OPENINGS IN INFORMAL SCIENTIFIC PROSE

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One of the most difficult parts of writing for many students and practitioners is the start. How do we clear our literary throats? What do our readers need to know before we really get started? And how do we "set the scene" or "provide background" essential to the understanding of the document we are about to write? As teachers of technical writing, we have probably all been asked such questions thousands of times - and this paper seeks some answers.

To do this, I analyzed the starts (the title and first paragraph or two) of the shorter (100-200 words) texts in four consecutive issues of *New Scientist*, a magazine chosen for its interesting and entertaining writing style as well as its clarity of technical expression. The issues analyzed are February 17 and 24 and March 3 and 10, 1990. My aim was to determine, and if possible classify and explain, the systems of meaning which tend to dominate the starts of informal scientific texts in technical journalism.

My decision to concentrate on informal texts rather than attempt a more wide-ranging analysis of all scientific texts was largely a matter of practicality, but was justified by the texts in the four issues studied. There were far fewer larger texts, and the starts for these were significantly different from the shorter texts - pointing to the need for further research of openings in formal scientific texts. The shorter informal texts tended to be informative reports

of events, whereas the larger more formal texts tended to be essays rather than reports providing explanations, exploration and enquiries as well as simply giving information.

The reports showed a very strong emphasis on problems, their solutions, and related evaluations. Many long titles show this emphasis to even the unpracticed observer:

(1) *European nations want action now on global warming* (17F20/1)*

(2) *New hitches may cut Channel Tunnel's capacity* (17F21/1)

(3) *Jungle fire puts rare animals at risk* (17F22/3)

(4) *Americans deprived of contraceptive choice, says report* (17F24/2)

Shorter titles, though obviously less informative, again often do the same:

(5) *Do-it-yourself danger* (17F25/1)

(6) *Kites killed* (17F25/2)

(7) *Galileo's glitch* (17F25/6)

(8) *Sick trees* (17F25/7)

As the first sentence or two of these and many other of the reports studied reinforce the emphasis on problems and solutions, this paper first explains openings in informal scientific prose in these terms, with other starting types being discussed later.

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*Provenance is indicated by the issue page and report on that page; thus 17F20/1 indicates the first report on Page 20 of the February 17 issue.

THEORETICAL FRAMEWORK

Fortunately a detailed theoretical framework exists as the basis for explaining the problem-solution starts. It was Winter who first recognized the strong connection between technical reports and problem-solution principles. Using a basic four-part structure (Situation-Problem-Solution-Evaluation), he explained document organization to his technical and business students in both Norway and England. To enable others to use and develop the principles, he produced an important study guide (1976), which has formed the basis for later research and teaching.

Working with Winter, Hoey analyzed many of the signalling devices relating to problem-solution principles as part of his book "On the Surface of Discourse" (1983). Also working with Winter, I explained some very short texts within the principles (1981), and developed a wide-ranging practical rhetoric (1984) to explain a very large percentage of short texts within the general concepts initially envisaged by Winter. My more recent work (1988) applies the principles to planning and writing technical documents. But it is my earlier work (1980) that has proved most useful in explaining the openings in informal scientific texts.

In my attempt to explain problem-solution concepts through a study of short texts - and vice versa - I developed a 12-part algorithm proceeding through the stages from the initial statement of an area of interest through problem recognition and solution to evaluation and implementation. In that study texts were recognized as being at a definable stage of the process, or as describing two or more stages (sometimes all twelve). Some of the stages were missing from texts because the work they were describing was not

yet complete, or because the work had been stopped before completion, or because readers would already know the information in stages not discussed.

In summary the 12 stages are:

(1) statement of the area of interest,
(2) clarification of the situation,
(3) recognition of the problem,
(4) recognition of related problems,
(5) decision regarding the significance of the problem,
(6) decision regarding the solvability (within constraints) of the problem,
(7) understanding the value, or causes, of the problem,
(8) creation of possible solutions,
(9) selection of best solution,
(10) refinement of solution,
(11) implementation of solution, and
(12) final evaluation.

Although this is an arbitrary list (we could equally have used 8 or 16 stages), it forms a useful starting point.

PROBLEM-ORIENTED OPENINGS

Most of the openings in the texts studied concentrated on a single element of the total problem-solution process rather than covering a series of stages. Of these many discussed a part of the wide concept of "problem" - its recognition, its cause, its seriousness, or its extent. As we cannot begin the problem-solution process at all until a problem has first been recognized, we should expect to find reports that indicate this earlier stage:

(9) *Inquiry deepens on conduct of American AIDS expert*

> An INFORMAL inquiry into the scientific conduct of Robert Gallo, best known as the joint discoverer of HIV, has been stepped up. (3M20/1)

The report then explains that Gallo's claim is suspect - and the inquiry is hoping to determine whether a problem exists with his claim. No thoughts of a solution are possible of course unless and until a problem is recognized.

A possible problem is recognized in the following:

(10) *Space may be 'too dangerous' for human beings*
BIOMEDICAL experts have bad news for President Bush: cosmic radiation and the effects of microgravity may pose too great a threat to human health to allow long trips into space. (3M24/1)

Often investigation reveals that a problem does <u>not</u> exist:

(11) *Acid test fails*

> RESEARCH scientists at Britain's Forestry Commission have dismissed the theory that tree planting causes the acidification of surface waters because the trees channel airborne pollutants to the soil and thence to the water. (10M30/1)

Tree planting is <u>not</u> a cause of surface water acidification, as suggested earlier, and so the efforts to find a solution to the problem must be directed elsewhere.

Many openings concentrate on the important issue of the cause of an already-recognized problem:

(12) *File closes on North Sea rig disaster*

> THE INQUIRY into the Piper Alpha disaster has identified the likeliest factors leading to the explosion that blew the rig apart. (24F17/1)

The knownness of the disaster is indicated in the first line of the text (and an accompanying photograph), and the report discusses most likely causes. The title here indicates that the need to know problems (the cause of the disaster) has been solved. A cause for a commonly-known problem is identified in:

(13) *Habits of consumption create energy addicts*

> PEOPLE are hooked on energy consumption in the same way that alcoholics are hooked on drink. This explains why we seem so intent on destroying our environment and risk destroying ourselves... (24F23/3)

The cause-effect relation is signalled by create in the title and then by This explains why.

Frequently informal science reports start with a statement of the problem, which is then discussed in more detail later:

(14) *Jungle fire puts rare animals at risk*

> A BLAZE has destroyed more than a third of the Poco das Antas nature reserve in Brazil, the only place in the world where the golden lion tamarin, a species of monkey, can be found living in the wild. (17F22/3)

And when we know that a problem exists, we often need to know just how serious it is. Is it something we can live with - or would it cost too much to rectify? The following opening introduces a report which questions the accepted level of seriousness of cocaine:

(15) *Canadians accuse US of 'hysteria' over drugs*

> THE ADDICTIVE potential of cocaine may have been widely overstated, according to a Canadian psychologist. "The drug is no more addictive or medically risky than drinking alcohol or coffee, gambling, smoking tobacco or marijuana, or making love to excess,"... (24F19/2)

SOLUTION-ORIENTED OPENINGS

Many reports emphasize the solution to a problem, often without overt mention of the problem itself. The report might give details of the solution, may evaluate it, may compare competing solutions, or may discuss testing or implementation. Some reports call for a specific solution:

(16) *Secrecy under the ice frustrates global warming studies*

> ATMOSPHERIC scientists want the American and Soviet governments to release data obtained from submarines passing under the Arctic icecap, in order to improve models of global climate change. (24F21/2)

The problems are indicated by frustrated and the implicit inadequacy of the present models, which need improvement - and the release of the information would remove the frustration and hopefully lead to the required improvement.

A clear call for a solution to a problem is seen in:

(17) *Prince's forest plea*

> THE TIME has come for an international convention to protect the world's rainforests, the Prince of Wales said last week. (17F22/2)

whereas the following indicates a solution which is ready to be implemented:

(18) *Crack troops*

> This caterpillar [photograph provided] is the latest weapon in President Bush's arsenal to combat the cocaine barons of South America. (3M26/6)

The solution may only be an attempted one:

(19) *Australia backs demands to bring bones home*

> AUSTRALIA will attempt to retrieve Aboriginal artefacts and remains that are in collections in at least 160 museums and institutions around the world. (3M23/3)

or the action being taken may enable a solution to be derived:

(20) *Germany bows to pressure over gene research*

> WEST GERMANY'S proposed "gene law" has passed through the committee stage in the Bundestag with fewer changes than scientists had feared. (10M28/2)

The gene law will enable scientists to conduct gene research in efforts to solve many problems.

Solutions may have their own problems:

(21) *Soviet brain drain may overwhelm Israel*

> ISRAEL is preparing to absorb an estimated 2000 scientists and researchers from the Soviet Union during the next year, thanks to that country's new policy of allowing free immigration to the West....Many Israelis are concerned about whether their country can absorb such numbers. (3M23/1)

Cost, of course, is often a serious problem with a proposed or actual solution - and it can be so great that the solution may not be worth it:

(22) *Higher costs confirmed for US supercollider*

> THE AMERICAN Secretary of Energy, James Watkins, told Congress on Monday that the US's planned particle accelerator, the Superconducting Super Collider (SSC), will cost at least two billion dollars more than the $5.9 billion estimated last year. He also admitted that the final cost estimate may be so high that the collider is not worth building. (10M29/3)

Report openings often introduce the testing of solutions before implementation:

(23) *New AIDS drug starts clinical trials*

> SCIENTISTS in Britain and France hope to begin parallel clinical trials to evaluate the efficacy and toxicity of dideoxyinosine (DDI), a potential new treatment for AIDS. (10M26/2)

and after implementation, we might even expect admission of failure:

(24) *Marshall admits failure on nuclear power*

> AFTER a quarter of a century trying to make sure Britain built reactors that worked, Lord Marshall, the country's best known advocate of nuclear power, admitted defeat last week. (17F24/2)

More usually, though, success is reported:

(25) *Bone marrow baby*

> A CALIFORNIAN woman announced last week that she had given birth to a child whose bone marrow cells are suitable for transplanting into the bones of an elder daughter who suffers from leukemia.
>
> The woman and her husband have openly acknowledged that the new baby was deliberately conceived as a potential cell donor for their 17-year-old daughter. (24F26/7)

or at least partial success:

(26) *Guyana fights a new battle to control malaria*

> GUYANA is now recovering from the worst epidemic of malaria it has ever experienced. (3M22/2)

MULTIPLE-STAGE OPENINGS

The more lengthy short reports often start by including a summary of a project from start to finish - including most of the stages in between. The

shorter reports, however, tend to concentrate on a single stage as we have just seen, or they include two or three parts. Here is an example containing details of the problem, the solution, and an evaluation that the solution worked:

(27) *Singular feats quench tyre fire*

> HOW do you extinguish a blazing pile of 14 million tyres? These firefighters succeeded last week by ripping it apart and dousing them one by one. (10M30/4)

Problem, solution and evaluation also occur in the following, except this time the evaluation is a negative one:

(28) *Do-it-yourself*

> UNORTHODOX home remedies are being used by Australians in Queensland to treat skin cancers they have diagnosed themselves, according to a new study.
>
> The people are risking their lives because the treatments are doing more harm than good, the researchers concluded. (17F25/2)

The following example explains the problem in the title and the first sentence, and the proposed solution in the next two sentences:

(29) *Americans deprived of contraceptive choice, says report*

> COUPLES in the US have less choice of contraceptives than couples in Western Europe and some less developed countries, according to a report published

this week by the US's National Research Council, the research arm of the National Academy of Sciences. The NRC argues the need for better, safer and more varied contraceptive methods to suit couples at all stages in their reproductive life. In particular, it stresses the need for a variety of contraceptives to suit women of all ages. (17F24/1)

The solution and the problem are combined within the first sentence of the following:

(30) *Missing head*

THE Massachusetts Institute of Technology has had to reopen its search for a new president following the surprise withdrawal of candidate expected to have been confirmed in the job by the institute's board of governors on 2 March. (3M26/7)

EVALUATION

Evaluation is a general term used to indicate judgment, including how good or bad something (e.g. a solution) is. Here is an opening indicating a new evaluation process:

(31) *Sick trees*

BRITAIN has set up a scientific task force to review the health of its trees. (17F25/1)

Although the title indicates a problem, there is a need to establish the extent of that problem - and that is an evaluation. In fact evaluation occurs at all stages of the process from initiation to success (or failure). The following example shows evaluation as the basis for a decision (a solution):

(32) *Britain reviews its stance over UNESCO*

> THE FOREIGN Office has written to more than 150 scientific societies and other academic organizations to sound out their attitude toward Unesco. Replies are being passed to the Foreign Office's minister Tim Sainsbury, who is expected to decide within the next few weeks whether Britain should apply to rejoin the organization. (10M26/1)

IMPROVEMENT

Improvement involves evaluation, problem and solution. The present solution to a problem is evaluated and found to be deficient in some respect i.e. it has a problem. This problem is rectified by the new solution, which overcomes the initial problem without the deficiency of the previous solution. It is the difference between the old and modified solution which solves the problem with the earlier solution. These elements are seen in:

(33) *It's cooler with propane*

> RESEARCHERS at the South Bank Polytechnic in London claim to have developed a refrigerator that relies not on chlorofluorocarbons, which harm the stratospheric ozone layer, but on a naturally occurring and cheap gas called propane. (17F35/4)

Present refrigerators, which use chlorofluorocarbons (old solution), are evaluated as having a problem, which is overcome by the new ones, which use propane (new solution). The comparative (cooler) is a strong indicator of the improvement in that as well as the next example:

(34) *Our fibres go further than yours, say Japanese*

> THE Japanese communications giant Nippon Telegraph and Telephone (NTT) has sent digital information through a record length of optical fibre, without having to amplify the signal electronically. (17F30/1)

The inclusion of without indicates that earlier solutions had a problem which is not shared by the new solution. The improvement in the following example is signalled by the time signal now:

(35) *Do-it-yourself searches for patents*

> THE BRITISH Library is now giving patent searchers the chance to look through the American patent records themselves, using a database on a CD-ROM disc. (24F36/3)

OPENINGS WITH INTERACTIVE PROBLEMS

A little researched topic within problem-solution communication occurs when one person (or group) creates a problem for another while trying to solve their own problem. Such interactive problems (Jordan 1981) are at the heart of many disputes, and occur frequently as openings in informal reports. Here is a typical example:

(36) *Protest groups move to halt space mission*

> ANTINUCLEAR protesters in the US are planning a campaign to stop the October launch of a European spacecraft to study the sun. The protesters claim that the spacecraft's nuclear-powered motors

> could become a major hazard in the event of an accident during liftoff. (3M19/1)

The protesters are upset with the potential hazard, and their attempted solution to this perceived problem causes a problem to the authorities.

People problems have very wide implications concerning almost all disputes, confrontations, disagreements - and of course any resulting legal action:

(37) *Animal researchers to get legal aid*

> LEGAL AID will soon be available for scientists, doctors and vets who seek redress when they feel they have been libelled by antivivisection groups. (17F20/2)

The antivivisection groups are causing problems to the medical professionals by their attempted solutions to stop their perceived problem. In turn the professionals are planning to solve <u>their</u> perceived problem (the libel) by taking court action - and the legal fund is a solution to their need for funds to implement that solution. (17F20/2)

People problems - it is not the most appropriate of names - can even be extended to include animals, insects, or any pest. Here is an example in which researchers are seeking to overcome a problem caused by pests - and in doing so are planning to cause a problem for those pests:

(38) *Cooked cockroaches*

> A PEST control company has found a way to exploit insects' vulnerability to heat in order to kill common house pests. (17F35/3)

OTHER OPENINGS

Almost all of the openings in the texts studied fitted into the broad theoretical framework of problem-solution-evaluation as explained above. A few, however, involved the recognition that our previous understanding of a scientific fact or principle was imperfect, and is now improved in the light of new evidence. Although we could include this as an "improvement" of the intellectual solution to the theoretical need-to-know problem, it is included separately here. A typical example is:

(39) *Genital warts may not always be spread by sex*

> THE VIRUSES that cause genital warts were thought to be acquired exclusively by sexual contact. For this reason, genital warts in children - which appear in the area of the anus and genitals - have been taken as a sign of sexual abuse. Now, however, Polish and French scientists have evidence that the viruses that cause genital warts - two types of papilloma virus - can be transmitted in other, nonsexual ways. (17F33/2)

The hypothetical signal thought to be indicates the earlier understanding, and predicts the new knowledge, which is signalled by Now; however indicates the transition between the old and new understanding.

New evidence which earlier questioned established knowledge may of course turn out to be erroneous:

(40) *Supernova pulsar was just a flash in the pan*

> A STAR discovered in January last year which threatened to upset most the current theories of

how matter is formed has turned out to be a mirage. (24F20/1)

And new evidence may help to confirm rather than question established knowledge:

(41) *Was the first Mrs. Einstein a genius, too?*

NEW EVIDENCE has been produced to support the claim made last year that Albert Einstein's first wife, Mileva Marie, was a major contributor to three seminal papers which he published in 1905. (17F33/1)

Perhaps the report of this paper will use this technique:

'New Scientist' openings follow problem-solution patterns

Recent research confirms earlier linguistic work claiming that most informal scientific reports deal primarily with problems, solutions and evaluations.

CONCLUSIONS

On the assumption that the texts studied here are reasonably representative of informal journalistic science texts, we can conclude that the openings of most such texts have strong connections with problem-solution activities. It would thus appear that instruction in problem-solution principles and their linguistic realizations should play an important role in technical writing curricula.

This analysis also casts doubt on the view that "introductions" establish the general framework within which the main body of the text is understood - a view inherent in advice often given for writers to introduce their work after writing the rest. In many of the texts studied, the title and first one or two sentences provide a useful summary of the details to follow. And in others the information at the start is vital substantive material of direct rather than background value to readers.

Obviously much more work remains into how writers start their technical texts. We must expect that the 'But' syndrome exemplified by however in Example 39 will have stronger influence in slightly more formal texts, and that starts for formal scientific texts may follow more traditionally-recognized methods:

(42) *Burning question answered about red hot peppers*

> ONE REASON for holding a conference in New Orleans is the cooking. Cajun cooks use hot spices much more liberally than chefs would consider reasonable in other parts of the US. (24F22/3)

Clearly we cannot ignore the burning question of how writers can or should start their writing - and the answers lie in further detailed analysis of how skilled writers and editors achieve that task.

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