The Scientific Paper

Scientific Writing

‘The fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication. It does not matter how pleased an author might be to have converted all the right data into sentences and paragraphs; it matters only whether a large majority of the reading audience accurately perceives what the author had in mind.’

Gopen and Swan (1990)
What was said and what was heard ....

Scientific Writing

- Writing is an integral part of research.
- Research is actualization of scientific thinking.
  End-point of that actualization:  scientific papers.
So, what might be worth researching and publishing?

**Dogs are sensitive to small variations of the Earth's magnetic field**

Frontiers in Zoology 10: 80

ISI citation count = 2 (up to Sept. 2014)

- 70 dogs of 37 breeds.
- 1,893 observations of defaecation and 5,582 observations of urination over a two-year period.

**Finding**

Dogs prefer to excrete with their bodies aligned along the North-south axis.

Tumerone shown to increase the regeneration of new neurons in cell cultures and in lab rats.


Eat more curry!
**Impact of the shape on sensory properties of individual dark chocolate pieces**
LWT - Food Science and Technology: 545 – 552
ISI citation count = 2 (up to Sept. 2014)

Yes, shape makes a difference

**Creatures of the night: Chronotypes and the Dark Triad traits**
Personality and Individual Differences 55: 538 – 541
ISI citation count = 8 (up to Sept. 2014)

People who stay up late at night (than those who go to bed earlier) are more likely to display anti-social personality traits such as narcissism, Machiavellianism, and psychopathic tendencies
Better sex lives leads to longer life span

Research has shown that
- the sexually frustrated live shorter lives
- on the other hand, mating partially reverses (-)ve effects on health and aging

However, this evidence is based on a study of fruit flies . . . .


ISI citation count = 4 (up to Sept. 2014)


ISI citation count = 2 (up to Sept. 2014)

“Whether a bird chooses the direction into which it decides to expel its faeces, and what role the wind plays in this, remain unknown.”

**Androgen receptor gene sequence and basal cortisol concentrations predict men’s hormonal responses to potential mates**

Proc. R. Soc. B 277: 57 – 63
ISI citation count = 13 (up to Sept. 2014)

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**Or:**

**Talking to young women is beneficial for men**

- 149 men (ave. age 19)
- One group interacted with a male (aged 25)
- Another group interacted with 7 women (ave. age 19)
- **Testosterone and cortisol levels measured**

- Associated with alertness; feeling of physical well-being; muscular endurance; is beneficial to cardiovascular health.
- Helps reduce stress and anxiety; >> makes someone who is stressed out much happier.
After 5 minutes of conversation . . . .

Watson & Crick’s seminal paper on DNA (1953)
Consider

- Almost all scientists agree that writing is integral to being a scientist
- Less than 5% are formally trained in scientific writing
- Most learn from examples in the scientific literature
- One in ten enjoy writing; the rest think it is a necessary chore

Lindsay (2011)
The Title of a paper

- The link between the reader and the writer.
- Identifies and describes the contents of a paper accurately, specifically and succinctly.

Informative style
“Laksa taken in the morning causes lethargy in public servants.”

Indicative style
“The effect of laksa taken in the morning on lethargy in public servants.”

Based on materials from Lindsay (1995) and Wilkinson, (1991)


ORIGINAL PAPER

C. Koeck

Shake flask culture of *Laccaria laccata*,
an ectomycorrhizal basidiomycete

Received: 9 October 1995/ Accepted: 4 December 1995

Abstract

Large-scale exploitation of the potential benefits of ectomycorrhizal fungi in improving plantation yields means that fermentation techniques for these fungi will be required. Starting with a base performance on a rich, complex medium, the effect of variations in some physicochemical culture parameters on biomass yield was studied. It was possible to reduce the amount of phosphate salts (to 1/20) and other ingredients (to 1/3rd) in the medium. A shaking speed of either 100 or 200 r.p.m. in an orbital incubator was satisfactory and biomass yield responded to an increase in eucalypt hardwoods to supply from plantations (Cameron and Penna 1988). Thus, there have been numerous studies on the manipulation of the ectomycorrhizal symbiosis in eucalypts in order to extract an advantage in plantation economics (Grove and Meljacuk 1994; Guthrie et al. 1988; Bougnier et al. 1987; Abouelkheir et al. 1986). It is now clear that for many plantation tree species, inoculation at the seedling stage with an appropriate ectomycorrhizal fungus results in faster tree growth.

Apart from quantitative studies on the enhancement
The sections

- Introduction
- Materials and Methods
- Results
- Discussion of Results
- Summary or abstract

IMRaD
What goes in each section?
The Bradford Hill Questions

- Introduction  Why did they start?
- Materials & Methods  What did they do?
- Results  What did they find?
- Discussion of Results  What do the results mean?

The Introduction

Exomycorrhizal fungi form structures called
exomycorrhiza on the roots of many economically
important trees such as pine, spruce, beech and
eucalypts (Borradaile and Marx 1976; Warcup 1980).
Exomycorrhizal fungi can increase the growth of host plants
by increasing their uptake of nutrients from the soil
(Barley and Smith 1983). Exomycorrhizal fungi are
important for the growth and survival of eucalypts
(Bowen 1973; Maksymishin et al. 1975; Warcup, 1980).
The eucalypt is an important plantation tree genus with
over 7 million hectares planted worldwide (Cameron
and Penzin 1988). In Australia, a detailed study has
advocated a change from reliance on native forests for

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at. 1988; Gagnon et al. 1988), and encapsulated pre-
grown mycelium (Le Trinh et al. 1985; Minster et al.
1987; Desch and Fox 1988). Deficiencies in the
efficiency, physical form and manufacturing processes
for the inocula currently available are revealed when
they are assessed using criteria for efficacious and
practical inocula which have been proposed (Tomaras
et al. 1987). The use of fermentation techniques will
enable inocula of higher quality to be produced.

Inocula produced by the submerged aerobiosis culture
of mycelia immobilized within hydrogel beads has been
found to be of high efficiency (Kniek et al. 1992). The
production process for hydrogel bead inocula requires
the ability to culture mycelia in both free and
immobilized states. This is because free mycelia is
used as a source of propagates for the production of
mycelia immobilized in the hydrogel. Thus, the
development of cultural conditions for exomycorrhizal
fungi in submerged aerobiosis culture is a necessary step
towards the production of hydrogel bead inocula.
Nutritional studies on the culture of exomycorrhizal
fungi (e.g. Ahmad et al. 1990; Olsa 1990) provide
important information in one of two areas required for
The Introduction

Usually includes at least the following:

- Derivation and statement of the problem and discussion of the nature of the problem.
- Discussion of the background of the problem.
- Derivation and statement of the research question or objective(s) of the research.

Structuring the introduction

- Problem >> Background >> Question >> Objective
- Background >> Problem >> Question >> Objective
- Question >> Objective >> Problem >> Background
Search of the literature

- To avoid repetition of research.
- The problem and its relation to earlier research.
- Development of hypotheses.
- To avoid misinterpretation of results.
- To avoid omission of pertinent references.

Materials and Methods

Materials and methods

Fungi

The culture used was Laccaria leccata (Scop. ex Fr.) Bert. & Bres. E499 from the culture collection of the Commonwealth Scientific and Industrial Research Organisation’s Division of Forestry, Penrith, W. Australia. In plate culture, the solid medium used was modified Melan-Nitsch agar (Marx 1968) and incubation was at 27°C.

Growth medium

The initial medium used in shake flask culture was the same as one previously used for ectomycorrhizal fungi (Litchfield and Arthur 1983) except for the source of glucose used. It comprised (g l⁻¹): peptone (Difco), 10.0; yeast extract (Difco), 2.0; NH₄NO₃, 3.0; KH₂PO₄, 2.38; KH₂PO₄, 5.65; MgSO₄·7H₂O, 3.0; CaCl₂·2H₂O, 0.0064; FeSO₄·7H₂O, 0.0011; MnCl₂·4H₂O, 0.0019; ZnSO₄·7H₂O, 0.0015. Glucose at desired concentrations was added prior to autoclaving. Variations of this formulation were tested as indicated in Table 1. In the case of the phosphate salts, reductions where mentioned, were made equally of both.

Stirrations

Media and apparatus were autoclaved at 121°C for 15 min.
Remember falsifiability?

Falsifiability
A scientific theory or hypothesis has the important characteristic that it is capable of being subject to experimentation that could show it to be untrue i.e. it is falsifiable.

What does this imply for the reporting in Materials & Methods?

Karl Popper
Materials and Methods

A clear and accurate description of materials and methods is required to interpret, explain and give meaning to the results.

Accurate description is required so that others can:

- replicate the experiments.
- modify the method with assurance that the original is changed in a particular way.
- Apply them under different conditions.
- compare the research reported with others.

For example:

What Nature says

Authors & referees

For example:

What Nature says
“An inherent principle of publication is that others should be able to replicate and build upon authors’ published claims.”

Guide to authors and referees (Nature, 2012)
Results

The cultures were characterized by the measurement of residual glucose, biomass yield and pH through the course of the fermentation. The initial medium formulation used proved

(Fig. 3). At the lower shaking speed, when the amount of glucose supplied was doubled to 20 g L⁻¹, again the slope of the glucose consumption and biomass accumulation profiles were not significantly altered (Fig. 4). However, the final yield of biomass was increased by about 1.7.

Avoid ending up publishing in this journal
Results

The results of research are the substance of science and are the objective of scientific research.

In reporting results:
• the overriding objective should be accuracy.
• information should be systematically presented.

Structure and contents
• The results section must ultimately address
  o the questions raised in the introduction and
  o any hypotheses formulated there.
• Since this section is a direct consequence of the methods,
  organize it to correspond to the methods section.
The results section should not be:

- merely a collection of tables and figures.
- They can be part of, and support the development of the argument but must not replace it.
- They must be integrated into the text and done so via more than an announcement.
- used to interpret the results.
- The results should consist of bare, dry, unembellished observations and measurements.
Discussion

Whilst the results are the substance of science, the discussion allows for the play of ideas that advance science.

The nature of discussion
1. The objective is to give the research, especially the results, meaning.
2. Integration of the results, the method, the related literature, and theoretical context.

3. Examination of the results to
   - determine whether they resolve the research question.
   - compare them within themselves and to other results.
   - explain and interpret them.
   - draw conclusions or derive generalizations, and make recommendations for applying the new results or further research.
A note about giving explanation
(informed speculation?)
to results in discussion.

**Occam’s Razor**

*Oc·cam’s razor*

**Variant(s):** also *Ock·ham’s razor* \ä-kämz-\*

**Function:** noun

**Etymology:** William of Occam

**Date:** circa 1837

“A scientific and philosophic rule
that entities should not be multiplied unnecessarily.”

**Interpretation:**
“that explanations of unknown phenomena be sought first in
terms of known quantities,
or requiring that the *simplest* of competing theories be
preferred to the more complex.”

*Merriam-Webster dictionary*
Example: Who/what makes crop circles?

Competing Explanations 1
Extra-terrestrials do it
Competing Explanations 2
More earthly and mundane causes

How we made the circles and fooled the world

All it took was planks, string... and a baseball cap

Sept 1991; Today newspaper
Which is the simpler explanation that is in keeping with Occam’s Razor?
The hourglass analogy of the research paper

Introduction

Materials & Methods

Results

Discussion

General context
Theoretical context
Empirical context
Specific hypothesis
Procedures
Analyses
Results
How results fit hypotheses
Empirical context of results
Theoretical context of results
General context of results

Summary or Abstract


C. Kork
Shake flask culture of Laccaria laccata, an ectomycorrhizal basidiomycete

Received: 9 October 1995; Accepted: 4 December 1995

Abstract Large-scale exploitation of the potential benefits of ectomycorrhizal fungi in improving plantation yields means that fermentation techniques for these fungi will be required. Starting with a base performance on a rich, complex medium, the effect of variations in some physicochemical culture parameters on biomass yield was studied. It was possible to reduce the amount of phosphate salts (to 1/9th) and other ingredients (to 1/3rd) in the medium. A shaking speed of either 100 or 200 r.p.m. in an orbital incubator was satisfactory and biomass yield responded to an increase in carbon substrate (glucose, from 10 and 20 g l⁻¹) though YOY declined. An increase in inoculum size encouraged hardwoods to supply fewer plantations (Cameron and Penna 1988). Thus, there have been numerous studies on the manipulation of the ectomycorrhizal symbiosis in eucalypts in order to extract an advantage in plantation economics (Grieve and Mahajan, 1994; Ogbuehi et al., 1988; Beaghar et al., 1987; Abiadla et al., 1996). It is now clear that for many plantation tree species, inoculation at the seeding stage with an appropriate ectomycorrhizal fungus results in faster tree growth.

Apart from quantitative studies on the enhancement of tree growth attainable with ectomycorrhizal fungi, appropriate technology for the mass culture of the fungi
Summary /Abstract

Often written last but of great importance.

• Can decide if the paper gets read.
• Gathered by database and abstracting services which are important disseminators of your work.
Elements of an effective summary

Broad outline of:
- Why the experiment was done.
- How the experiment was done.
- The main results.
- Main conclusions.

Should be written as a self-supporting section.

Referencing

There are various formats for referencing and citation (these go together)

- Harvard (Author-Date system)
- Vancouver (Number-Citation system)

Consult a journal’s “instruction to authors” on specific requirements for citations and referencing.
**Vancouver system**

Arabic numerals in parentheses (1), square brackets [1], superscript¹, or a combination[¹].

* e.g.
The moon is made of Wensleydale cheese¹.

Reference

**Harvard system**

Parenthetical referencing embedded in the text.

* e.g.
The moon is made of Wensleydale cheese (Wallace and Gromit, 1989).

Reference
UK: Ardman Productions.
Citations

Citations serve to:

- Provide authority for views made or positions taken, or statement cited
- Allow for checking of the accuracy of the citation made
- Allow further/other information to be sourced regarding the citation (additional references)
- Acknowledge conflicts with other works
- Acknowledge/credit the originator of cited works

After Lindsay, 1995; and Posner, 2007

It is about being **intellectually honest**

The serious consequences of failure to acknowledge

2014
Head,
Curtin Marketing Dept. resigned
(citation problems in her papers)

2011
Defense Minister,
Germany resigned
(citation problems in his PhD thesis)

2002
Vice Chancellor,
Monash University resigned
(Citation problems in 3 of his books)
The serious consequences of failure to acknowledge
The serious consequences of failure to acknowledge

The serious consequences of failure to acknowledge
What is the relationship between failure to cite adequately and plagiarism?

Plagiarism

“Plagiarism means presenting the work or property of another person as one’s own without appropriate acknowledgment or referencing”
(Curtin University)

Plagiarize

“... to steal and pass off (the ideas or words of another) as one’s own; use (another’s production) without crediting the source”
(Merriam-Webster Dictionary)

Consequence


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One of the conditions for submission of a paper for publication is that authors declare explicitly that their work is original and has not appeared in a publication elsewhere. In case of any data should be appropriately cited. As such this article represents a severe abuse of the scientific publishing system. The scientific community take a very strong view on this matter and apologies are offered to readers of the journal that this was not detected during the submission process.
Forms of citations

Information-prominent
“Red cars are the fastest (Bloggs, 1999).”

Author-prominent
“Bloggs (1999) claimed that red cars are the fastest.”

One’s position is given by choice of wording in the text

“Red cars are the fastest (Bloggs, 1976).”
Implication: Accepted concept; Bloggs first to present; the author agrees.

“Bloggs (1976) found that red cars are the fastest.”
Implication: Concept deduced by Bloggs; the author agrees.

“Bloggs (1976) claimed that red cars are the fastest.”
Implication: The verdict is still out; the author is neutral.
**Word choices** (after Monash, 2010)

**When you agree with an author’s conclusions:**
- Acknowledge; demonstrate; prove; identify.
  
  *e.g.* Bloggs *acknowledges* that there may be other factors ...
  
  Bloggs *demonstrates* this as an additional factor ...

**When you disagree:**
- Confuses; disregards; ignores.
  
  *e.g.* Bloggs *confuses* this factor with ...
  
  Bloggs *disregards* this factor ...

**When you feel the author is unsure/unclear; not being explicit:**
- Suggests; implies; intimates.
  
  *e.g.* Bloggs *implies* that this factor is ...

**Referring to the information without expressing an opinion:**
- Notes; proposes; believes.
  
  *e.g.* Bloggs *believes* that this factor is ...
  
  Bloggs *proposes* that this factor is ...

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**Being neutral**

(demonstrating your knowledge without allowing judgment to intrude)

*e.g.* Further factors were described by Bloggs ...
  
  Bloggs reported that...

**When you convey the author’s positive attitude:**
- Accept; emphasize; note; point out; subscribe to.
  
  *e.g.* Bloggs accepts that these factors ....
  
  Bloggs subscribes to the idea that ....

**When you convey the author’s negative attitude:**
- Attack; dismiss; dispute; oppose; question; reject.
  
  *e.g.* Bloggs disputes the concept of ....
  
  Bloggs questions the validity ....
Using evaluative expressions to indicate your own views of a citation (after Monash, 2010)

The work/study/paper . . .
. . . disregarded . . .
. . . neglected to consider . . .
. . . overlooked . . .
. . . took no account of . . .

Some evaluative adjectives
incomplete reliable robust
efficient credible conclusive
questionable cumbersome unsatisfactory
useful over-simplified comprehensive
simple complex

A potential problem:
Proper use/choice of sources

Consider this citation
Freshwater fish contain less n-3 fatty acids than marine fish (Kumar et al., 2008).

Checking reveals the source as
Non-gelatinized starch influences the deposition of n-3 fatty acids in the muscle of a tropical freshwater fish, *Labeo rohita*.

**Introduction**

Present trend of increased health consciousness among the consumer has diverted the attention of animal nutritionist to the product quality improvement beside the growth of the animal. Hence more emphasis is being given for enhancing the n-3 fatty acids content of the animal product as a strategy for quality improvement. Some n-3 enriched products like egg, meat are already present in the market, whereas some other like fish and milk are in the pipeline.

Compared with marine fish, freshwater fish contain less n-3 fatty acids. Though some molecular approach has been initiated to introduce desaturase gene into freshwater fishes (Zheng et al., 2004) as a strategy to enhance the n-3 fatty acids content, no significant outcome has come yet. In this regard, dietary manipulation seems to be more practical than the gene manipulation approach. Hence the influence of muscle fatty acids because of dietary nutrients needs thorough understanding. Though the relationship between dietary fatty acids with fatty acids profile of muscle has already been established, its relation with other nutrients like carbohydrate has not been established especially in fish, which may be helpful to the nutritionist for their product quality improvement programme.

Is it valid to cite this paper in the manner shown? No, the paper has no substantiating data.
The recording of data

Patent for the first practical telephone

Alexander Graham Bell

The Lab Record Book

- Is a legal document recording your work
- Proof that you conducted the research
- Disputes; plagiarism
- Required to proof right to own a related patent
  “First to invent”; “first to file”
Required features

- Permanently bound pages.
- Consecutive page numbering.
- Entries in chronological order without blank pages; written clearly.
- Pre-experimental details (work/ideas) recorded.
- Results obtained at a later stage recorded in date order and cross referenced to earlier entry.
- Additional materials (e.g. photographs; printouts) are attached with stapling or adhesive.
- Record of equipment details (manufacturer; model); indicate purpose if unclear.

Controversy over pagination
Controversy over pagination

21 Dec 1988, Pan Am 103 ends flight at Lockerbie

Critical evidence:

- Timer fragment found in the remnants of a shirt.
- Shirt linked to a purchase from a shop in Malta.
- Shop owner identified the suspect.
Problem:

- Finding of timer fragment recorded by explosives expert, Dr Hayes.
- The find was recorded in Hayes' note book on Page 51.
- The subsequent pages were re-numbered from 51-55 to 52-56.
- Was Page 51 inserted after the fact?
• Sketches used to detail method or equipment setup.
• All errors remain legible e.g. ruled out rather than erased or covered. Provide reason if unclear.
• Alterations (additions; changes) signed and dated.
• Each experiment/work period signed and dated by writer.

**Higher level requirement**

• Duplicate copy kept separately.
• Witness (not a participant in the work) also to sign off.
• Do not fear “writing too much.”
• It is a complete record – treat it like a diary
• How much detail?
  Any knowledgeable person should be able to understand your procedures used to obtain your results.
• The more details, the easier it will be to claim “first to invent.”
• Requirements for patenting provide for a high standard which benefits the writing of scientific papers.

A cautionary tale

Who owns research data at your university?
A cautionary tale

Chronic Fatigue Syndrome (CSF):
A cause proposed

• 2006
  A group announced linkage between XMRV and prostate cancer.
  Not corroborated.

• 2009
  Another group had a paper accepted in Science which claimed that XMRV is associated with CFS.
  One of the key authors was Dr J. Mikovits, Director of the Whittemore Peterson Institute (WPI).
The problem was: No other researchers could find XMRV in other CFS patients.

Most favored explanation of the results of the Science paper is contamination of samples.

Sept. 2011: Amidst the resulting controversy, Dr Mikovits was sacked as Director of the WPI.

Nov. 2011: Dr Mikovits was arrested of a charge of stealing WPI property (lab notebooks and related data).
CORRECTIONS & CLARIFICATIONS

RETRACTION

Science is fully retracting the Report "Detection of an infectious snoavirus, XACoV, in blood cells of patients with chronic fatigue syndrome" (1). Multiple laboratories, including those of the original authors (2), failed to independently detect XACoV-related viral sequences in chronic fatigue syndrome (CFS) patients. In addition, there is evidence of poor quality control in a number of specific experiments in the Report. For example, Fig. 1, Table 1, and Fig. S2 have been retracted. In response to concerns expressed about Fig. 2C (unnotated), the authors acknowledged that they omitted important information from the legend of this figure panel. Specifically, they failed to indicate that the CFS peripheral blood mononuclear cells (PBMCs) shown in Fig. 2C had been treated with acetylsalicylic acid (NSAID) and interferon-α. This was in contrast to the PBMC samples shown in Figs. 2A and 2B, which had not been treated with NSAID. All three issues, Science has lost confidence in the Report and the validity of its conclusions. We note that the majority of the authors have agreed in principle to retract the Report but they have been unable to agree on the wording of their statement. It is Science's opinion that a retraction signed by all the authors is unlikely to be forthcoming. We are therefore editorially retracting the Report. See the note at the end of this retraction explaining that the scientific community has devoted to unsuccessful attempts to replicate these results.

References

In summation

Why is good writing important?
(Springer, 2013)

"Science is complex, but the writing used to describe it need not be. Good writing is simple writing."

- Better chance of acceptance for publication
- Better impact of a manuscript
- Accelerates understanding and acceptance
- Increased faith in the quality of the work reported

"Poorly written and complicated manuscripts annoy readers, peer reviewers, and journal editors, and hinder their understanding of complicated scientific concepts."
Sources

Monash (2010) “Signal your position”
Posner, B. (2007) Citation plagiarism?
Springer (2013) Why is good writing important?
<http://www.springer.com/authors/journal+authors/journal+authors+academy?SGWID=0-1726414-12-837206-0> 22 Nov 2013