Technical-Abstracting Fundamentals. II. Writing Principles and Practices†

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Abstracts can serve their purpose best only if they are carefully written to transmit important information to readers quickly and accurately. This requires knowledge of audience needs, habits, and desires; ability to identify the key facts in the document; ability to organize these facts, to present them in the order best suited to the audience; and ability to write the abstracts clearly, concisely, and in conformity with the style rules of the medium involved. Some of these abilities are inborn, but all can be learned by study, practice, and criticism.

Audience.—The primary audience for a given abstract is usually the same as that for the entire document—readers who can use the information presented or will be interested in learning of its existence. Unlike the original, however, the abstract may well be "published," among other places, in large collections of abstracts serving readers with a wide range of interests. Only a minority of these readers will be interested in any given abstract in the collection. One might almost say, therefore, that the abstracter has a greater duty to the reader who is not interested than to the one who is. Obviously, the abstract must transfer its information quickly to the interested person; but it must also warn the uninterested person, in the minimum number of words, not to waste his time by reading further.

For knowledgeable readers, the need for brevity in an abstract implicitly dictates the elimination of background information. This is not always understood by the inexperienced writer of abstracts, including many authors of the original documents. It is also not yet understood by the computer instructed to write "auto-abstracts," since it often selects sentences in the introductory material because their wording is as significant statistically as that in sentences in the unique portions of the document.

The sheer need for brevity is not the only reason why the writer of an abstract must understand the exact scientific or engineering disciplines of the most-probable readers of his abstract, plus the industrial, govermental, or other "missions" in which the readers will put the information to use. Each discipline or technology has its specific needs for specialized information, needs that the writer of the abstract must attempt to satisfy. These needs dictate the selection of facts to be included in the abstract, and to some extent how they should be organized.

Type of Abstract.—In the first paper in this series[16] we looked at definitions of ten types of abstracts—types that are differentiated by the information they contain and who prepares them. This is not the place to discuss the "auto-abstract," nor will we dwell in any detail on exactly what facts to choose in a "slanted" abstract and how to edit abstracts that are "author" prepared, "subject-expert" prepared, or "professional-abstracter" prepared, plus those that must be "rewritten" from existing abstracts. In this paper we are chiefly concerned with how to write abstracts, so we will be more concerned with the differences in content and value of "title-only" abstracts, "annotations," "indicative" abstracts, and "informative" abstracts, especially the "reader-oriented" version of the latter.

As regards *title-only abstracts*. Stevens[12] tells us that the title "is the key to the article or report... must tell the reader as specifically as possible what was found. It must be more than a label... it should identify the document." He also believes that a title "should be eight words or fewer," needs a strong verb (not "to be" or "have"), and should not be "cute"—should not mislead the reader or be completely nondescriptive. Using his rules, we can see why "Supersonics Increase Oil-Burner Efficiency" would be better than "Application of Supersonics to Oil Burners," and why we would not want to be cute with "Let It Roar!"

Until Stevens' points are applied by most authors and editors, however, we must accept the fact that most present titles are *subject* oriented rather than findings oriented, and that some are inexact, difficult to understand, or even misleading. However, since titles must be used in tables of contents and are being increasingly used in "key-word-in-context" and other title-based indexes, very real incentives exist to improve them. Should this happen to a large extent, there will be more occasions when they can safely be used in lieu of other kinds of abstracts.

Annotations and *indicative abstracts* differ only in length—both are designed to amplify the title, to *describe* more clearly and completely the *contents* of the document, not what it teaches. An annotation is usually only a few words or a sentence, but an indicative abstract can be as long (detailed) as style rules permit. This difference is illustrated in Fig. 1 and 2.

McClelland[9] has provided some hints on annotations that will be helpful to those who must use them. As regards indicative abstracts, *Chemical Abstracts*[11] has stated the case succinctly: "General statements about the contents of a paper may require almost as much space as a brief report of the actual results obtained by the author." However, they usually take less time to prepare.

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Figure 1. An Annotation

IONIZING ENERGY AS AN AID IN EXCHANGE TRITIUM LABELING. R. M. Lemmon, B. M. Tolbert, W. Strohmeier, and I. M. Whittemore (Science 129:1740-41(1959);--Effect of silent electric discharge and of Co-60.

Figure 2. An Indicative Abstract

IONIZING ENERGY AS AN AID IN EXCHANGE TRITIUM LABELING. R. M. Lemmon, B. M. Tolbert, W. Strohmeier, and I. M. Whittemore (Science 129:1740-41(1959). --The effect of exposure to silent electric discharge or to cobalt-60 γ-rays on incorporation of tritium in organic compounds, e.g., benzene, is reported.

Informative abstracts transfer the salient facts instead of simply telling that information now exists on a certain subject. In recent years, at least three variations have been employed:

1. The "conventional," "bibliographical-data-first" informative abstract (Fig. 3). We have dubbed this type the "mystery-story" abstract: the title of the document and other bibliographical indicia (*e.g.*, authors, journal name, volume number, issue number, page numbers, and date of publication) precede the text of the abstract; the text itself then usually proceeds through statements of purpose and method before it finally comes to results and conclusions. Borko and Chatman's study of the abstracter guides of 130 abstracting sources finds this to be the commonest arrangement.
2. The "findings-oriented," "topical-sentence-first" informative abstract (Fig. 4), which we have also termed the "reader-oriented" abstract. It quickly presents the important findings, conclusions, and/or recommendations, with the novel material placed first in the topical sentence, if possible. The bibliographical material is dropped to the end of the abstract. This abstract was first described by Weil in 1958.[14] It has since received increasing attention[8, 15] and use by others. We firmly believe that this type of abstract is much more in consonance with modern methods of written communication than other types of informative abstracts.
3. The "title-first" variation of the "reader-oriented" informative abstract (Fig. 5). This begins with the document's title but follows it with a findings-oriented topical sentence. The American Petroleum Institute's Central Abstracting Service uses the title (usually subject oriented) as the first words of the topical sentence whenever the title's wording permits this. Title-first abstracts are probably acceptable alternates to those beginning with a full-fledged topical sentence: (a) for use on a reader-alerting page that is intended to be an expanded table of contents, (b) if abstracters deliberately wish to place stress on scope, or (c) if the abstracters or publishers do not want to assume the responsibility for selecting the main findings.

Comparison of the abstracts in Fig. 3–5 shows why we believe that the entire bibliographic citation is better placed at the end than at the beginning of each abstract in secondary journals containing a number of abstracts on each page, and in card files. With this format, the reader goes easily and directly to the emphasized portion of the first sentence of each abstract. On the basis of this findings-oriented portion he may very well want to read the rest of the sentence and then the rest of the abstract, but if he is not interested he can quickly skip to the next abstract. He needs the bibliographic information only if, after getting to the end of the abstract, he decides that he wants to see the source document.

Figure 3. A Conventional (Bibliographic-Data-First) Informative Abstract

IONIZING ENERGY AS AN AID IN EXCHANGE TRITIUM LABELING. R. M. Lemmon, B. M. Tolbert, W. Strohmeier, and I. M. Whittemore (Science 129:1740-41 (1959). --The tritium labeling of organic compounds with the Wilzbach technique--that is, by simple exposure to tritium gas--is greatly accelerated by the simultaneous exposure of the system to a silent electrical discharge. The incorporation of tritium into benzene was increased by a factor of about 10^4 without undue decomposition. Cobalt-60 γ-rays increased the rate of tritium labeling at the expense of molecular destruction. Thus, exposure to γ-radiation is inferior to exposure to higher tritium specific activities for a given exposure time.

Figure 4. A Reader-Oriented (Topical-Sentence-First) Informative Abstract

ORGANIC COMPOUNDS CAN BE RAPIDLY TRITIUM-LABELED by incubation with tritium gas under a silent electrical discharge. For example, 500 μl of benzene incorporated 0.67 mc tritium after 1 hr contact with a hydrogen-tritium mixture containing 40 mc tritium under a 20 kv/ma. discharge, about 10^4 more than was incorporated without the silent discharge. Cobalt-60 gamma rays were much less effective, and were destructive.
R. M. Lemmon, B. M. Tolbert, W. Strohmeier, and I. M. Whittemore: "Ionizing Energy as an Aid in Exchange Tritium Labeling." (Science 129:1740-41 (1959)

Figure 5. A Title-First Informative Abstract

IONIZING ENERGY AS AN AID IN EXCHANGE TRITIUM LABELING. Organic compounds can be rapidly labeled by incubation with tritium gas under a silent electrical discharge. For example, 500 μl of benzene incorporated 0.76 mc tritium after 1 hr contact with a hydrogen-tritium mixture containing 40 mc tritium under a 20 kv/ma. discharge, about 10^4 more than was incorporated without the silent discharge. Cobalt-60 gamma rays were much less effective, and were destructive.
R. M. Lemmon, B. M. Tolbert, W. Strohmeier, and I. M. Whittemore (Science 129:1740-41(1959)

We are convinced that the days of the "mystery-story" conventional abstract are numbered as regards collections of abstracts—that most readers and publishers will soon see the communication values of abstracts that do not force readers to wade through bibliographical information before getting at facts.

We know that some readers of abstract bulletins strongly prefer the topical-sentence-first format. In a 1959 survey of the preference of some 600 readers of Esso Research abstract bulletins, the results shown in Table I were obtained,[15] despite the fact that these readers had received conventional abstracts for 38 years and reader-oriented abstracts only for 1.5 years.

We are also convinced that librarians and others who use bibliographical information are not penalized by the topical-sentence-first format if the citation is clearly and distinctively presented (indented, italicized, etc.) at the end of the abstract.

Table I

Survey of Esso Research Abstract-Bulletin-Reader Preference for Types of Informative Abstracts
(Based on Mailing 600 Questionnaires)

For your own reading, do you prefer:	Answers (% of 402)
The topical-sentence-first format	61
The bibliographical-data-first format . . .	31
Other	1
No particular preference	7
Total	100

Of course, some readers of abstracts tell us that they prefer to see the journal name first, to determine the validity of the source. Others, in fields with a limited number of experts, say that they prefer to know who the author is before they find out anything else. We believe that these readers will have little real trouble working with "reader-oriented" abstracts, since it is easy to go directly to the clearly-visible bibliographical data at the end of each abstract.

The writing of technical abstracts must be done with sympathetic understanding of the problems of the present-day scientist and engineer, who are hard-pressed for time for all of their assignments yet want to keep abreast of developments in their fields. Their plea is expressed by the following bit of doggerel:

So tell me quick and tell me true
Or else I haven't time for you—
Not how this study came to be
But what its news can do for me.

To which we now add the refrain:

And if it isn't meant for me
Please tell me fast so I may flee.

Writing the Reader-Oriented Abstract.—If at all possible, therefore, the first sentence in a reader-oriented abstract must be a topical sentence that contains the most important findings, conclusions, and recommendations of the document. The new material should be at the start of the sentence, prominently displayed (in bold-faced type, capitals, or underlined) to aid in rapid scanning. Such a topical sentence is essentially a one-sentence abstract of the abstract, and should be so considered. (If it is properly prepared, it will contain most of the key descriptors needed for indexing).

Direct statements (active voice) rather than indirect statements (passive voice) are much preferable for this type of topical sentence. Thus, we would say: "Bauxites sweeten straightrun and thermally-cracked gasolines in the presence of air," not "Straightrun and thermally-cracked gasolines are sweetened by bauxites in the presence of air."

Good writing for easy reading requires that we keep the topical sentence as short as possible. Qualifying or limiting details that are not part of the novel aspect are presented in succeeding sentences, no matter how essential they are to the total concept. This is also true for auxiliary findings. Information on methods used to obtain the results reported is never part of the topical sentence unless it is the method that is uniquely described in the document.

If it is impossible to pinpoint what is novel, or to express it in a few words, the initial portion of the topical sentence must still do its best to differentiate the document (and its abstract) from other documents (and their abstracts) in the same publication or group of abstracts. Since originality is not important, the topical sentence may employ all or some of the document's title if this best serves our purpose—and if the topical sentence does not immediately follow the title in the abstract.

When groups of abstracts on related subject matter are to be published together or filed together, the writer or editor should take care to avoid the use of stock phrases at the beginning of each topical sentence. Otherwise, a group of abstracts on lubricants may all begin: "A lubricant contains..." This slows down delivery of the information that is unique in the abstract, and may anesthetize the reader.

In this type of topical sentence, the syntax involved in putting important facts first sometimes forces us to use the passive voice, *i.e.*, where use of a direct statement would otherwise push the main subject of the abstract to the end of the first sentence. Thus, for subject emphasis we would be forced to say: "The relative adsorption coefficients of ether, water, and ethylene were measured by..."

By no means can all abstracts summarize factually all of the important information presented in lengthy documents. Because of the limitations imposed by brevity, few abstracts can consist solely of informative sentences. Once the key findings are presented, therefore, a few indicative (general) sentences may be needed to complete the description of the document's important contents, *e.g.*, "Boiling points for branched-chain hydrocarbons are tabulated," or "Fifteen references are cited"—perhaps even parenthetical statements such as "(15 references)." In other words, abstracts should be as informative as practicality allows, but not to the point of excessive length.

Some types of documents do not permit truly informative abstracts, of course. We may have to be more descriptive than informative in the case of reviews, or for documents covering many different subjects. Documents that contain mathematics that are difficult to verbalize fall into this category. In these cases, the abstracts cannot practically be made very informative, and should be kept as short as possible.

We rarely need to mention in the body of the abstract WHO did the work and WHEN or WHERE it was done or reported unless these are not clear from the bibliographical citation (or in the accompanying full document) and are uniquely important. We design our abstracts to tell WHAT was found and, where pertinent, WHY and HOW the work was done.

Content of Abstract.—Technical abstracts must be prepared for documents that contain different types of information and that are intended for different kinds of scientists and engineers. These documents may report the results of new research, deal with the economics of industrial processes, describe plants, discuss programs, make proposals, etc. Intended audiences may be chemists, chemical engineers, biologists, pharmacologists, chemical-market analysts, physicians, etc.

The research or analysis document reports a new piece of human knowledge obtained by observing and/or thinking about data. The abstract should contain the

findings, conclusions, and recommendations; the chief experimental results from which the conclusions were drawn; and indications of the methods used in obtaining the data. The abstract should not contain introductory or background material unless it is directed at a readership that is not knowledgeable in the field. It should not include details of the experimental methods unless these themselves are new; in that event it should give "the basic principle, range of operation, and degree of accuracy."[13] It should not attempt to include detailed experimental results unless the full-length document will not be readily available or is in a language that readers are not likely to know.

Abstracts of proposals, or descriptions of new programs or industrial processes, should include the purpose, the method or steps in the program or process, the advantages in comparison with other such programs or processes, the disadvantages, and the costs.

The exact technical audience will dictate other required contents. As cited in a recent survey on criteria for acceptable abstracts,[2] pharmacologists will want to know "how many individuals there were in the experimental series; whether human or animal, and the species; what percentage reacts, etc.; and in the case of a new drug, its composition...," whereas geologists ask the writer of abstracts to "orient (the document) in place and geological time...locate local stratigraphic names in the general geologic column...(name) new minerals, fossils, etc." At Esso Research, for further example, the interests of our chemists and chemical engineers include operating conditions, physical properties, catalysts, design details, generic and/or specific chemical names of reactants and products, and exact investigational techniques and equipment where these are unique.

Identifying the Key Information.—Once it is determined what type of abstract will be written, and what kinds of information it will contain, work on the abstract of a given document can begin: identifying the key information, organizing it, and writing.

If the abstract is written by the author of the original document, he may tackle the abstract either before or after he has written the full text. It is hard to say which is preferable, since the writing habits of different authors really govern here. Stevens,[12] concentrating on an abstract that will appear on the first page of the original document, tells the author to "prepare the abstract before you start writing the body of the paper...because it will serve as an excellent outline...will keep you on the track." Although his type of abstract is the conventional one, *i.e.*, contains "a statement of the exact problem, a brief comment about the procedure, and a summary of the significant results...in that order," his proposal that the author amplify these with one or two sentences, at most, would undoubtedly enable the author to identify the key information to be reported from among the many details in his notes and mind.

The assigned writer of an abstract faces an entirely different task. He is confronted by a document whose contents are unknown to him before he scans it. To identify the key information he *could* read the entire text for its message, then rescan it to jot down salient points, or he *could* make notes during his reading if that would not interfere with his flow of thought. Either of these is a traditional technique. Both, however, fail to apply the teachings of rapid reading and scanning.

The following sequence has proved useful at Esso Research for identifying key facts in papers, bulletins, Government publications, theses, books, and similar documents:

1. Read the introduction first if you are unfamiliar with the subject.
2. Read the author's abstract if one is included. Use it as far as possible if a further check of the document proves it to be a good one.
3. Review the summary and conclusions of the paper.
4. Scan the text for additional information, examining the captions of tables and figures.
5. Jot down marginal notes as you go along, and underline salient phrases and passages.
6. Then, and then only, write the topical sentence and the rest of the abstract (what was found and, where pertinent, why and how the work was done), plus the bibliographical citation.

Authors of documents who write their abstracts after they have written the full texts may very well benefit by following points 3–6 in the above procedure. Lack of a definite method of checking what he has written causes many a writer to leave important facts out of his own abstract.

Length of Abstracts; Shortening Abstracts.—The desirable length for a given abstract is usually a function of the type of document involved, the availability of the document, the ability of the average reader to read the language of the original document, and available funds. It is important to remember, however, that readers often react unfavorable to unduly lengthy abstracts, so brevity has a value that transcends economics.

If a magazine article or meeting paper deals essentially with a single idea or piece of work, a reader-oriented abstract can adequately describe it in six or seven sentences (125–150 words), not including the bibliographical citation (or accompanying indexing descriptors). On the other hand, the abstract of an internal company report may sometimes have to approach a single-spaced typewritten page in length (500–600 words), especially if it must contain some introductory information for audiences of different backgrounds and interests.

Stevens[12] prefers an abstract of not over 250 words; Borko and Chatman's survey[2] distills the criteria: "brief (100–500 words)." Unesco's "Guide"[13] says, "should only in exceptional cases exceed 200 words, so as—among other things—to permit it, when printed, to be cut out and mounted on a 3 × 5 in. card."

Abstracts of reviews and news items are generally kept as short as possible by most writers, if these documents are abstracted at all. Also, short abstracts are usually prepared for documents containing extensive mathematics, except in secondary journals in this field.

Longer-than-usual abstracts (abstracts than contain more details) may be justified if the full-length documents will not be readily available to the reader. This approach may also be advisable if the original is in a language that readers are not likely to know.

One approach to writing long abstracts that are still readable is to write the abstracts in two parts. The first

part is essentially a reader-oriented abstract, six or seven sentences long. The second part, which either directly follows the first or is contained in one or more separate paragraphs, can give as many details as are desired. It can even contain a clearly identified introduction for readers not familiar with the subject material. A variation of this idea is used in the "Problem Notes" section of the *Report on NRL Progress;* a captioned "Background Statement" precedes each abstract of a project report.

For financial and other reasons, including reader and publisher preference, most publishers of abstracts specify a maximum length for their abstracts. Presumably these maxima take into account the other factors just discussed, but theoretical values often must give way to economic expediency.

Since brevity is, therefore, quite important, it will be informative to look at a number of ways of keeping abstracts to minimum length:

1. Use standard abbreviations for physical units and common-place words ("lb" for "pound," "N. Y." for "New York"). Heavy use of abbreviations for all manner of terms is an obvious way of shortening an abstract, but it is one that slows reading considerably, hence is unpopular with readers. It also slows all but the most experienced writer of abstracts. (Nevertheless, for substantial financial reasons, *Chemical Abstracts* instructs its abstracters to employ a long list of standard abbreviations.)
2. Use a generic expression to replace a series of related specific terms if this is permissible from an indexing standpoint and if readers will accept such generalizations. Thus, "Methane, ethane, propane, *n*-pentane, and iso-octane" can be expressed as "Five C_1-C_5 paraffins," and "livestock" can be used instead of "cattle, sheep, and hogs."
3. Limit the abstract strictly to new information. Thus, the exact method or apparatus should be mentioned, but no details need to be given if the presumed reader knows all about it from his previous reading or can readily obtain the information if desired.
4. Leave out the author's future plans. He may never carry them out.
5. Statements saying that the work described in the document is an improvement over the previous state of things do not belong in an abstract. The author should not have written the document if he were not going to report an advance.
6. Avoid involved phraseology, and do not give the same information two ways.

Instead of	Say
in an amount at least sufficient	at least enough to
at a temperature of 250° to 350° F.	at 250–350° F.
specially designed or formulated	nothing
commingled	mixed
A can be oxidized using B or other catalysts	A can be catalytically oxidized
at a high pressure (2000 psi)	at 2000 psi
at a high temperature (1500° F.)	at 1500° F.

7. When a paper does not have a central theme or conclusion to draw, outline the subject matter covered in the topical sentence. Follow this with an organization of the author's main points. In this way, the reader can tell whether he can utilize the material to draw his own conclusions or to supplement his own experience.
8. If you are writing a "title-first" abstract, don't repeat the words of the title.

Writing Style and Hints.—The generally accepted rules for good writing apply full-force to the writing of abstracts. Correct spelling and good grammar should not be neglected; slipshod work in this area can cause the reader to misinterpret the abstract. It can also cause the reader to lose respect for the abstracting service, even to cease relying on it, defeating the whole purpose of abstracting.

The following points should be kept in mind:

1. Write in "fluent, easy-to-read prose... strive for simplicity and general understandability."[1] Don't hesitate to use clear, direct statements (see also points 11–29).
2. Be exact, concise, and unambiguous. Avoid general statements where you can be specific. "Detail is often necessary to bring out novelty or to emphasize a point, *e.g.*, it may not be sufficient to refer merely to 'steel' if '3% Ni steel' is specified."[11]
3. Condense but, as a general rule, do not personally interpret the author's remarks. If you do comment on the document because your readers expect this, be certain that your comments are clearly labeled as such. Also, if you feel that the author's phraseology is ambiguous or incorrect, put the questionable statements into the abstract verbatim inside quotation marks. Finally, it is sometimes desirable to "indicate the treatment of the subject by such words as 'brief,' 'exhaustive,' and 'theoretical'."[13]
4. Be consistent in tone and emphasis with the document being abstracted, unless you are writing a slanted abstract, but rarely follow "the arrangement, wording, or proportion of the original."[1]
5. Use short sentences, but with some variety in length and structure to avoid monotony. Some of the larger sentences may begin with dependent clauses or phrases.
6. Use complete sentences and constructions, except when supplying the last bits of descriptive information, *e.g.* "(12 references)."
7. Place general statements, where needed, toward the end of the abstract, *e.g.*, "Boiling points for branched-chain hydrocarbons are tabulated."
8. Use active-voice verbs instead of passive ones. "A exceeds B" makes better reading than "B is exceeded by A." Using the active voice helps to avoid such weak verb forms as "is," "was," "are," and "were." The verb should follow the subject of the sentence as closely as possible.
9. The noun form of verbs makes dull reading. "Separating butadiene from butenes" reads better in an abstract than "the separation of butadiene from butenes."
10. Use the past tense to describe the specific activities that the author is reporting, since these are already in the past. However, the conclusion that he draws from these activities are facts (of permanent value until proved otherwise) and therefore prevail in the present; accordingly, they should be written in the present tense.

11. Use short, simple, concrete, familiar words. Avoid "laboratory semantics," repetition, and all unnecessary words. The work "tanks" is more descriptive than "large storage containers for liquids." Use Anglo-Saxon forms instead of Romance whenever possible, *e.g.*, "indexes" instead of "indices."
12. Use trade jargon and colloquialisms sparingly and carefully. Although jargon can give an authentic flavor to an abstract, its use has pitfalls. The same jargon words may mean different things in different fields, or nothing at all except to a very few readers. The abstracter must therefore be certain that his readers will understand correctly every jargon term that he uses.
13. Avoid both overusing and awkward omission of articles, *e.g.*, "Pressure is a function of temperature," not "The pressure is a function of the temperature," but "The refinery operated..." not "Refinery operated..."
14. Further on brevity, don't confuse the need for true brevity with jarring terseness, the so-called telegraphic style. Don't be cryptic, either, as in: "The formulation had a lower content of low-molecular-weight rubber than GR-S."
15. Avoid using long series of adjectives and/or nouns to modify a noun, *i.e.*, the so-called "high-polymer adjective." Use prepositional phrases to break these up, and hyphenate the noun groups left as unit modifiers. For example, we would say: "The oxygen-containing propylene-based polymer of high melt index" instead of: "The oxygen containing high melt index propylene based polymer."
16. Try to avoid using dangling participles and sentences ending in a preposition, but do use an occasional split infinitive if it promotes rapid comprehension, *e.g.*, "to rapidly exceed" instead of "rapidly to exceed."
17. Avoid the overuse of synonyms that can lead to absurb-sounding phrases—the so-called "sin of synonyms." We would not say: "The resin exchanges potassium ions for *basic electrolytes*." We would simply be content with "... *hydroxyl ions*," despite the repetition of "ions."
18. Avoid cacophony, *e.g.*, "Data to date indicate," or "Scope of the slope."
19. When using abbreviations for units in combination with a number, omit periods and write the number as a numeral, *e.g.*, "3 ft," not "three feet" or "three ft." However, do use a period when the abbreviation would otherwise be spelled the same as a word, *e.g.*, "in." not "in" for inches. Also, use the singular form of the abbreviation for all quantities, *e.g.*, "0.1 yd" and "150 yd," not "150 yds."

Each discipline and field or mission has its own additional list of writing hints or rules, used to promote uniformity and clarity. The "Directions for Abstractors and Section Editors of *Chemical Abstracts*,"[11] described by Crane,[3] has long been the standard used or modified by abstracters in the chemical field, confronted as they are by a complex nomenclature. In addition, such style manuals set forth certain arbitrary decisions that represent policy.

At Esso Research, for example, our style manual includes most of the rules just listed and additional rules such as: "Give certain other information after the text of the abstract. If there are more than ten references, put the number at the end of the abstract in parentheses, *e.g.* '(11 references).' When pertinent, put either of the following phrases at the end of the abstract, after the number of references, if any, but in separate parentheses: '(little more info in article)' or '(no more info in article).' After any of these combinations (or by itself at the end of the abstract), mention in parentheses the language of the original for a document which is not in English, *e.g.*, '(in German).' When an article is in English in a normally-foreign-language journal, use '(in English)'."

Slanting Abstracts.—There is nothing mysterious about the "slanting" of abstracts. This is simply the writing of an abstract of a given document in a manner best suited to the needs of a given audience, be this a group of executives,[7] a discipline, or a "mission." Although Herner[5] reports that there is less slanting by major disciplines than would have been expected, and more dependence on "author" abstracts than is commonly acknowledged, there is no doubt that different "publishers" sometimes prepare abstracts of the same document that differ materially from each other in style and purpose.[4,8]

A slanted abstract often highlights novel information in a document that is important only to the specific audience of the abstracter and is only incidental to the main subject of the document's author. Abstracters are often instructed to look for such information and not to put sole reliance on titles in deciding whether or not to scan a document in order to determine whether it should be abstracted.

The "Directions for Abstractors and Section Editors of *Chemical Abstracts*"[11] has long been an outstanding example of rules for slanting for a specific audience.

Bibliographical Indicia.—Completeness, brevity, and clarity are among the criteria for the bibliographical indicia that *must* accompany all abstracts except when they are part of the original document. When the reader of an abstract that is detached from its original determines that he needs the original, he must be able to cite the reference completely and unambiguously so that it can be located for him quickly and correctly.

No single standard for bibliographical indicia has been universally adopted, although many good ones exist. Indeed, each abstracting group seems to create its own standards and format. The rules employed by The Chemical Abstracts Service,[11] will be of definite interest to students of bibliographical indicia. Several generally-accepted style manuals have been listed by Jenks and Huntsman.[6]

Minimum details for articles, books, bulletins, theses, and similar documents include the authors' names, the document's title, the name and address of the "publisher" or the title of the periodical, the date of publication, the inclusive pagination of the document, and any other information needed to differentiate the document from a previous edition or other parts of a series. For patents, the country of issue; patent number; names of patentees and assignees; dates of application, exposure, and/or issue; and class numbers are among the necessary details.

Rewriting and Editing Abstracts.—Informative abstracts obtained from outside sources must usually be rewritten if they are to be made "reader-oriented." Similarly, drafts of abstracts must usually be edited—or at least checked. Editors of secondary journals must also review abstracts for appropriateness.

Table II

Hints for Writing Good Reader-Oriented Informative Abstracts

Do	Don't
scan the document purposefully for key facts	change the meaning of the original
slant the abstract to your audience	comment on or interpret the document
tell what was found	mention earlier work
tell why the work was done	include detailed experimental results
tell how the work was done	describe details of conventional apparatus
place findings early in the topical sentence	mention future work
put details in succeeding sentences	begin abstracts with stock phrases
place general statements last	use involved phraseology
separate relatively independent subjects	use questionable jargon
differentiate experiment from hypothesis	waste words by stating the obvious
be informative but brief	say the same thing two ways
be exact, concise, and unambiguous	use noun form of verbs
use short, complete sentences	over-use synonyms
use short, simple, familiar words	use "high-polymer adjectives"
avoid unnecessary words	use a choppy, telegraphic style
use generic expressions when possible	
employ normal technical English	
use direct statements (active voice)	
describe conclusions in the present tense	
use abbreviations sparingly	
avoid cacophony	
cite bibliographical data completely	

These procedures involve checking the abstract for adherence to the style rules established for the specific "publication." For a "reader-oriented" abstract, the topical sentence is checked for clear emphasis on the major findings and for factual correctness, and the entire abstract is scanned for accuracy, clarity, completeness, brevity, and "good grammar" in the sense of this paper. More or less rewriting is usually required, especially when the abstract is obtained from an outside source not under the control of the "publisher."

As will be developed in the third paper in this series, the prime responsibility for the final quality of any abstract rests on the editor. He is in the best position to consider the interests of readers outside the author's specific field of interest, or the abstracter's training and abilities. Authors, reviewers, and abstracters must all play their parts, and must be assisted by a clear statement of requirements (still all too rare), but only work by the editor himself can assure uniform quality.

Little has been published on the editing of abstracts, chiefly because it seemingly involves "little more" than training abstracters and checking drafts. These aspects were discussed in a 1957 paper.[10] The "Special Directions for Section Editors" of *Chemical Abstracts*[11] are also of interest.

Conclusion.—This paper has given many "do's" and "don'ts" for writing abstracts, some of which are summarized in Table 2.

Our suggestions are not inviolate, of course. One additional rule overrides them all: the writing must be good. In most situations, however, our rules can help produce abstracts that give the reader more information for a smaller output of time and effort on his part.

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Technical-Abstracting Fundamentals. III. Publishing Abstracts in Primary Journals†

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Papers included in journals have long been the primary medium for the first publication of technical information. Indeed, it is their evergrowing number that has accelerated research on ways to alert scientists and engineers without asking them to attempt the impossible task of scanning all the pertinent journals for themselves. Table-of-contents bulletins, computer-produced permuted keyword indexes, and even computer-based profile-matching services have come into existence to challenge traditional-style abstracting journals and reviews as vital supplements to the amount of journal reading that individuals must still do for themselves.

Later papers in this series will examine the role of these alerting media. This paper, however, will look at the primary journals themselves, first to see how they are responding to the challenge of increased competition for the limited time of readers; then to concentrate on modern aspects of one of the methods long used to assist journal readers—publishing abstracts with the original papers; and finally to look at such other important roles of abstracts as publication instead of papers, with full versions available in some form from a central source.

Structuring Journals.—Editors of technical periodicals have always done more than simply receive papers and have them typeset, printed, and distributed in issues of their journals. Technical-society editors, in particular, have created exemplary systems for reviewing papers for novelty, accuracy, completeness, and clarity, prior to acceptance. The editors of technical-business magazines ("trade journals") have sought out authorities to write original articles, and have concentrated on clarity of presentation.

In laying out issues of their publications, editors of journals have been concerned, within budgetary limits, with such matters as using readable and attractive types and page formats; arranging papers in some logical sequence; balancing papers with brief news items and advertisements; and other devices that will encourage the peruser to read everything in the journal that is useful (or can be made to appear interesting) to him. Color, catchy makeup, artful placement of pictures, clever titles, and lively topic headings are the hallmarks of at least the technical-business magazines,[14] sometimes consciously combined with other treatment of the texts in a manner termed "structuring".[3]

As is now evident, the inclusion of an abstract with a paper is a structuring device, albeit one that has often not been recognized as such or employed to best advantage.

Properly used, structuring is a valuable service. Readers appreciate such devices when they concentrate and clarify the messages of individual papers. But when graphic overselling causes them to read papers that are of little value to them, readers can only become resentful.

What is present, here, is the struggle on the part of individual editors to increase the readership of *their* journals, each of which presumably exists to serve a unique demand. This is a struggle that sometimes runs head-on into the need of readers for gaining pertinent information in the smallest possible unit times.

Traditional Role of "Author Abstracts."—Many technical-society journals have traditionally published an abstract written by the author on the first page of each paper. This abstract serves two purposes. It helps the scanner of the journal to decide whether or not to read the full paper immediately, and it often imparts to the less-interested reader enough of the paper's unique infor-

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