

*Robert Schoenfeld*

# The Chemist's English

*Second, revised edition*

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Library of Congress Card No. 85-17858

CIP-Kurztitelaufnahme der Deutschen Bibliothek

**Schoenfeld, Robert:**

The chemist's English / Robert Schoenfeld. -- 2., rev. ed. -- Weinheim; New York: VCH, 1986  
ISBN 3-527-26597-X (Weinheim)  
ISBN 0-89573-599-7 (New York)

© VCH Verlagsgesellschaft mbH, D-6940 Weinheim (Federal Republic of Germany), 1986  
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Composition: Filmsatz Unger, D-6940 Weinheim

Printing: betz-druck gmbh, D-6100 Darmstadt 12

Bookbinding: Josef Spinner, Großbuchbinderei GmbH, D-7583 Ottersweier

Printed in the Federal Republic of Germany

# Preface

I imagine you, dear reader, in a bookshop, having just picked this little volume off the shelf. You turn to this Preface to find out whether here is something worth buying. Well, I am an honest man; I won't sell my goods under false pretenses. This book does not set out to *teach* you to write good English. The skill of good writing cannot be taught, just as the skill of doing research cannot be taught.

All right, the book will teach you to avoid a number of annoying errors that may cause delay in getting your work published, and for this merit alone you may consider the book is worth having. But any such merit is only a by-product. I do not set out to give you a recipe for good scientific writing; I want to give you an *appetite* for good English.

I said that the skill of doing research cannot be taught. Your professors can show you how to acquire a data base and how to manipulate it, and how to gain mastery of the gleaming tools of scientific research. But you need more, and nobody can give you that: you need the desire to explain what has hitherto remained unexplained. Unless you have that you will remain an honest data-gatherer all your life; but research is something else.

Much the same is true of writing. You need the data base: the vocabulary. Then you need certain manipulative skills, such as shaping a sentence by putting a noun phrase and a verb phrase into it and getting the two to agree. All this can be achieved by teaching at a very low level; in fact, if the language in question happens to be your native one, you may reach 90% of your speaking potential and 80% of your writing potential in your teens. So, certainly, there is a teachable component in language. But it is not enough; to become a good writer you must also have an intense *desire* to communicate. And there is no recipe or algorithm that will give you this desire.

Perhaps this book can help. It is written, above all, for scientists, and it makes two assumptions: (1) you have something to say; (2) you are inhibited by fear of making mistakes.

I am confident I can remove that fear. First, by making you laugh; you will find that every misfortune that has happened to you has already happened to others, sometimes with pretty amusing results, and yet these others have survived the experience. Second, by analysing these mistakes. You will protest that others have already tried to do that for you, with the result that you have become more inhibited than ever. But those others have used the traditional methods of the grammarian, whereas I am a chemist talking to chemists. We shall use the chemist's tools: we shall treat sentences as though they were molecules, and the words as though they were atoms. We shall then perform such familiar operations as determining how these atoms are bonded together, how strong the bonds are, and what contribution each part of the molecule makes to the general stability.

Let me sum up what this book sets out to do. I do not promise to teach you good writing. I promise to keep you entertained and hope to give you confidence, so that you will want to sit down as soon as possible at your writing desk, eager to tell your public about your latest results. Who knows, I might even interest you in the laws of language. Did you know that the science of language is still in its infancy? For centuries it was believed that the traditional study of grammar, in the footsteps of Roman scholars such as (I have just looked up the name in an encyclopedia) Priscian, would yield all the facts about language that could be known. But then came the computer age and people tried to translate from one language to another by electronic means. It promptly became apparent that very little was known about the laws of language. For instance, in an English sentence, by what process do you find the verb? (Your dictionary will tell you that *sentence*, *instance*, *process* and *find* could be either verbs or nouns.)

The other day I found out (but inevitably many others must have commented on the fact before me) that about half of the human race puts the adjective before the noun, and half behind. Now why should that be? Surely one order is more efficient than the other, and should have prevailed. That's linguistics for you, one fascinating but yet unexplained fact after another.

I hope you will want to read the collection of essays that follows. But perhaps you draw back; you wonder whether you might not be better off with a traditional book on English style, written by a professor of English. There are a number of such books on the market, by distinguished authors, and I have often turned their pages in admiration, but in all my years as an editor I have never found a chemist whose prose style has been improved by reading them. In our library there is a particularly famous one, "English

Prose Style" by Herbert Read (G. Bell & Sons, London); it has gone through numerous reprintings and these have invariably been greeted with enthusiasm by critics in literary magazines. In the introduction, the author develops the reasonable thesis that good writing can be learned by reading consistently good writers. Let me cite one of his sentences:

Take this test only: of how many writers, in the search for an appropriate and representative passage, could we trust to the offering of any page we opened at?

I don't want to be sardonic. I shall just say that this sentence reminds me of a highly strained molecule. Is that the kind of prose you want to write your next paper in?

It was precisely because I felt that the standard texts were not helpful to chemists that this collection of essays came into being. I published Parts 1 – 30 in the *Proceedings of the Royal Australian Chemical Institute* and its successor *Chemistry in Australia*, and Parts 31 – 33 in *CHEMTECH*. I thank the Royal Australian Chemical Institute and the American Chemical Society for allowing me to make use of this material. I am the editor of the *Australian Journal of Chemistry* and in some of the articles allude to specific Australian problems; I hope this will interest rather than annoy my readers.

The community of research chemists in Australia and New Zealand is not numerous; we meet at congresses; everyone seems to know all the others and to be on first name terms with them. This explains the tone of my articles: I imagined myself chatting to a group of friends. When I began to get correspondence from overseas I found that readers from outside our circle of acquaintance also liked this type of presentation; thus I have not changed it in this book version. I have taken care in revising, though, to make sure that these articles are accessible not only to chemists but to scientists of other disciplines as well.

Have fun with my articles. If you agree with my opinions, this will flatter my vanity; if you disagree, prove me to be in error by fashioning this or that particularly taut and effective paragraph in your next article or book or report. The best science has been done, and the best prose has been written, by those confident enough to disagree with authority.

Melbourne, Spring 1985

R. Schoenfeld

# Contents

1	To Get Acquainted . . . . .	1
2	The Search for the Missing Ablative . . . . .	6
3	Arguing with Authority . . . . .	10
4	Defying the Dictionary . . . . .	13
5	To Reflux or not to Reflux . . . . .	16
6	Amazing Revelations: English Scientists Secretly Practise German Vice! . . . . .	19
7	Of Nuts, Muttons and Shotguns . . . . .	23
8	Tetravalency of Carbon Disproved! . . . . .	27
9	This Chapter Explains . . . . .	30
10	The Painful Plight of the Pendent Participle – Preamble . . . . .	33
11	Discussing the Sentry Participle, We . . . . .	37
12	The Case Against the Advocate . . . . .	41
13	That's the Way She Crumbles, Language-Wise . . . . .	44
14	Now, from the Pen that Gave You Monglish, Comes Gerglish . . . . .	48
15	The Chemist and the Capercailzie . . . . .	52
16	That Fellow Acronym He All Time Make Trouble . . . . .	57
17	On the Divisibility of Earth/Worms . . . . .	61
18	Instant Stylistics . . . . .	67
19	A Piece of Classified Information . . . . .	72
20	An Investigative Examination of Driveliferous Jargonogenesis . . . . .	77
21	Brevity = Soul of Wit? . . . . .	81
22	One, Hand, Clapping . . . . .	85
23	Alphabetical Disorder . . . . .	90
24	Is You Is or Is You Ain't My Data? . . . . .	95

# XII

## Contents

25	Yes, Virginia, There <i>is</i> a Temperature . . . . .	99
26	The Truth about the Truth . . . . .	105
27	They Also Serve Who Only Pull and Tug . . . . .	110
28	On the Training of Old Dogs for Which-Hunting . . . . .	116
29	A Package of Strings . . . . .	121
30	A Clash of Symbols . . . . .	125
31	In Praise of Prepositions . . . . .	129
32	A Prowl Among Personal Pronouns . . . . .	136
33	How Good is Your English? How Good is English? . . . . .	143
34	A Chemical Analysis of the English Sentence . . . . .	150
35	Lights! Camera! Action! . . . . .	162
	Index . . . . .	169



# 1 To Get Acquainted . . .

I am an editor of the *Australian Journal of Chemistry*. Some years ago, I began to write a series of articles on some peculiarities of scientific English that I found amusing, hoping to share my amusement with others. In this I was successful; I received invitations to lecture at universities and research institutes; and during the convivial occasions that followed, my hosts confessed why they found it difficult to write. "All these rules of grammar", they said, "frighten us off".

So let this be the first message of this book: Don't be frightened of grammar. When you sit down to write your paper or thesis or report, your most dangerous enemy is not the split infinitive – it is ambiguity. A split infinitive is very often acceptable anyway, but where it needs correcting it can be corrected by a copy-editor. However, the copy-editor, unless he is a mind-reader, cannot correct an ambiguity. So, even if you are not a smooth writer, don't sit there staring at the blank page; get your facts down first and fix up the dangling participles afterwards.

- And why are you so afraid of grammar, anyway? You are a graduate in chemistry or a related science; that means your mind is disciplined enough to understand and organize large sets of difficult concepts. Why should grammar (I speak of traditional or schoolmaster's grammar here) be beyond your reach? I shall prove to you, here and now, that grammar is a science inferior to chemistry.

Let us perform a thought experiment: we assume that at a given university two research workers, a traditional grammarian and a chemist, begin their work at the same hour. Their work is at first of the same order: they each study a population of experimental data. Pretty soon both these learned men begin to observe certain patterns and regularities in their populations, and that permits them, by deductive reasoning, to formulate a scientific law. For the grammarian, this may take the form of "All nouns of multitude preceded by the indefinite article take the plural". The chemist

will say "All ketones react with phenylhydrazine to give a phenylhydrazone".

So far so good; neither man has outperformed the other. But now they bend their heads over their work again and it is not long before they find exceptions to their laws. The grammarian finds that there are nouns of multitude, such as *set*, that capriciously prefer the singular. The chemist discovers that there are ketones that will not form phenylhydrazones no matter how hard one tries. At this point the difference between the sciences begins to emerge. The grammarian cannot take his research any deeper. All he can do is to amend his law to: "All nouns of multitude . . . take the plural *except for* . . ." For him, an exception to his law is a setback. To the chemist, though, it is a signal that he is about to find something new. He wants to know why his wayward ketones misbehave, and comes up with new insights into the geometry of molecules or the changes in electron distribution brought about by substituents. Instead of amending, and thereby weakening, his first law, he will replace it by a more subtle one beginning with "Ketones form phenylhydrazones only if . . ." And having formulated this law, and having sent the story of its genesis to his favorite journal, our chemist will race back to his laboratory in an eager search for what the grammarian dreads most: exceptions.

I hope you are convinced: we chemists are smart enough to deal with problems of grammar. In fact, this will be one of the themes of this book: if we use the chemist's tools of deduction, we shall often discover that the laws of grammar are not disjointed statements lying side by side, but can be connected by a logical thread.

Have I cured you of your fear of your old schoolmaster's ghost? There is still another fear that may afflict you as you sit, pondering, in front of the blank page. You may have the feeling that knowing English is not enough, that the Chemist's English is somehow different from the language you learned at school, and that you are not at ease with this strange language.

To a certain extent this is true, but it is nothing to be afraid of. This book is meant to be accessible not only to native speakers of English, but also to non-natives sufficiently advanced to consider publishing in that language. But let us assume for the moment that you have been brought up on English. You have, of course, a feeling of complete mastery over Standard Spoken English (SSE) and you also feel at ease with Standard Written English (SWE), but Chemist's English (CE) is something else again, and at times you may find yourself translating a phrase from SWE to CE rather than writing directly in that language.

Is CE really a separate language, then? Legitimately, we could call it a subspecies of SWE. There are significant differences between CE and SWE in sentence construction (CE has a far higher proportion of sentences with the verb in the passive form) and vocabulary (in CE words with emotional undertones are taboo, and pronouns of the first person are avoided). There are also slight differences in grammar.

Let us take a sentence in SSE and turn it into SWE and CE. For example, you may be chatting with a friend in the laboratory, and you say in SSE:

We had an idea that the hydroxy group was tertiary, so we stewed the compound up with acetic anhydride. (1)

Next we find you writing to a colleague, in SWE. The sentence now becomes:

We suspected the hydroxy group was tertiary, so we heated the compound with acetic anhydride. (2)

Now to translate into CE. We have been trained to avoid "we", and the word "suspect" is suspect, so we write:

In order to determine whether the hydroxy group was tertiary, the compound was heated with acetic anhydride. (3)

Let us note in passing that there is a decrease in signal-to-noise ratio through the series [the SSE sentence (1) has implications of an impulsively formed hypothesis and of forcing conditions; these are progressively lost]. But the point I am trying to make is this: sentence (3) is acceptable CE, but would not be considered good SWE by most authorities.

The SWE grammarians' argument against (3) is as follows: The phrase "In order ... was tertiary" expresses a purpose, and whenever such a phrase precedes the principal sentence, that purpose is ascribed to the subject of that sentence. I have used non-technical language, and I hope you will get the point: if you look at sentence (3) again, you will see it literally means that the compound (not the authors, who are not mentioned) got curious about the nature of its hydroxy group. Let us abandon CE for an instant, and create the equivalent of (3) in the Sociologist's English:

In order to determine their suitability for the chemistry course, the students underwent an aptitude test. (4)

No doubt you will read (4) with a slight feeling of unease; it is a bad sentence because it does not say exactly what was meant. It seems as if the students themselves had clamored for the aptitude test, whereas in fact it was inflicted on them by the instructors.

[I should mention here that the trouble with sentences (3) and (4) does not arise when the phrase of purpose *follows* the verb of the principal sentence, presumably because in that case there is no room for confusion. "The solution was boiled to drive off HBr" is good CE and correct SWE, and a sentence such as "The wheat was sown early that year, to take advantage of the unusual weather" could occur at the beginning of a fastidious author's novel.]

We are left with the fact that sentence (3) is acceptable in CE whereas a meticulous editor might object to it in SWE. Perhaps I had better present my evidence concerning the acceptability of (3). On the day I decided to write this chapter, I had on my desk No. 9/10 of *J. Chem. Soc., Perkin Trans. 1*, 1972. A ten-minute search uncovered four relatives of sentence (3). I shall quote from p. 1165: "In an attempt to generate the cation . . . by an alternative route, the diazonium sulphate . . . was heated in methanol." Similar sentences occur on pp. 1205, 1223 and 1232.

I took this to prove my point, as the *J. Chem. Soc.* is a carefully edited journal. I should still mention that I was less successful with No. 8 of Vol. 94 of *J. Am. Chem. Soc.*, which I picked up next. I found only one sentence of type (3) (top of p. 2844), but there were several instances of authors following up an "in order to . . ." phrase quite correctly with "... we heated . . .", "... we determined . . ." etc. Such sentences, of course, are perfect SWE because the purpose is correctly seen to be that of the subject. It would obviously be irresponsible to theorize from such a small sample, but the thought did cross my mind that contributors to American journals might be less inhibited about the use of the first person plural, and thus less likely to get themselves into grammatical mischief.

Be that as it may, we remain with the conclusion that CE and SWE are drifting slightly apart, and the question arises whether we should worry about this. Some very distinguished people do worry, and occasionally I read articles in which chemists are asked, in substance, to write their papers in SWE rather than CE. Personally, I agree with these eminent writers, but this book is concerned with the Chemist's English now prevailing, not with some ideal language.

Under prevailing customs, then, the CE sentence we have analysed would be considered acceptable in any scientific journal I can think of.

Very early in my career I might have been zealot enough to move the phrase of purpose to the back of the sentence, but every editor soon learns to be as tolerant as possible. However, prevailing customs also permit the authors – and this is the best solution, provided it is not done to excess – to use the first person plural whenever a sentence expresses something subjective like an opinion, a purpose, a decision.

Prevailing custom, alas, is still against the use of the first person singular. I admit there are moments when the use of this English one-letter word is contraindicated. Figure this one out:

Analysis revealed that Cl and Br were present in appreciable amounts; but as stated in Part I I found I only in traces. (5)

Thus a certain amount of care with the letter is certainly desirable, but if you are the sole author of your paper I see no harm in your using *I* in those places where, as a member of your group, you would have written *we*.

I realize I contradict myself here: just a moment ago I said I would simply record prevailing customs, and here I find myself advocating a change. But customs are progressively changing in the direction I desire, the change suggested is only marginal, and I hope I shall be forgiven if I try to push things along just a little. Certainly, in my journal, all you have to do is to promise not to write about atomic iodine, and I shall promise in turn not to put any road-block in the way of your legitimate little ego-trip!

## 2 The Search for the Missing Ablative

So you think you have problems with grammar? Be glad you were not born a Goth or a Phoenician. Some ancient languages had grammatical forms of the most bizarre complexity. In the Basque language, if you alter the ending of a verb you thereby indicate that you stand in awe of the person you are addressing. In Hebrew, if you change a verb's vowels you thereby give it special emphasis.

No one is sorry that such odd refinements are missing from English grammar. We would much rather preface a verb with "respectfully" or "emphatically" than learn a whole new set of verb forms. But some of these ancient forms did have their uses. If you listen (as every scientist or technologist ought to, these days) to a moral philosopher, you might hear him complain about the fact that the English language does not have a gerundive. A gerundive, in Latin, was a suffix which, when tacked on to a verb, indicated that the action the verb described *ought to be done* (*nunc est bibendum*, *Carthago est delenda*). In English, "to praise" has a *de facto* gerundive in "praiseworthy", but very few other verbs do, and our philosopher has to circumlocute to express thoughts that Seneca could have formulated with a few syllables.

Anyhow, we chemists do not miss the gerundive much (except those of us who have just established a purseworthy hypothesis). But we certainly could do with a nice ablative. In fact, the absence of an ablative is one of the most annoying problems in the Chemist's English.

The ablative, in case you have forgotten, is a Latin case which works as follows. You make some clever change to the ending of a noun, and it thereupon becomes apparent that what-the-noun-means is the cause or the motive or the instrument of what the verb says is going on. Quintus killed Sextus (somebody always gets killed in these Latin exercises) *in* a rage, *with* a knife, *by* a stratagem, *by means of* slow poison — all the italicized prepositions Cicero was able to leave out, because he had studied his ablatives.

In the Slav languages, something like the ablative still survives, but all other modern languages have lost it. Why did this very useful grammatical form die out? No doubt its signal-to-noise ratio was too high for that imperfect decoding system, the human ear; there were some problems of ambiguity; and it was a bother having to remember a new suffix for each declension and for hordes of irregular nouns. So most modern languages, instead of altering the ending of a noun, place a preposition in front of it. In German, this preposition is *durch* (replaced occasionally by synonyms such as *vermitteltst*), in French *par* (or *au moyen de . . .*), in Italian *per* (or *tramite* or *mediante . . .*).

In English, we seem at first glance to have a particularly impressive array of synonymous prepositions: *with*, *by*, *by means of*. But closer inspection uncovers what is in fact a genuine weakness in scientific English. The prepositions are not interchangeable, that is, their meanings do not always overlap. Hence we must choose them with care and cannot always be certain of our choice. And custom is very capricious: we heat our solutions *with* a Bunsen burner, *by* ultraviolet radiation, *by means of* a heating mantle.

For Chemist's English there exists a rough rule of thumb: *with* is used for simple instruments, *by* for more complex ones and above all for abstract names of methods and techniques, *by means of* for yet more complex instruments and concepts. (Crystals are separated with a spatula, liquids by distillation, and vapours by means of the Hirakawa Smith-Jones 345 A Kromo-Graf apparatus.) "By means of" very often overlaps "by" and sometimes "with", in fact it comes nearest to being an all-purpose pseudo-ablative; but it is a cumbersome phrase and its constant repetition makes for leaden prose.

What proves that the problem is very real is the fact that chemists are still earnestly searching for a simple English word that will perform all the services rendered in other languages by *durch*, *par* and *per*. In my time as an editor I have seen three such words rise to prominence, with varying degrees of acceptance.

The first of these, and in my view the best qualified, was *through*. This comes, of course, from the same root as *durch* and I suspect it is no coincidence that it had its crest of popularity at a time when many standard textbooks were all-too-faithful translations from the German. *Through* in the sense we are discussing appears only very occasionally in the chemical literature now; it just has not passed the popularity test (perhaps the literal meaning is too readily present in the reader's mind) and we all feel that there

is something odd about "The compounds were separated through chromatography". And yet this public rejection is somewhat unjust. *Through* as a synonym of *by means of* has a perfectly honorable history; its predecessor in Old English was used in precisely the manner of *durch*, and English Kings reigned *thurh godes fultome* before they became monarchs by the grace of God. This use has never died out; phrases such as "through sheer persistence" do not at all seem contrived. Hence, if chemical writers were to attempt a cautious and moderate revival of *through*, perhaps as an occasional substitute for *by means of*, they would thereby protect the Chemist's English from less desirable alternatives.

The second of these ablative-substitutes occupies a dominant position at the moment. This is *using* as employed in

The substance was analysed *using* mass spectrometry. (1)

I am very much opposed to the use of this word, although I know full well that if an expression, no matter how badly conceived, gains wide acceptance, an editor's protests are to no avail. But let me, while I still have the English dictionaries on my side, explain my objections to the misuse (we shall see in a moment there is also a legitimate use) of *using*. The argument runs as follows: (i) *using* is listed in the dictionaries as a participle; (ii) a participle, if correctly used, is always attached to a noun or pronoun; (iii) *using* in sentence (1) is not so attached; (iv) therefore it is incorrectly used.

This situation has of course come about by the chemist's preference for sentences with passive verbs. Had the sentence run

We analysed the compound using mass spectrometry. (2)

then the word *using*, being correctly attached to *we*, would have passed muster. [A careful author, in sentence (2), would insert a comma before *using*, to make it quite plain that *using* is attached to *we* and not to *compound*.]

When I first wrote about the missing ablative, in 1974, I was fairly forthright in my condemnation of sentence (1). Now, revising in 1984, I have to be much more prudent. All I can report at the moment is that sentence (1) is still incorrect in Standard Written English, but is tolerated by most editors of the Chemist's English.

I still live in hopes that this particular tolerance can be reversed. It still seems to me that sentence (1) cheapens the English language; in fact I feel so strongly about the matter that I shall return to it in the chapters on participles and prepositions. But I am aware that my chances in this



campaign are small. It is far more likely that the misuse of *using* will spread from the Chemist's English to Standard Written English, and that then the English dictionaries, most of which record such developments uncritically, will list *using* as a preposition. With that my battle will be lost, and I must admit, in fairness, that the transmutation of participles into prepositions is a time-honored English process – think only of *pending*, *owing*, *according*, *except* . . .

Thus I must content myself with saying that your paper will impress discerning readers much more if you keep the cousins of sentence (1) out of it. Whenever this sentence tempts you, see whether you cannot replace *using* with *with*, or by *by*, and you may even consider *by means of*. If all these remedies fail, there is still sentence (2).

Most editors are only wary of *using*, but they genuinely dislike the third ablative-substitute, *via*, as badly used in “separated *via* chromatography”. I must admit that, to my intense grief, this use of *via* has found its way into the otherwise very scholarly Webster's Dictionary. But members of reputable scientific publishing houses agree with Sir Ernest Gowers: “*Via* can only be properly used of the route; to apply it to the means of transport is a vulgarism.” Translated into Chemist's English, this means: you can only use *via* for intermediates, not for techniques. Isolate a base *via* its picrate by all means, or proceed from an alcohol to an acid *via* an aldehyde. But don't try to determine the structure of these compounds *via* n.m.r. If you do, the reviewer may return your manuscript to you for correction, *via* the editor.