

fies the noun "writer." Adverb: The book is lying *on the table*. Here the phrase modifies the verb "is lying.")

When the qualifying details in a sentence are put into prepositional phrases, they are all treated in precisely the same way, technically speaking. But some details obviously are more important than others; hence, the cataloging of details clearly is a detriment to informing because the main details simply do not have the impact on the reader they should have. To repeat, the cataloging of details is the most serious error in most poorly written reports.

How can the technical writer eliminate as many prepositional phrases as possible? The following rewrite of the example says essentially the same thing as the original:

The company does not know whether it can meet most new-customer orders, because its new manufacturing line is not yet installed.

Here is a good example of *analytical writing*, which is the chief asset of good informative writing. If the clue to catalogical writing is overuse of the prepositional phrase, the clue to good analytical writing is *a judicious use of the dependent clause*. In the rewritten sentence, there are two dependent clauses: "whether it can meet most new-customer orders" and "because its new manufacturing line is not yet installed." There are no prepositional phrases.

For at least three good reasons, dependent clauses help make sentences more informative:

- They analyze detail, highlighting what is important. The very words that introduce clauses strengthen this analysis, because they tell the *when, if, because, who*, and so forth of the clause. These strong words help the reader interpret what is being described.
- They force the writer to break up the equating of detail that is characteristic of a series of prepositional phrases strung together.
- They make writing sound much more natural. Anyone who doubts this, should reread the examples in the section aloud.

In analytical writing, dependent clauses act as adjectives or adverbs in a sentence; in addition, they may act as nouns. Here are some examples:

I heard *what you said* (noun, object of the verb "heard").

The book (*that*) I read was very interesting (adjective, modifies the noun "book").

He sings *when he takes a shower* (adverb, modifies the verb "sings").

With a little practice, anyone can learn to recognize dependent clauses quickly. Three points need to be remembered: (1) A dependent clause is not a complete statement. (2) It must have an introductory conjunction or relative pronoun (*if, when, which, that, because, since*, and the like), although the relative pronoun *that* can often be omitted, as in the second example above. (3) To qualify as a clause, it must have both a subject and a verb, such as *you said, I read*, and *he takes* in the above statements.

Here is another example of the difference between catalogical and analytical writing; prepositional phrases are in parentheses, dependent clauses are italicized:

Catalogical: The need (in the company) for great increases (in space), caused (by a steady growth) (in research work), has necessitated the addition (of a new wing) (to the laboratory).

Analytical: *Because its research work has been growing steadily*, the company is adding a new wing *that will greatly increase its laboratory space*.

Once again, the rewritten sentence eliminates every prepositional phrase. In most catalogical sentences, however, it is difficult if not impossible to eliminate every prepositional phrase, nor should a writer strive to do this. Yet it should be possible to reduce the number of these phrases by at least one-half. The report writer's tool for doing this is, of course, the dependent clause.

Here is a longer example of catalogical writing; the subject matter has to do with two-phase flow systems:

Variance of the mechanism for momentum transfer with respect to the flow pattern is to be expected, but this is not too well understood. Uncertainty even surrounds the correctness of reliance on visual description of flow patterns as a means of identifying the regions involved in possible changes in the mechanisms for momentum transfer. Consideration, in addition, of entrance effects, as well as the possibility of transient or unsteady state behavior being of importance, makes the relative efficiency of existing correlations seem even more remarkable. Knowledge of the flow pattern and all the physical and geometric properties of the system enables one to predict, in the best correlations, pressure drop within an accuracy of about 25 percent.

This four-sentence paragraph contains a large number of prepositional phrases (24, to be exact). There are no dependent clauses. This is a dull, uninformative catalog of details the reader must interpret if he is to extract concrete meanings. After wading through several paragraphs of this sort, most engineers would be ready to head for the hills.

A more analytical approach would have helped the reader immensely. Actually, the original version of this passage was more analytical; the above excerpt represents this writer's catalogical version of a well-written paragraph that appeared in a recent issue of *Chemical Engineering* (Dec. 6, 1965, p. 139). Here is the original paragraph, with its analytical approach restored:

It is to be expected that the mechanism for momentum transfer might vary with the flow pattern, but this is not too well understood. It is not even clear whether visual description of flow patterns is sufficient to identify the regions where the mechanisms for momentum transfer might change. When, in addition, entrance effects are considered, as well as the possibility that transient or unsteady state behavior is of importance, it is remarkable that the existing correlations work as well as they do. If one knows the flow pattern and all the physical and geometric properties of the system, the best correlations will predict the pressure drop within an accuracy of about 25 percent.

The statistics here are much more encouraging: The number of prepositional phrases has dropped from 24 to 12, and there

are now eight dependent clauses, listed below by introductory word, subject, and verb only:

that/mechanism/might vary
 whether/description/is
 where/mechanisms/might change
 when/effects/are considered
 that/behavior/is
 that/correlations/work
 as/they/do
 if/one/knows

Because the paragraph is quoted out of context, and because some technical terms might not be familiar to everyone, this text cannot inform completely. But few persons would deny that the analytical version is much more informative than the catalogical one; it is also much more natural.

The report writer who has begun to suspect that his writing is more catalogical than it ought to be should take the following simple test:

Test 1: Take a short passage from one of your reports (one typewritten, double-spaced page is long enough). In the passage, blot out every prepositional phrase with a red pencil and every dependent clause with a green pencil. Blot out the whole phrase or clause, not just key words. If, when you have finished, more red than green is on the page, you can be reasonably certain that you are not handling details as informatively as you might.

HANDLING IDEAS

If details within a sentence must be presented carefully, it is equally important to concentrate on presenting ideas—sentences themselves—in an informative way. As with details, sentence construction can be catalogical or analytical. Learning to connect ideas or sentences analytically is a major step toward more informative writing.

In any paragraph, some ideas obviously are more important than others. But the writer who catalogs ideas refuses to recognize this fact. As a result, his technical reports are likely to follow the pattern of the following paragraph (in each sentence, the main subject and verb are in italics):

This expanding drum *brake* for motors *has* shoes made of electrical steel laminations, mounted on a common anchor pin. *They/serve* as armatures for the brake release solenoid. *The drum/is* aluminum. The brake *lining/is bounded* directly to laminated shoes. The release *solenoid/is connected* across electric motor terminals. *It/is energized* when the motor starts, holding the shoes away from the drum. *Interrupting* current to the solenoid automatically *applies* shoes to the drum, with brake pressure applied by a helical spring between the shoes. Manual *release/is* by a cam, applying pressure below the pivot point of the shoes. The drum *brake/is* available for mounting on NEMA C frames or independently housed and foot-mounted. *It/is* available with 2 to 20 foot-pound ratings.

A quick examination of this ten-sentence paragraph reveals an interesting fact: Almost every sentence begins with the main subject and verb. What we have here is a tedious catalog

of ideas, each technically constructed in precisely the same way. By limiting himself to this approach—subject-verb, subject-verb, subject-verb—the writer has made informing virtually impossible. In this paragraph, the main ideas simply don't get through clearly to the reader because minor ideas are given the same construction. Too, it is extremely difficult to tie ideas together when this pattern predominates; this sort of writing doesn't "track."

In informative writing, sentence construction is much more varied. Consider the following excerpt (once again, only the main subject and verb of each sentence are italicized):

Operating and maintenance *supervisors* of an oxygen generating plant *were* quick to credit polyelectrolytes with increasing plant-operating efficiency, reducing downtime, and eliminating manual mud removal.

The *plant*, located on the site of a steel mill, *supplies* oxygen for steel making. Although it has a closed cooling system and makes up with clean water, a sticky *mud/was settling* in its pipes, heat exchangers, and compressor jackets because atmospheric dust from the mill was entering the water through the cooling tower.

The *mud* greatly *reduced* heat-exchanger efficiency, *caused* power consumption to go up and operating efficiency to go down. Because the *operating* temperatures of the oxygen compressor ran high, the *compressor/had* to be shut down every two months and manually cleaned to restore temperatures to design levels. Besides the expense of cleaning, *oxygen/was vented* when the compressor was down.

In this passage, arrangement of main subject and verb is much more varied, as it should be. Some of the main subjects and verbs are preceded by dependent clauses, others by phrases. The writing does "track," and, incidentally, is much more natural than the catalog of ideas previously quoted.

Test 2: In a passage from your writing, underline the main subject and main verb in each sentence. (In this test, ignore the subjects and verbs of dependent clauses.) If the main subject and verb appear at the beginning of more than half the sentences in the passage, you have good reason to believe that you are not presenting ideas informatively.

The percentage (one-half) given in this test is arbitrary and perhaps a bit high, but it does give you a goal to strive for. If it does nothing else, it should provoke you into making a few thoughtful changes, such as putting a few connective phrases or clauses between ideas.

ABSTRACT vs. CONCRETE NOUNS

We can define the ideal engineering report as one that every reader will interpret exactly the same way.

Very often, engineering reports are hard to interpret not because they are too technical but because they contain too many ordinary, everyday words of a certain kind: abstract nouns. Abstract nouns are by definition ambiguous, and the more often they crop up, the less informative the writing.

Admittedly, abstraction appears in all forms of writing, including technical reports. Words like *profits*, *industry*, *economics*, and *manufacturing* are as abstract in their own way as words like *truth*, *love*, and *justice*. Whenever a writer has to

