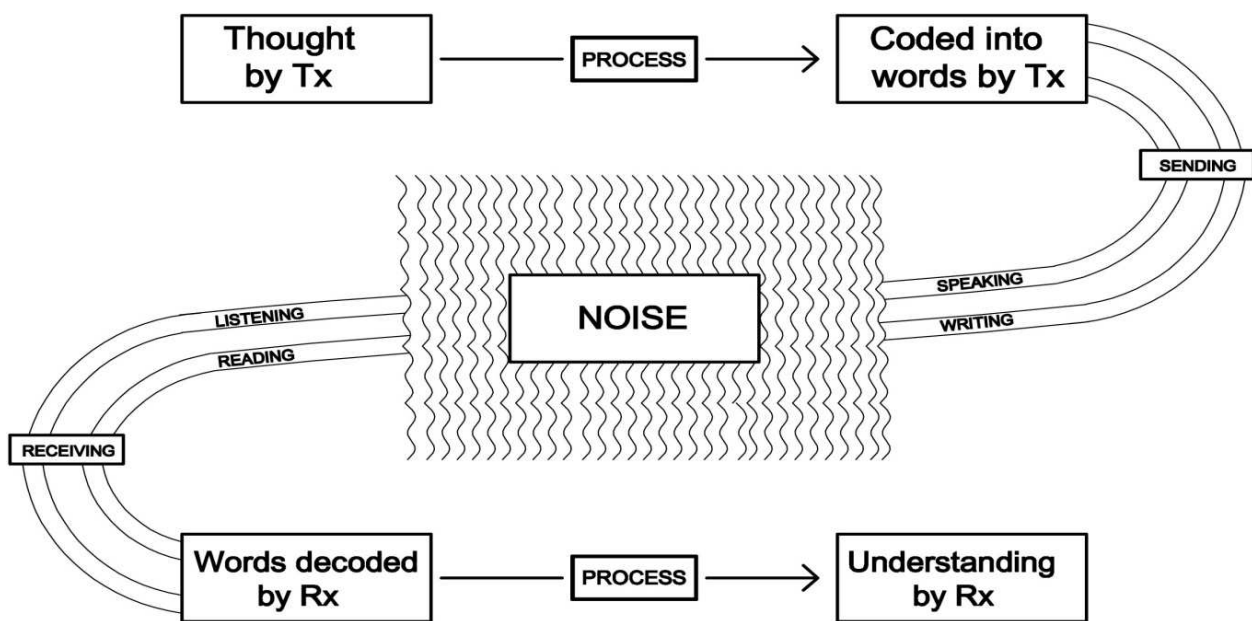
using two *actions*:

- sending a message by a writer or speaker,
- receiving the message by a reader or listener,

through two *channels*:

- speaking-listening,
- writing-reading.

These *processes*, *actions* and *channels* of communication can be represented diagrammatically as follows:



Tx = writer/speaker Rx = reader/listener

'Noise' is any extraneous sound that disturbs or disrupts communication in either of its two channels and seriously reduces its effectiveness. The arrival of late-comers at a meeting, the ringing of mobile phones, the noise of air-conditioners, background music, interruption by messengers, are all 'noises'. All types of noise should be prevented before the presentation of a paper or lecture starts.

The *writing-reading* channel is usually the more important communication channel for scientists and technologists who are required to record and communicate their work in writing. However, good speaking skills are also important for them because their written work must often be presented effectively in speech form at conferences, seminars and tutorials.

The most important reason for scientists and technologists to develop their communication skills is because they are under an obligation to write and speak, not only so that they are understood but, what is more important, so they are not *misunderstood*.

PART 1 – WRITING

Writing is probably the most underrated and, after management, the least developed skill required by scientists and technologists. Although modern communication aids and methods such as the internet, personal computers, e-mailing and 'sms-ing' have facilitated the sending and receiving of communications, their 'language' and their brevity have discouraged, and indeed adversely affected, the development of good writing skills.

Four *rules* for better writing are:

- (i) Know the subject matter before starting.
- (ii) Arrange the material logically.
- (iii) Use appropriate language.
- (iv) Write clearly and concisely.

Four *steps* to better writing are:

- (i) Read good prose and listen to good English.
- (ii) Practice the art of writing.
- (iii) Accept editors' criticisms.
- (iv) Practice finding fault in the writing of others.

THE PURPOSES OF WRITING

For personal use:

- to aid memory, eg diary and lists,
- to record observations and results, eg field notes,
- to improve planning and organisation, eg schedules and drafts,
- to improve creativity and thinking, eg notes on ideas and concepts.

For written communication with others:

Letters which should be *prompt* and *courteous* for official purposes, or *friendly* if personal.

Directives for conveying orders should be in the *imperative, ordered* and *unambiguous*.

Memoranda are reminders and should therefore be *succinct* and *impersonal*.

Articles are exercises in public relations or for conveying non-technical information. They should be *simple* (conveying a single or very few concepts) and preferably with pictures, as are found in trade journals.

Advertisements are written to persuade and are usually characterised by *exaggeration, repetition* and *sensation*. Many examples are found in newspapers and magazines.

However, this manual is particularly concerned with the writing of two kinds of communication: technical reports and scientific papers.

Technical reports

The writing of technical reports is an important staff function in technical and scientific organisations and institutes. Technical reports are written for special purposes, according to house rules, for permanent in-house record and are not usually published. They should be *accurate, clear, concise, ordered* and *stylised*.

Scientific and technical papers

The writing of scientific and technical papers is a very important staff function for scientists, engineers and technologists. These papers are essentially records of observations, tests, experimental results, research or hypotheses written for publication and for presentation at meetings and conferences. They should not express unsubstantiated opinion and should, like technical reports, be *accurate, clear, concise, ordered* and often *stylised*.

CHARACTERISTICS OF SCIENTIFIC AND TECHNICAL WRITING

Scientific and technical (S&T) writing is often about new ideas and methods or proposals for change in established paradigms. People are usually sceptical about new ideas and generally resist change, therefore S&T writing needs to be *convincing* without being vulgarly persuasive ('pushy').

Scientific and technical writing should, therefore, be characterised by:

Accuracy. A report or paper should reflect what is called scientific method, which is *careful observation and precise measurement followed by unbiased assessment and accurate recording*.

Clarity. Clear understanding by Rx (the reader or listener) requires clear thinking and clear writing by Tx (the writer or speaker), which requires *avoiding ambiguity and vagueness*.

Objectivity. This means *distinguishing between facts and assumptions, identifying sources, assessing errors and indicating limitations and differences for significance* but without underrating.

Ordered. This means *presenting information and concepts in logical order*, usually but not necessarily always in the order of occurrence or importance.

Simplicity. *Avoiding jargon, repetition, verbosity, elaboration and pomposity.*

PREPARING AND PLANNING A REPORT OR PAPER

Thorough preparation and careful planning are the key to a successful, easily written and easily read report or paper. A well prepared plan also reduces the risk of omission or excessive length and improves the balance of the paper.

Steps in the preparation and planning of a report or paper should be taken in the following order:

Step 1. Know the subject. This implies thorough preliminary research of the subject of the paper or report. This is especially important when papers are to be refereed before acceptance for publication or when reports are to inform senior management.

Step 2. Follow implicitly the 'Instructions to Authors'. In the case of scientific papers for publication the relevant journal usually has specific instructions it requires authors to follow. In the case of in-house reports, companies usually have their own rules on the structure and content of their publications.

Step 3. Draft a Composition Outline. This is a skeleton of the paper or report consisting of a list of the headings, sections or paragraphs. Some of these, and particularly the length of the paper or report, are usually specified in the 'Instructions to Authors'. The composition outline should be used to allocate the approximate length, in number of words or pages, to each section. This will avoid later tedious editing and rewriting to achieve the paper's required length. An example of a shortened composition outline is shown in the box below.

Composition Outline for a paper of 4 000 words (8 pages)		
	Words	Pages
Title, Author(s), Abstract and Keywords	200	0.4
Introduction.....	300	0.6
Methods, Materials and Procedures.....	1 000	2.0
Results	1 000	2.0
Discussion.....	600	1.2
Conclusions and Recommendations	300	0.6
Summary	300	0.6
Acknowledgements, References and Appendices	300	0.6

Step 4. Define the purpose and scope of the report or paper by drafting a title and an abstract, and by choosing the keywords for the report or paper. Drafting the abstract and choosing the keywords before writing is a good test of the author's knowledge of the subject matter, as required in Step 1 above.

Step 5. Collect and collate all relevant information required for the paper or report. Having data and references at hand before starting to write saves time, avoids interrupting the thought processes to look for information and makes composition easier.

WRITING THE FIRST DRAFT

Authorship of papers and technical reports should be restricted to those who make a *conceptual* contribution (see the section on Acknowledgements).

Guidelines for the task of writing

- If possible, write the first draft at one session (eg in one weekend).
- Break up all writing 'sittings' into spells of between one and two hours with exercise or mental leisure breaks of five to ten minutes.
- Do not allow 'sittings' to be interrupted, eg by making or taking phone calls. Use a retreat away from the phone and other distractions.
- Do not revise individual paragraphs or sentences nor check spelling or improve words and phrases during the writing of the first draft. These interruptions spoil the flow of inspiration. Revision for these purposes should be done later as a separate exercise.
- Adhere strictly to the composition outline, particularly in terms of topic and concept. Length is not critically important for the first draft.
- While actually writing, have a reader in mind, possibly a colleague.
- The introduction is difficult to write – leave it to last.
- Start each chapter or section by coming to the point immediately by stating a fact, hypothesis or problem, and then elaborate on the theme.
- The first and last few words, sentences or paragraphs are often the only parts read; they should, therefore, be the most meaningful.
- End each paragraph, section or chapter by connecting it logically to the next. This maintains the flow and relevance of the theme or hypothesis.

The main reasons for poorly written reports and papers

- Not knowing the subject well enough.
- Not regarding writing as an important task.
- Inadequate planning of the paper or report.
- Not allowing enough time for the task.
- Careless choice of words.
- Lack of practice.
- Distractions and interruptions.

The results of poor writing

Important work may be ignored because the writing is poor.

Faulty conclusions may be drawn from a report containing mistakes and inadequacies in either the research, or in the writing, and these could be quoted in good faith.

A poorly written report or paper may be rejected and this means the author and those who have assisted him have wasted their time.

THE STRUCTURE AND CONTENT OF PAPERS AND REPORTS

Title. The title should be as short as possible but must clearly indicate the subject of the paper or report. In formal papers and reports the title usually appears on a separate title page which should also indicate the often omitted date of issue or publication.

Authors. The names of the authors are given in full in more formal papers, especially theses, on a separate title page and sometimes also on the cover. The Authors' designations are seldom indicated these days and usually only if called for in the 'Instructions to Authors'. In less formal reports and papers, designations are also not commonly used and authors names often appear only on the first page of the paper or report.

Preface. A preface is seldom necessary, particularly for technical reports.

Keywords. Six to (a maximum of) eight words that best identify the contents of the paper or report.

Abstract. An abstract is usually required only for papers to be published in a scientific or technical journal; its length and location is usually defined in the 'Instructions for Authors' and usually follows the authors' names.

Summary. A summary is required for all but the shortest or very informal reports. Summaries used to be at the end of a paper (and may still be required there) but the modern trend is to call the summary the 'Executive Summary' and have it either instead of an abstract or following it. Because the summary is often the only part of a report read, high priority should be given to writing it. A summary should:

- be brief, not more than 10% of the length of the paper itself.
- be written after the report has been completed and in plain language, ie not in jargon or 'shorthand'.
- cover the same ground and in the same order as the report itself.
- not contain any material not mentioned in the paper or report.

Table of Contents. A table of contents is required for longer reports and papers which have a number of chapters, sections and headings.

Introduction. An introduction should indicate the purpose or the motivation for writing the paper or report. It should also give the authority, terms of reference or client's requirements if it is a commission. The introduction should also include:

- a brief description of the reasons, or sequence of events, leading to the problem or investigation. Only sufficient historical detail should be included to ensure that readers can understand the rest of the report.
- a description, or outline, of how the subject of the report will be developed.

Method and Procedures. In longer reports, especially those of an investigative kind, it is usually necessary to describe the methods of investigation, the procedures used and sometimes also the itineraries and purposes of journeys made in carrying out the research or compiling the report.

Results and Findings. These should be described in logical (not necessarily, though usually, in chronological) order and balanced. In longer reports sub-headings may be necessary. It is important not to include results or findings outside the terms of reference of the investigation or study except perhaps for comparative purposes.

Conclusions. Conclusions are the inferences drawn from the results and findings. They must be given as definite, unqualified statements even if they were stated in earlier sections. No descriptive material should be given in this section.

Recommendations. It is common practice and usually preferable to include recommendations in the Conclusions section, but in some reports it may be necessary for policy or diplomatic reasons, to have them in separate sections. They should be made as definite, unqualified statements.

Summary. In very long papers and reports, such as theses, a summary is usually required and should be located in this position (but see the earlier paragraph above on this subject).

Acknowledgements. Persons or organisations who assisted the authors with the report *conceptually* should be acknowledged in this section. There is a modern tendency to include in this section all the names of those whose assistance was in terms only of physical input, eg assistants who may have rendered invaluable help by managing trials or data collection but who made no conceptual contribution. This practice should be avoided or kept to a minimum.

References. Other published work quoted or used in writing the report or paper must be listed in the References section. The form and style in which they are presented is usually defined in the 'Instructions to Authors' of the particular journal and these should be followed strictly. If no such instructions are available it is important to consult a list of abbreviations used in scientific writing. The modern tendency is to omit full stops.

Examples of references:

Thompson GD (1980). The economics of sugarcane fertilization. *Fert Soc S Afr J* 2: 47-53.

Kealey T (1996). *The Economic Laws of Scientific Research*. Macmillan Press Ltd.

Singels A, Smit MA, Redshaw KA and Donaldson SA (2005). The effect of crop start date, crop class and cultivar on sugarcane canopy development and radiation interception. *Field Crops Research* 92: 249-260.

When a person's verbal statement or opinion is quoted, or when one refers to unpublished data, this should be acknowledged in the text and as a footnote, eg (personal communication¹) or (unpublished data²) and should not be shown in the references section.

Bibliography. Longer reports, especially theses and books, sometimes include a bibliography. This is a list of source material used in the writing of the report or book, or material that is recommended for widening students' or readers' interest in the subject.

Appendices. Detailed information and data that would interrupt the flow of a paper's narrative but which must be presented to support the findings or conclusions reached, should be placed in an appendix. If there is more than one, each appendix should have a number and be listed numerically in the table of contents, eg Appendix 1. Arthropod species found in Field 24, Appendix 2. Dates of sampling in Field 24.

REVISION TO PRODUCE THE SECOND DRAFT

Revising is an essential part of good writing and can take as much time as writing. It is not enough to read through the first draft, making the necessary corrections and improvements; revision is best done by carrying out the following four revision steps separately and in this order:

- Check to ensure the content and order comply with the planned composition outline of the paper.
- Use the PC Spell-check, or preferably technical and scientific dictionaries, to check spelling, especially of unfamiliar words.
- Improve your use of words and phrases using the thesaurus.
- Adjust the length to comply with the composition outline and 'Instructions to Authors'. (Note: To facilitate this task most PCs provide a 'number-of-words' function.) Papers offered for publication that exceed the specified length can result in the paper being rejected or shortened by the editors.
- An alternative to drastic shortening is to offer the paper in two parts, each complying in terms of length. However, this needs the prior approval of the publishers.

¹A Singels, SA Sugarcane Research Institute, Mount Edgecombe, South Africa, 2011, abraham.singels@sugar.org.za

²B Jones, Borer numbers on Estate No. 1, Internal Report No. AAA, Fictitious Sugar Co, Physical address if necessary, 2010, brian.jones@whatever.com

PRODUCING THE FINAL DRAFT

- Check all formats for compliance with 'Instructions to Authors', especially line and margin spacing, page numbering position, headings and location for tables and figures, and style for references.
- Read through the whole paper aloud to yourself, or preferably to a colleague, to ensure balance and euphony.
- Ask a colleague to read and criticise the second draft and incorporate his/her acceptable corrections, changes and improvements.

Finally, check the following:

- Page margins should be consistent throughout.
- No 'styles' should be assigned to text or headings, as these can interfere with the publisher's method of layout. This would include space above/below paragraphs, left/right indentations and line spacing.
- Pages should be numbered correctly and in the right order.
- Tables and figures must be correctly numbered and annotated, and located in the right places in the text, or, where required, on separate sheets.
- Titles, headings and captions must be clear and understandable without needing reference to the text.
- The use of brackets () [] should be consistent throughout the text.
- There should be no unnecessary capitalisation.
- The use of italics for emphasis should not be overdone.
- 'ifs' and 'buts' do not look good in scientific papers where precise findings are reported, and 'probably' and 'maybe' should not be used.
- Ensure that the references are cited accurately (check originals in the literature again), are listed in the correct order (check this through the text) and are in compliance with the 'Instructions to Authors'.

SUBMISSION OF COPY

The final version of the paper is usually sent electronically to the publisher or to an editor nominated by the publisher. If, however, it is required on disk or as a hard copy, it is important to ensure that it is first saved, preferably on a separate disk so that changes required by the editors can be effected quickly and easily.

Registered mail or courier should be used for sending disks or hard copies.

Originals of figures are sometimes required by publishers; if so, they should, after copying, also be sent by registered mail or courier and packed to avoid being bent or damaged in transit.

WHAT EDITORS WANT

Internal editors of industrial and commercial companies are usually required to take into consideration a publication's:

- suitability from their customers' point of view,
- effect on the industry's or company's image,
- compatibility with company policy,
- potential for causing customer or financial loss, and
- restrictions imposed by, or infringement of, patents.

Internal editors are likely to be more concerned with their organisation's image than with the standard of the report's semantics, syntax and composition. They are also likely to make more editorial changes than external editors. These can include shortening where the length is excessive, although the paper or report is usually returned to the author for that to be done.

Scientific papers and reports offered for publication routinely go to external editors and referees, appointed by the relevant scientific or technical journal, for editing and assessment.

External editors and referees are primarily interested in a paper's:

- originality (especially in doctoral theses).
- objectivity, integrity and veracity.
- completeness, as well as the paper's suitability for the journal's specialised or specific readership.
- compliance with the 'Instructions to Authors'.

External editors or referees will themselves seldom make more than minor changes in a paper but they may return a paper to the author with suggestions for its improvement. If they consider a paper worthy but only with major changes, they may (and often do) return it for appropriate rewriting.

External editors pay attention to the *semantics*, *syntax* and *composition* of a paper. If these characteristics of a paper are good they make for easy reading and understanding, influencing editors favourably. If they are not good, the effect on editors can be unfavourable and may result in a paper's rejection. Authors should therefore pay special attention to these important matters.

The following is an extract of a badly written report rejected and returned by the editor and then accepted after rewriting by the author:

Original, returned to author for editing:

The results are interesting. Our sun proves to be about average weight, or perhaps somewhat over. Taken as a whole, the stars show only a small range in weight; if we compare the sun to a man of average weight, most of the weights of the stars lie between those of a boy and a heavy man. Yet a few stars have quite exceptional weights. A colony of four stars, 27 Canis Majoris, is believed to have a total weight nearly 1000 times that of the sun.

Edited version accepted by the editor:

The results are interesting. They indicate that the sun is a star of average mass. Stars generally have a smaller mass range, for example, no greater than the range found between the mass of a man and the mass of a boy. The four components of the system 27 Majoris Canis is thought to be nearly a thousand times heavier than the sun.

SEMANTICS – THE MEANING AND USE OF WORDS

The use of words in writing and speaking is preceded by thinking, which can be as much inhibited by a lack of vocabulary as writing and speaking are. An adequate vocabulary is therefore important for scientists and technologists, all of whom are required to think, write reports and papers, and occasionally to present them at meetings and conferences.

Only about 2000 words are necessary for good scientific and technological communication in English, which is now the language most used worldwide for this purpose.

To develop a vocabulary, when reading have a dictionary at hand and look up every word the meaning of which you do not know. It is also helpful to use a thesaurus to find a word with a better meaning, because no two words have exactly the same meaning and using the wrong word can change or obscure the message.

Some rules for the use of words

As a general rule prefer short words to long, eg *ease* instead of *facilitate*; *need* instead of *necessitate*; *start* for *commence*; *show* for *exhibit*; *about* for *concerning*; *use* for *utilise*; *expect* for *anticipate*.

Do not use foreign words, especially legalese, and Latin words unless it is unavoidable, eg for *inter alia* prefer among other things; for *circa* 1999 prefer about 1999; for *status quo* prefer condition or situation.

Use standard English words not dialect, colloquial English or slang which may be understood only locally, eg for *guys* prefer *men, boys, people*; for *kid(s)* prefer *child, children*; for *catch on* prefer *understand*; for *petters out* prefer *ends*.

Beware of buzz-words and phrases, word habits and favourite words, eg:

- *basically* can usually be omitted altogether; for *absolutely* prefer *yes*; replace *fantastic* with *good, better, best* or *excellent*
- for *at this point in time* prefer *now* or *at present*
- prefer *over* to *around* in *the protest around high prices*
- replace *in actual fact* with *in fact* or *actually*
- prefer *we expect* or *we are planning to, we're looking at*
- *pertaining to* or *with regard to* is most often better replaced with *about*
- replace *what we did was we went home* with *we went home*
- prefer *on that subject* to *in that regard*
- *at the weekend* not *on the weekend* but *on the holiday weekend*.

Avoid pomposity and arrogance; their use suggests self-importance and is pretentious. Replace '*The ultimate yield of the crop will depend on favourable precipitation*' with '*The crop yield will depend on good rains*'.

The use of long or obscure words is not scholarly or clever and shows disrespect of the reader, eg replace:

*Scintillate, scintillate little globule aurific,
fain would I fathom thy nature specific,
loftily poised in the ether capacious,
strongly resembling a gem carbonaceous.*

with

*Twinkle, twinkle little star,
how I wonder what you are;
up above the world so high,
like a diamond in the sky.*

Do not qualify a word whose meaning is already clear, eg omit the italicised word in the following phrases:

almost unique; the *actual* number; *absolutely* perfect; *conclusive* proof; *quite* impossible; *very* true.

Avoid tautology, that is, repeating the same thing in different words. In the following examples, leave out the words in italics, they are unnecessary:

The reason for this is because... In *my own personal* opinion...

Avoid using the abbreviations & and @ in text, rather spell out in words.

Avoid using nouns as verbs (even when dictionaries allow it). Eg replace *loan me a book* with *lend me a book*.

SYNTAX – THE FORMATION OF SENTENCES

Long, involved sentences imply inadequate and careless thinking, as well as causing difficulty for the reader in both reading and in understanding. Sentences of more than 20 words are difficult to read and sentences of more than 30 words are very difficult to read. Proper construction of sentences and punctuation can make long sentences easier to read, but it is better to break up long sentences into shorter sentences. Variable sentence length makes for better prose which is easier to read and to comprehend.

Some syntax guidelines:

Prefer few words to many, eg for *'The spring still has a certain amount of flexibility'* write *'The spring is still flexible'*; and *'In order to flex the spring'* write *'To flex the spring'*.
Prefer a word to a phrase, eg for *'In the majority of cases'* write *'In most cases'*.

The following is an example of editing during revision to achieve the objectives of the last three guidelines:

Original composition: *In the first place, the development of farming systems that are so productive that indiscriminate reclamation of virgin lands can be avoided is a necessary condition to control further degradation of the surface of the earth and the destruction of natural ecosystems.* (42 words, one sentence)

Edited version: *To control further degradation of natural ecosystems, it is necessary to develop farming systems that do not exploit virgin lands.* (20 words)

Use short sentences for introducing and concluding new topics, and longer sentences for developing a theme.

Beware of word repetition; it is effective for emphasising a point but can distract a reader. However, word repetition is often necessary for technical accuracy and is better than using a less accurate word for the sake of elegant variation.

The following are some examples of common errors in the use and meaning of words and in phraseology, with suggested better alternatives.

Common errors

Singular and plural

it is a phenomena of the system

the data is available

the results suggests

his results is considered good

the team are playing well

Better alternatives

it is a phenomenon of the system

the data are available

the results suggest

his results are considered good

the team is playing well

Word choice

a vast amount of people
it did not compare so good

it complies to the regulations
the people which attended
the discussion around the subject
less visitors came to the show
the precision of the calculation
the accuracy of the measurement

a vast number of people
it did not compare well
or, it was not a good comparison,
or, the comparison was not good
it complies with the regulations
the people who attended
the discussion on (or of) the subject
fewer visitors came to the show
the accuracy of the calculation
the precision of the measurement

Word order

what time is it?
sheep muscle protein
a large vehicle fleet
the word only should be used
to convey doubt
me and John went home at once

what is the time?
muscle protein of sheep
a large fleet of vehicles

the word should be used only to convey doubt
John and I went home at once

Phraseology

what we have to do is write the report
another idea suggests itself to me
we are busy to close the case
factors which mitigate against
at this point in time
in the event of my cheque being returned
like I said
if at all possible
such is by no means the case
he played a standout game
in order to be effective

we have to write the report
I have another idea
we are closing the case
factors which militate against
now
if my cheque is returned
as I said
if possible
that is not so
he played an outstanding game
to be effective

COMPOSITION – BUILDING A THEME

A good composition is one that holds the reader's interest and is easy to read. This is achieved by using the following guidelines:

Start effectively by coming to the point quickly with an accepted statement of fact or of the problem.

Maintain a balance by careful planning and a thorough knowledge of the subject.

Be concise; the importance of length has been stressed earlier.

Emphasise the main points, making them stand out from the necessary supporting detail or argument by:

- stating the crucial concepts in the first and last sentences and paragraphs.
- using appropriate titles, headings and sub-headings.
- leaving out irrelevant detail or unnecessary information.
- using more forceful words for important points, but beware of jargon.

Repeating, numbering and indenting helps to emphasise, but beware, using these to excess can irritate.

Beware of numbering without purpose and mixing symbols, all of which distract the reader's attention.

Achieve rhythm, which is the *quality of sounding well*. It is proper and deliberate in poetry, desirable but should not be contrived in prose (ie in reports and papers). Test rhythm by reading the report or paper aloud. Rhythm can be improved by avoiding where possible:

- unintentional alliteration, eg *rotated rather regularly*.
- grating repetition of words, syllables or words, eg *appropriate approach*.
- repetition of sound, eg *such a success story, an elaborate laboratory*.
- repetition of cognate forms of different parts of speech, eg *local locality, follow the following*.
- repetition of a word with different meanings, eg *a point to point out, except for rare exceptions*.
- excessive punctuation also inhibits rhythm.

Develop style to achieve readability. Style is *proper words in proper places* and is the basis of good prose. It can also be defined as *without unnecessary ornament, irrelevancies, illogicalities or ambiguity*. Style comes with practice and can be improved by reading good books.

The essential characteristics of good prose are:

- lacking encumbrances for quick reading.
- euphonious when read aloud.
- consistent in the use of language.
- ordered, with each sentence a single step in the building of paragraphs, and each paragraph in logical order in the construction of the narrative or argument.

Below is an example of the editing of a technical report to improve composition.

Original version of the report.

The farm was visited by Mr IM Moider and Mr UR Mayhem, Irrigation Consultants, and the farmer accompanied them.

The soil of the farm is derived from dolerite parent material on the western side. The remainder of the farm is alluvium. The farm is roughly divided into two parts by a stream. The northern side of the farm is very flat with average slopes of 1%. On this section a flood irrigation method is used. The farm's southern section is steeper with an overhead sprinkler irrigation system and the main problem are wet areas in the fields in the northern section. All the roads are well built up and gravelled and culverts provided where the main irrigation channels cross the roads. During the visit the farmer indicated that at this point in time he could not afford to change the system to overhead irrigation. Due to the variable changes in the slopes it would be necessary to change the field boundaries so as to accommodate the changes in row direction that would be required for the necessary irrigation channels.

Edited version of the report

The farm was visited by Messrs Moider and Mayhem, irrigation consultants. They were accompanied by the farmer. The soils on the western side of the farm are derived from dolerite; the remainder are alluviums. The steeper southern section is irrigated by a sprinkler system. All roads are well made, gravelled and have culverts for irrigation canal crossings. Poor drainage due to changes of slope on the northern section, can be improved by altering field boundaries, road and irrigation canal alignment. When the farmer can afford to make these expensive changes, the consultants would be pleased to design a flood irrigation layout that will improve water use efficiency and drainage.

PUNCTUATION

The purpose of punctuation is to clarify meaning and improve readability. Excess punctuation disrupts and too little hinders reading. Writing with good style needs less punctuation than writing with poor style.

Full stop or period

- A full stop is used to end sentences. It should be omitted in titles, headings and legends; *ie* (for i.e.), *Dip Tech* (for Dip.Tech.), *BSc* (for B.Sc.), and must not be used after SI units, eg *a mass of 15.6 kg* (not 15.6 kg.).
- A period is no longer obligatory after abbreviations, except *no. for number*, and, in the United States, *fig. for figure*. Where it is available on keyboards, # is now generally accepted as the abbreviation for *number*.

Comma

- A comma is used to indicate a brief pause and to separate groups of words, phrases and clauses for clarity, eg *the wheels, each weighing a ton, were hoisted into place*.
- A comma should not be used when independent clauses are joined by *and, but, when, neither, or* or *nor*.
- To avoid confusion with the SI decimal point (,) commas should not be used in equations, formulae or to divide a number into thousands, eg for one thousand five hundred and sixty seven, write *1 567* (not *1,567*).

Semicolon

The semicolon is a mark of coordination used to join clauses together which are not joined in other ways, and in clauses containing internal punctuation; it emphasises similarity and separateness of meaning between clauses, as have been used in this sentence.

Colon

A colon is used to introduce a long quotation or list; a comma is used for short quotations and lists.

A colon is used to separate long descriptive clauses, parts of ratios, (eg 2:1) and in lists of references to separate volume, parts and page numbers, when that is required, eg *S Afr J Sci* 60(3): 360-362.

Question mark

is used after a direct question, eg *'Is a change required?'* but should not be used after an indirect or rhetorical question, eg *'The question was asked whether a change was required'*.

Exclamation mark

is rarely justified in scientific and technical writing except, of course, as the factorial symbol (!).

Dashes

- Use the em (long) dash to indicate an abrupt break or shift in thought, as parentheses or as brackets within brackets, eg *he decided – on the spur of the moment – to return*.
- Use the en (short) dash to indicate the range between numbers, or to mark phrases for emphasis and as a hyphen, eg *9-19, two-thirds*.

Hyphen

A hyphen should be used as little as possible, eg no hyphen in *rained, keyword, sugarcane*; no hyphen in words beginning with *re*, unless another 'e' follows, eg *relocate* but *re-entry*, or if the word looks odd without a hyphen, eg *co-worker*.

Parentheses or brackets

- Are used to set off comments or explanations that are independent of the sentence, eg *the disease (which is prevalent in Africa) is fatal; all drivers (especially women) should be tested*.
- To group mathematical expressions, eg $([a + b]) - ([c + d])$, but their use for this purpose should be avoided whenever possible.

- Avoid using brackets for marking paragraphs, especially when using lower case letters and roman numerals, eg a), b), ii), xv), etc.

Apostrophes:

- Should be used for the possessive, eg *the committee's approval*, but should not be used for the possessive in place names, eg *Piggs Peak* not *Pigg's Peak*.
- Should not be used in scientific and technical writing to indicate omitted letters, eg for *can't*, *won't* write *cannot*, *will not*.

Quotation marks

- Double quotation marks are used around direct quotations, new technical terms or old terms used in a new sense, and in some titles, eg "*I am not*", he said, "*very happy with the decision.*"
- Single quotation marks are used around a word, title or term (especially a foreign, slang or unusual term) within a quotation which is in double quotation marks, eg The critic said, "*The book, entitled 'The Yellow Diamond' is excellent.*"

Slash

- A slash is used to indicate ratio when only two terms are involved, eg: $2/5$ but because this can be confused with a fraction, prefer $2:5$.
- Slashes should not be used for ratios with more than two integers, eg for $2/3/4$ prefer $2:3:4$.
- Some institutes use slashes to indicate 'per'; others use the period and negative exponents, eg: $g/m^2/day$ or $g.m^2.day^{-1}$.

ABBREVIATIONS

- Limit the use of abbreviations to notes, table headings, appendices and references, eg *tc/ha/a* is acceptable for notes, but for table headings write *Cane t/ha/a*.
- Provided it has been defined previously in the text it is acceptable to use an abbreviation for a unit when it follows a number, eg *50 ha*, *12 g*, *15 °C*. Note the space between number and the unit, except in *1%*, *>15* and *<2*.
- It is acceptable to use abbreviations for phrases used frequently in a technical report provided they have been defined previously. This is done by writing out the phrase in full followed by the abbreviation in brackets when it is used for the first time, eg: *estimated recoverable sugar (ers)* or *(ERS)*; thereafter the abbreviation can be used on its own.
- Use only those abbreviations that are accepted in the relevant '*Instructions for Authors*', or official lists of SI units.
- Do not use the abbreviations of foreign words and phrases or of slang.

Note: *Percentage* is one word but *per cent* is two words.

NAMES

- The use of correct botanical or scientific names is essential in writing technical and scientific reports and papers because different common or local names are often used for the same thing, eg '*Stem borer*' means the *Chilo stem borer of corn* in the United States but means the *Eldana stem borer of sugarcane* in South Africa.
- Pedantic and repeated use of full scientific names should however be avoided. Use the common, accepted or shortened scientific name after using the full scientific name when it is first mentioned. Eg after first writing *Eldana saccharina* Walker (Lepidoptera: Pyralidae), it can be written as *Eldana*, *eldana* or *eldana* (in lower case) in later text.
- Trade names should be avoided, or used circumspectly, because the same product may have more than one trade name, eg *Glyphosate*, *Roundup*, *Ridder*, and are sometimes changed even when the product remains essentially the same or with only minor alteration to the active ingredient.
- When a trade name is used it must start with a capital letter and should have its patent registration indicated, at least the first time it is mentioned.
- The upper case or capitals tend to be used too frequently; they should be used only for the beginning of sentences, for proper names and for titles, eg *its name is the Public Health Department* but *the work is carried out by the staff of the public health department*.

NUMBERS

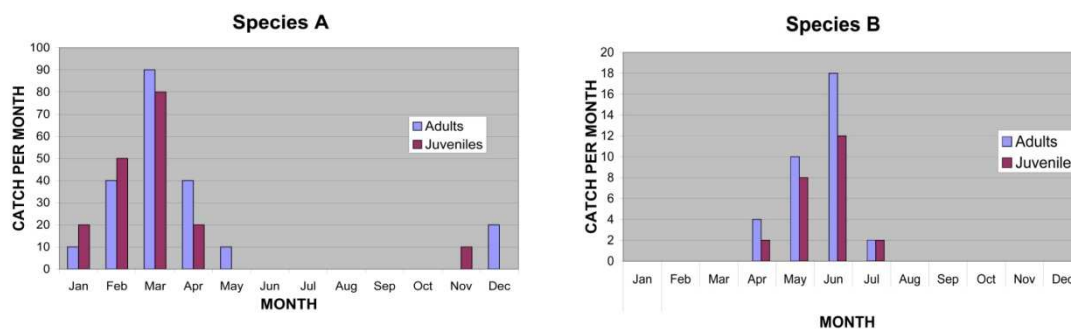
- Express numbers in words at the beginning of a sentence and for numbers under 9, but in numerals for numbers over 10, eg *Twenty of the samples were analysed, eight were found to be adulterated and the remaining 12 were found to be pure*.
- Use numbers, not words, before symbols or abbreviations, eg *12 kg/ha*.
- Always use a zero prefix for numbers less than 1, eg *0.49*.
- Always define the units used with numbers, eg *15% by volume, not 15% vv* (except on labels).
- Hyphenate cardinal and ordinal numbers, eg *twenty-one samples*, and the *twenty-first sample*.
- Choose not to use consecutively two numbers nor two words for numbers (except in the US for the date), prefer *29 February 2012* to *February 29 2012*.
- Beware when rounding-off numbers: whereas *109.1* rounded-off to *109* may represent an acceptable error of less than 0.1%, *1.9* rounded-off to *2.0* represents a probably unacceptable error of over 5%.

TABLES AND FIGURES

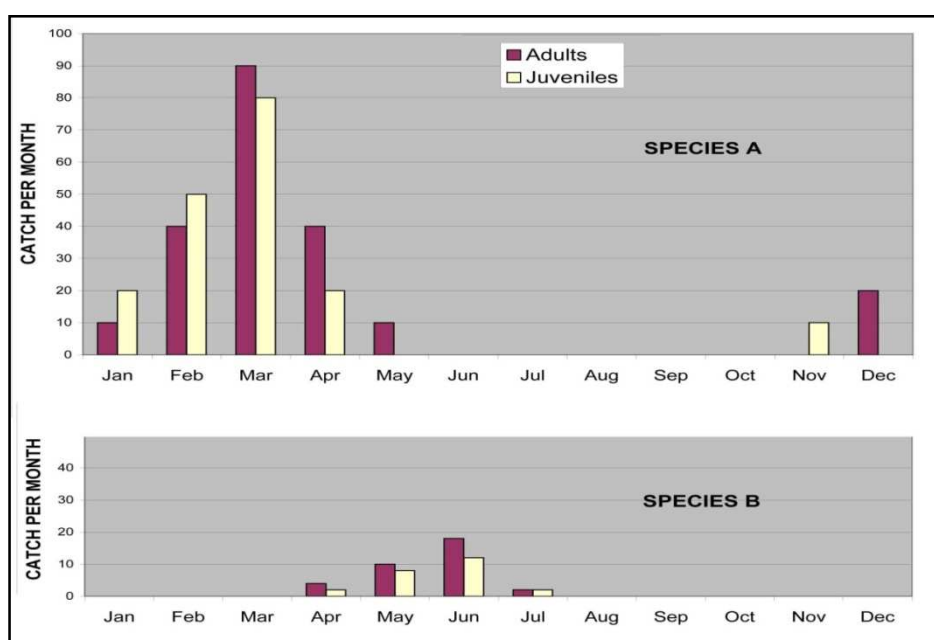
- Tables and figures (ie graphs, diagrams and illustrations) should be as clear and as simple as possible because their purpose is to aid understanding.
- Figures stimulate interest and can improve precise description.

- Do not repeat in words in the text the information given in a table or figure.
- Table headings should be above tables but figure headings should be below the figures.
- Headings and captions should be in lower case (except the first letter), clear, concise and complete in themselves, ie not needing elaboration or explanation in the text.
- Tables and figures should be numbered (for later reference or publication) and located in the text to minimise interruption in the flow of thought while the text is being read.
- It is often required that tables and figures are submitted for publication on separate sheets with numbering and captions on the back in pencil; in which case their position in the text must be indicated clearly.
- Tables that have to be exhaustive or complicated should be in an appendix.
- Graphs and bar charts should not contain a heading that mimics the figure caption.
- Care is needed to avoid misrepresentation by tables, figures and especially by photographs, as indicated by the diagrams that follow.

The first two diagrams below suggest, misleadingly, that the *catches per month* for the two species A and B are of similar order. This is because the scales for the y-axes have probably been chosen deliberately to give that impression.



In the next two diagrams it is immediately clear that the catches per month are of a very different order; this is because the y-axis scales have been chosen appropriately to give the correct impression.



PART TWO – PRESENTING

There are three kinds of presentation: *to persuade*, eg advertisements in which facts are often distorted; *to entertain*, which may be fictional, humorous or sarcastic, and *to inform*. Scientific and technical reports and papers are written to inform and should therefore be factual not fictional, without distortions and jokes, albeit with humour if that is the natural style of the presenter.

A scientific paper for publication in a journal is *written* to inform readers of detailed research or review of research in the style and form required by the publishing journal. However, the purpose of a *presentation* at a conference or congress is to *summarise* for delegates the objectives, background, main findings and conclusions of the research or review described in a paper. It is certainly not to read the full paper to the audience.

The style and form of presentation are seldom prescribed by conference organisers but the time allowed for presentation is usually very specifically defined and invariably enforced strictly by conference chairpersons.

For most scientists and technologists what to say is not a problem and saying it may be daunting but the main difficulty is usually how best to convey the information effectively in the limited time available. To achieve this it is necessary to plan and practise the presentation carefully.

THE PRESENTATION PLAN

In Part 1 of this manual, on the *writing* of a paper or report a Composition Outline, allocating pages, lines or words, to each heading, section or part of the paper was recommended.

For *presenting* the same report or paper at a conference or congress a Presentation Plan should be used to allocate *time* (not pages, lines or words) to the material to be presented; bearing in mind a presentation is a summary and should not attempt to cover all the material in the written paper, nor necessarily in the same order.

The form a Presentation Plan takes is a matter of personal choice, but one successful example of a Presentation Plan for a scientific paper to be delivered in a prescribed time is PowerPoint, illustrated on the last page of this guide. For a twenty minute presentation it consists of twenty blocks, one for each slide projected for one minute. Each block contains only headings as reminders for the presenter of the material and of any graphic(s) he wishes to discuss or describe in that minute.

VISUAL AIDS

A verbal presentation is much more effective if it is supported by visual aids and the most appropriate kind of visual aid to use in a presentation depends on the kind of audience. For

small and informal groups, chalk, marker and magnetic boards or flip sheets may be suitable. For larger and more formal groups there is little alternative to a PowerPoint presentation. (For instructions on producing a PowerPoint slide presentation consult a Microsoft Office manual.)

Advice on using visual aids

Observing the following hints on using visual aids will improve an audience's understanding of the presentation.

Limit each visual aid to a single concept; to make a number of points rather use a series of slides than one complex and confusing slide.

Do not include anything in a visual aid that you do not intend to mention or discuss in the presentation.

Minimise the use of decimals in tables, rounding-off whenever that is possible without affecting meaning or accuracy (see section on NUMBERS).

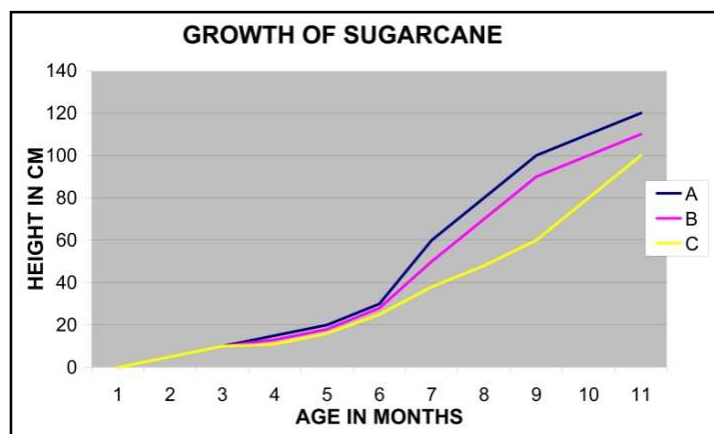
Take a visual aid off the screen as soon as the message has been digested or discussed otherwise the audience's attention will remain on it and not on the next slide or subject already being introduced.

Tables should have a maximum of four columns and four rows.

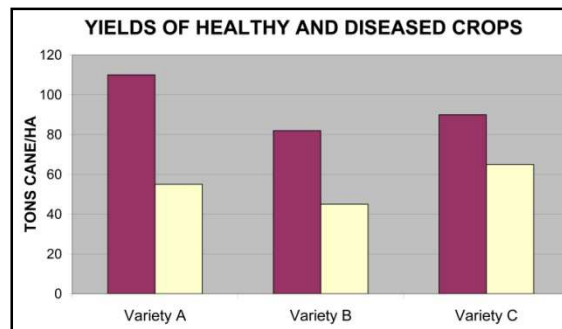
FACTORY DATA			
SEASON	1972	1973	1974
SUCROSE % CANE	14.2	12.2	12.3
FIBRE % CANE	16.8	16.9	17.5
MOIST % BAGASSE	50.4	52.6	50.5
POL % BAGASSE	2.4	2	2.2

Graphs indicate *trends*, keep them simple with short labels, preferably not more than three curves per graph.

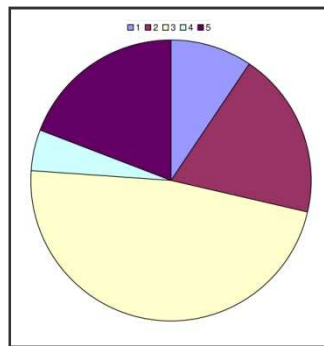
Graph lines should be the right thickness and colour, eg yellow does not show up well on a white background.



Bar charts indicate *magnitude*; there should not be more than six bars in each chart.



Pie charts indicate *proportion*; and should have a maximum of six, and preferably not more than five, segments per chart.



PREPARING FOR THE PRESENTATION

The fullness of presentation notes used at the podium depends on the presenter's experience, confidence and on the kind of occasion.

The *reading* of a presentation is undesirable but may be justified only on very formal occasions, for very complex subjects or for material which may be legally sensitive. Under normal circumstances a paper or report should be *delivered* verbally in the spoken idiom, from presentation notes or projected slides, without using slang or jargon.

As part of the planning and rehearsal process, well in advance of the conference and depending on the amount of time allocated, the presenter will have, converted the presentation plan into a 10 or 20 slide PowerPoint presentation to be projected at an average of one slide per minute during the presentation. Each slide contains the headlines of the material to be delivered or a visual aid to which the presenter wishes to refer, or to elaborate on, during that minute.

An advantage of this *one-slide-a-minute* method is that the audience focuses on what the speaker is saying at the time and when the next slide comes up their attention moves on

instead of still thinking of what was said before. The PowerPoint method also makes it easier for the presenter to keep to time. However, the success of the PowerPoint method depends on the presenter knowing his presentation notes so well that he is able to deliver his message from memory with only headline reminders on each slide. This is greatly facilitated by thoroughly rehearsing the presentation notes that have been prepared.

Rehearsing

There are six good reasons for rehearsing:

- To be able to make a verbal presentation without reading notes.
- To make the presentation within the allowed time.
- To make possible a smooth and lucid presentation at the podium.
- To deliver a comprehensible summary of the paper or report.
- To do justice to the paper, especially if it is being presented by a co-author or on behalf of another author.
- Because a well rehearsed delivery reduces the inevitable nervousness of the occasion.

Rehearsing is a most important and generally underrated part of the preparation for a presentation. The amount of rehearsing that should be done depends on the importance of the occasion, but most of all on the presenter's experience and confidence. In rehearsing the presentation the notes should first be read slowly (as if delivering to an audience) and timed; then edited to comply with the time restriction. The next rehearsal would preferably be another timed delivery to a colleague or on a tape recorder and then edited (to include the colleague's comments or suggestions) and again to fit the time allowed.

That might be the minimum amount of rehearsing needed by an inexperienced or nervous presenter but could be a little too much for a really experienced presenter.

PRESENTING THE PAPER

“Put it to them *briefly*, so that they will hear it *clearly*, so that they will appreciate it *picturesquely*, so that they will remember it and above all *accurately*, so that they will be guided by its light.”

Joseph Pulitzer

A paper received from colleagues is used here (with their permission) as an example of how to present a paper in the twenty minutes usually allowed, using a PowerPoint presentation.

The conference sectional chairperson will start proceedings by announcing the title of the paper and usually also the names of the authors as well as the name of the presenter; in the case of this example:

*Advances in sugarcane soil fertility research in Southern Africa
by JH Meyer and R van Antwerpen
to be presented by JH Meyer*

As the chairperson has named the authors, there is no need for them to be repeated by the presenter himself. He only needs to start his delivery with a salutation such as 'Good Morning' or 'Good Afternoon', as the case may be. He will then project the twenty slides of the PowerPoint Presentation (shown on the next page), one every minute, to remind him of the subject matter he memorised and rehearsed, and which he now delivers.

The presenter may prefer the time reminder (in brackets after each five slides) not to be included on the projected slides. If so, the time reminders should be included on the hard copy of the PowerPoint plan which the presenter needs to have in front of him on the lectern.

To emphasise again the importance of keeping to time, the presenter should also have a clock or timer within his sight on the lectern.

How to end a presentation is always a problem; if the conference programme makes provision for it, the presenter can end his presentation by letting the chairperson know that he would welcome questions and comments. After that it is the chairperson who can effect a suitable ending with thanks to the presenter and authors. If time has not been provided in the programme for questions, an appropriate ending is more difficult; many presenters just end by saying 'Thank You', but it is the presenter and not the delegates who should be thanked.

A convenient and appropriate ending for a presentation is for the presenter to acknowledge and thank co-authors and others who have contributed to the writing of the original paper and to the presentation.

THE POWERPOINT PRESENTATION OF 20 SLIDES

1 Objectives Background to the study	2 Crop nutrition research Varieties and N use efficiency	3 Potassium, phosphorus and lime requirements	4 Show, discuss FIGURE 1 Nitrogen management	5 Show, discuss FIGURE 2 Soil-specific N recommendations (5 MINUTES)
6 Improved N use through fertigation Silicon	7 Show, discuss TABLE 1 Show, discuss FIGURE 3	8 Organic carriers Economics of fertiliser use	9 Improved fertiliser management through leaf analysis	10 Fertiliser Advisory Service Monitoring long term trends (10 MINUTES)
11 Advances in soil management practices Soil crusting	12 Minimum tillage Erosion	13 Soil conservation Green manuring	14 Trash management Compaction	15 Salinity Sodicity (15 MINUTES)
16 Yield decline and soil health	17 Yield decline cont. Organic matter Microbiology	18 Soil/cane management Water use efficiency	19 Systems agronomy	20 Conclusions Acknowledgements (20 MINUTES)