

## COMMUNICATION FOR AEROSPACE STUDENTS: A POLYTECHNICAL APPROACH

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Teaching communication skills to a variety of technical disciplines has some similarities to John Keats' analogy to human life, the "...large Mansion of Many Apartments".

Keats' "Thoughtless Chamber"--in which humans remain so long as they do not think--is a fair approximation of engineering students whose interests have taken a technical turn, to the exclusion of almost all else. Likewise, his second room, the "Chamber of Maiden Thought", with its intoxicating light, atmosphere and pleasant wonders, is akin to technology students' bemusement with finding out how things work. And Keats' many dark doors "... all leading to dark passages" are indeed a "... burden of the Mystery".

The third room in Keats' Mansion is the "Chamber of Life", into which--surely--we are all endeavouring to lead our students.

### Defining the scope

In making a definition, we must define that which is to be excluded as well as that which is to be described. Teaching communication to technology students does not include instruction in basic English composition skills nor does it encompass precise directions for writing lecture papers.

As a model, I shall consider the teaching of communication to aerospace engineering students because this discipline embraces applications of almost all known sciences plus a few 'black arts' and special features. Also, I happen to be an aerospace engineer who teaches in a polytechnical institute, writes for a number of international aviation journals and does engineering consulting work for the federal government.

### Aerospace communication

Specialized experience and current technical knowledge are very useful in the teaching of technical communication, not because of the formal instruction required, but because of the individual help needed by students in tutorial periods. Any competent instructor can impart essential guidelines for writing memos, letters, reports, proposals and

presentations. But a specialist can inject realistic details and highlights by referring to contemporary practice, relating it to historical precedent, and answering questions on it.

In the case of aerospace engineering students, there is such a wide diversity of topics available that--paradoxically--no precisely aerospace subjects need be addressed! Indeed, depending on the year of the program in which communication is taught, the instructor may be too well-informed for the students' understanding. If the students are in their third or fourth year of a degree program, they will know something about their own subject, but in earlier years most will have only sketchy ideas and so will be confused rather than helped if an instructor assumes they know very much.

Thus, it is despite rather than because of my own direct and continued involvement with aerospace that I am using this discipline as the model for teaching communication to all technology students. However, I shall show how some detailed knowledge of an instructor can be used to advantage to point up aspects of teaching or add to a student's understanding. But such knowledge is not restricted to 40 years of specialized experience--it includes information acquired on a wide range of subjects over a longer period. The point here is that an instructor uses the entire register of useful memory to elucidate points in an attempt to make an impact on students' minds.

It is my practice to teach communication in a pragmatic manner so that, whatever the discipline--aerospace, mechanical, metallurgical, industrial, electrical, civil, survey, computer applications, graphic arts, landscape architecture or whatever--the same basic messages are conveyed. Thus, as is essential for uniformity with my department, it really doesn't matter from which specialty the students come. Conversely, when the students ask questions or discuss their interests, then whatever the instructor happens to know is invaluable--not so much to teach as to establish a useful and credible rapport. Incidentally, this dual approach--plain technical communication for class instruction, but highly specialized for individual student dialogue or tutorial periods--lends itself to teaching combined classes which may, for instance, be a mixture of aerospace/mechanical/metallurgical/industrial or perhaps electrical/electronic/computer/power technology students.

### The classroom case

Take the case of aerospace technology students. It would be very misguided to give a strong aerospace slant to teaching these students communication, for several reasons.

First, although aerospace students obviously have some reason for specializing and a few may have some knowledge of the area, they have started their post-secondary education by studying basic mechanical engineering technology. So, with a few exceptions who are already

enthusiasts, they do not know much about their own subject! Second, they must be taught the same techniques of communication whatever their technological specialty. Third, it would be all too easy for the instructor to flaunt a smattering of abstruse technical information which, far from being interesting or useful, would only intimidate or baffle students.

An invaluable first assignment is to ask students to spend a period writing about their reasons for choosing aerospace and their aspirations on completing post-secondary education. This not only gives a measure of composition skills, which is particularly useful in classes with high percentages of students whose first language is not English (or whose parents' first language is not English), but indicates what percentage of the class really knows anything about the subject and how many are simply dazzled by the glamour of it.

Having introduced the subject of technical communication as a basic tool of engineering, the instructor proceeds through the primary areas of audience analysis and message mechanics to the meaty area of technical style--writing style, word style (word choice and jargon), illustrations, and numeral and number style. The course moves on to formal reports--preparation and research, outlining, documentation, definitions and descriptions, and summaries. As a corollary of material presented, there are examples, exercises and at least eight in-class assignments worth half the total course mark, plus a formal report worth the other half of the final grade.

Students are required to research and produce individual reports on subjects of their own choice, subject to consultation and approval by the instructor. It is here that the wisdom of not slanting instruction toward aerospace is apparent, since by no means all students choose aerospace topics and some who do so are uncertain of their subject matter or are not equipped to deal with it.

Without question, the biggest difficulty experienced by students is lack of adequate sources of information for reports. This is where the instructor can be of great practical assistance, although the extent to which this advice may be implemented depends upon the periodicals available in the institute's library, supplemented by the resources of a public reference library. In "real life", an engineer would have immediate access to numerous reports from companies, research institutes and government agencies, learned-society journals, periodicals of many types, lecture papers and abstracting services. The student, however, tends to look to books--which is often a mistake.

By their nature and timeframe, books are inevitably limited in value as student references because they are either devoted to principles rather than applications, or because they are outdated soon after publication as a source of current developments in a fast-moving field. Reports and lecture papers, even if there were library space for them in microfiche form, would be mostly far too technical for neophytes

and would be far too time-consuming for students' use. The simple answer is periodicals, of which the institute library should have a useful holding--depending on the insistence and wisdom of program-department chairmen.

Periodicals for aerospace students include the members' journals of the learned societies--the Journal of the Canadian Aeronautics & Space Institute, Aerospace from the Royal Aeronautical Society, Aerospace America from the American Institute of Aeronautics and Astronautics, Aerospace Engineering and Automotive Engineering from the Society of Automotive Engineers, Spectrum from the Institute of Electrical and Electronic Engineers, and so on.

The specialized weekly magazines Aviation Week & Space Technology and Flight International, plus Jane's Defence Weekly, are invaluable. Several daily news letters include Interavia Air Letter, Aerospace Daily and Defense Daily. There is a range of monthly magazines such as AIR International, Interavia Aerospace Review, International Defence Review, Air Transport World, Airline Executive, Commuter Air, Commuter World, Helicopter World, Canadian Aviation, Canadian Aircraft Operator, Aerospace Canada, Wings, etc.

Then there are special-interest publications such as the Journal of Aircraft, Journal of Propulsion, Journal of Spacecraft and Rockets, the Aeronautical Journal, the Journal of Hydronautics, the Journal of Energy, and others.

Many major aerospace and related companies have excellent house organs. And there are several general-interest magazines such as High Technology and Scientific American. I have nothing against popular publications like Popular Science or Omni as stimulators of interest, but as sources of information they leave something to be desired.

By using the Engineering Index, Aerospace Abstracts and the DIALOG computer-abstracting services, whole worlds open up to be searched in the realms of aerospace. (See Figure 1.)

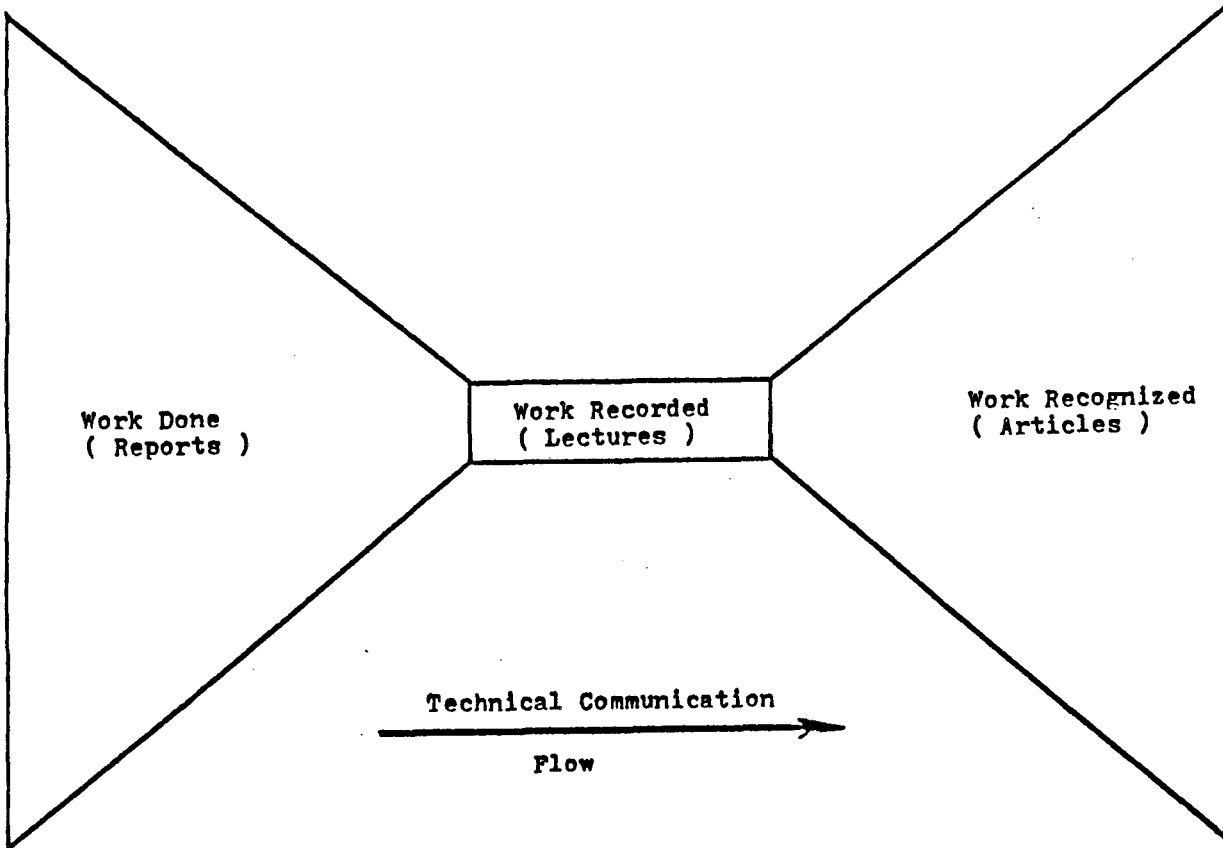
I cannot emphasize too strongly the value and utility of technical periodicals for student report references. It is true that, sometimes, lecture papers or industry reports are useful sources but, apart from being hard to get hold of for students, they are not the best medium for transmission of information at a level which students will comprehend.

Let me remind you of the flowpath for technical information (see Figure 2):

1. Details are written up in reports by experienced specialists in many different areas of a subject.
2. Large numbers of reports are produced for use by management and by technical specialists.

ORIGIN CATEGORY	CANADA	UNITED STATES	INTERNATIONAL
Trade Press	Aerospace Canada Canadian Aircraft Operator Canadian Aviation Wings	Airline Executive Air Transport World Aviation Week and Space Technology Commuter Air	AIR International (UK) Commuter World (UK) Flight International (UK) Helicopter World (UK) Interavia Aerospace Review (Switzerland)
Society Journals	CASI Journal	Aerospace America (AIAA) Aerospace Engineering (SAE) Journal of Aircraft (AIAA) Journal of Spacecraft and Rockets (AIAA) Journal of Propulsion and Power (AIAA)	Aerospace (RAeS, UK)
General-Interest Magazines		High Technology Scientific American	New Scientist (UK) The Economist (UK)
Indexes		Engineering Index	
Abstracts		Aerospace Abstracts	
Computer Search		DIALOG	

Figure 1  
 SELECTED PERIODICALS



WORK DIABOLO  
Figure 2

3. From time to time, a senior engineer is asked to give a paper at a conference held by a learned society. Each paper is based on many reports from a variety of sources. Those attending the conference may buy preprints and, at the end of the year, all lectures given (a few are cancelled or withdrawn for security reasons) appear in the transactions or proceedings of the societies.
4. Editors of the society-members' journals select the more topical papers and from them derive short articles of three to five pages. These articles on the most interesting and innovative developments are well-illustrated, often more simply than the original artwork for the lectures. In parallel, editors of trade magazines and house journals similarly base articles on the most significant aspects of the lecture papers. Also, the trade press has writers visit companies and attend conferences to obtain information on the most newsworthy material. And companies have information-research departments to make press releases of news and background material on fresh items. (See Figure 3.)

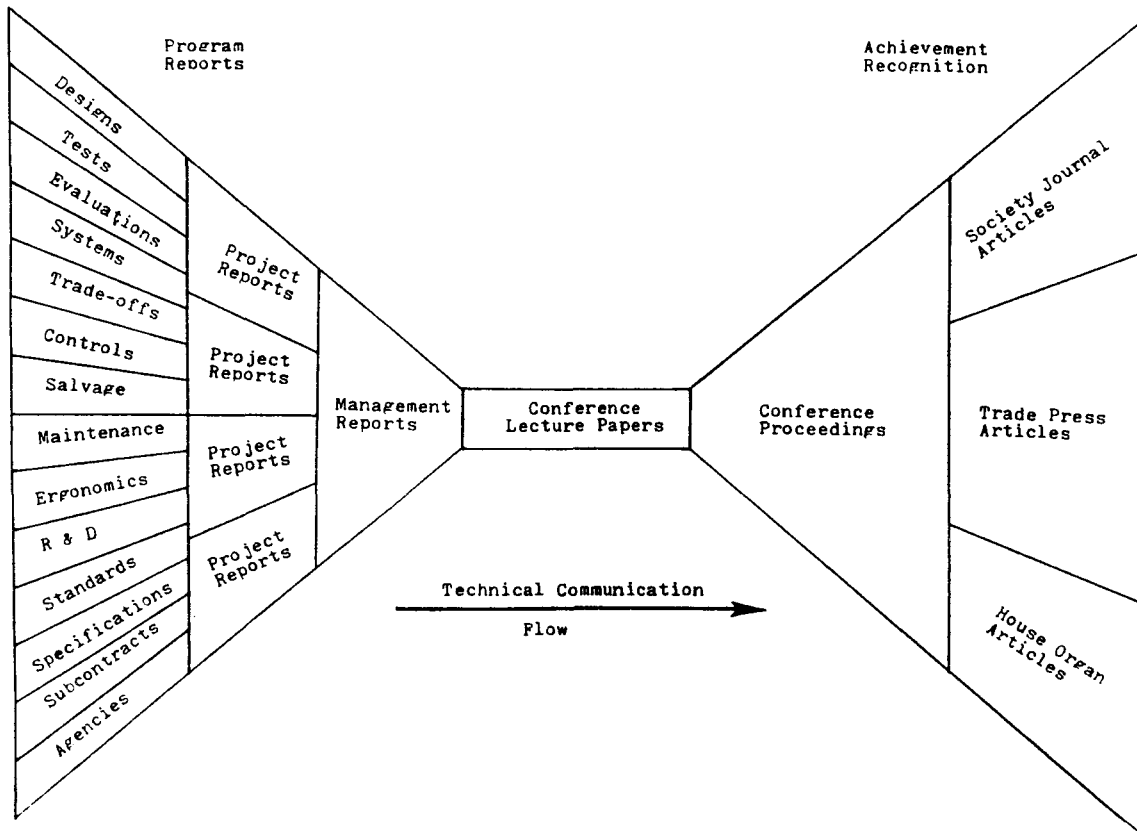
So it is that, fortuitously, periodicals are both the most suitable and the most easily accessible sources of students' reference material for technical reports. The only trick is to know which are the best ones. Students should be urged to become members of the appropriate Learned societies so that they not only keep up with events, but receive the members' journals each month. They should also be encouraged to subscribe to one good monthly trade magazine and to look through other publications in the institute library or public reference library.

In the case of aerospace students, I advise them to join the local branch of the Canadian Aeronautics and Space Institute or the Society of Automotive Engineers; to buy AIR International; and to use a library to see the journals of other societies and look at Aviation Week, Flight International, High Technology, Canadian Aviation, Scientific American and so on.

#### Producing the report

As those of you who have read my book, Modern Technical Communication, know, I emphasize how important it is to have adequate illustrations in technical reports. Every picture may not be worth a thousand words, but it is a good rule to have at least one good illustration to accompany each thousand words--whether it be a report or an article. It is very important to get students to see that graphics are essential to reports for easiest understanding by readers.

Students may do their own simple line diagrams or, if the illustrations are complex, may use photocopies--provided that they write their own captions and cite the sources.



DIALECTIC DIABOLO  
Figure 3



Another important aspect is guiding students to choose subjects that are practical in terms of the scope of the reports. Often, a student will choose a complex, highly technical subject that would take a large team of engineers several months of fulltime work to complete. Instead of discouraging the student, I find that it is usually easy to get him or her to take only a portion of the topic.

For example, one student wanted to do a report on the design of the Concorde supersonic transport airplane. When questioning revealed a very sketchy appreciation of the sheer size of such a project, he agreed to concentrate either on the wing aerodynamics or the engine installation.

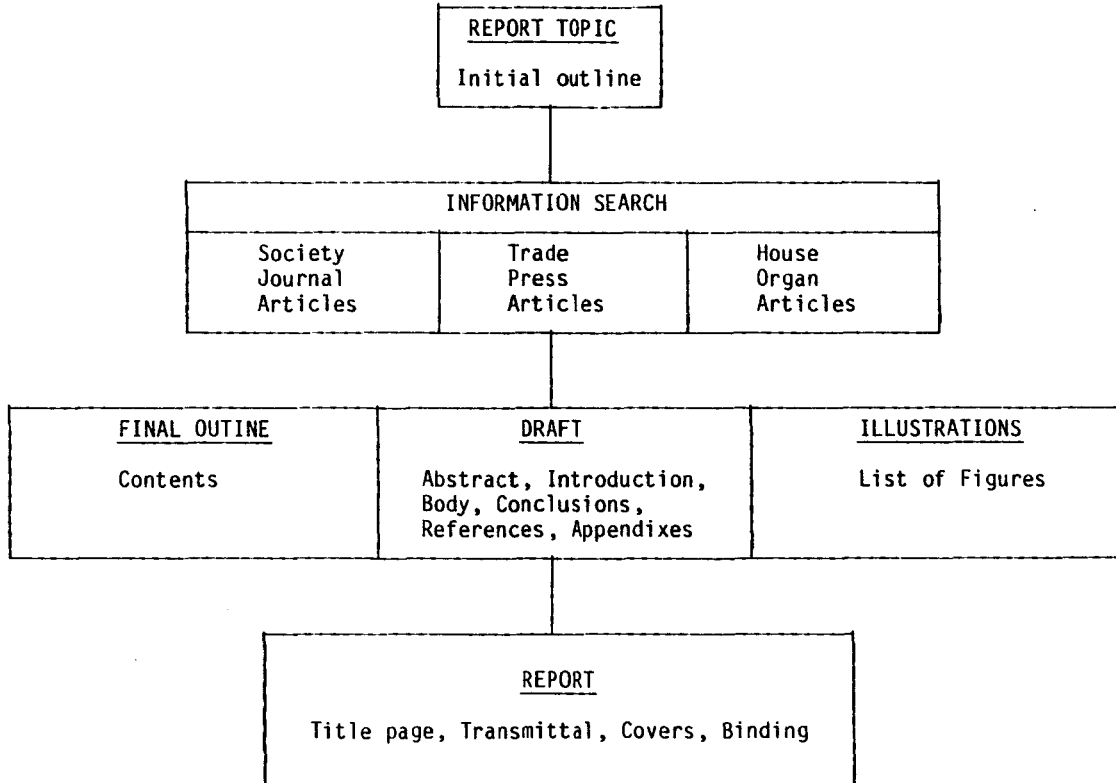
On the other hand, some students have an excellent grasp of a topic and have had it in mind for some time. One student proposed to do a report on air navigation aids in the Northwest Territories. It turned out that she was from that area and also had a commercial pilot's licence with several thousand hours' flying. The report was an 'A+'! (See Figure 4.)

#### The broad view

Being deeply involved in the students' chosen field has both benefits and pitfalls, as I have indicated, but all can be turned to advantage quite easily if a broad view of aerospace is taken.

First, to encourage those students who are not yet very sure of their program, I point out that the subject of aerospace is really part of the overall subject of transportation. Also, although their main interest may be the exciting new aerodynamic shapes moving through the sky--or, at least, through the pages of magazines--they should be well aware of the engines which propel aircraft and of the materials of which both engines and airframes are built. This introduces subject areas for students to think about, which gives the instructor very useful flexibility.

As an example, the instructor can develop a report outline with a numbering system for manufacturing a metal part of an aircraft engine--perhaps a turbine blade. This item covers industrial, metallurgical, aerospace and mechanical technology all at the same time. And it permits the instructor to talk about the importance of materials and their applications in everyday life--like carbonfibre tennis racquets or titanium masts for sailing boats or composite materials for violins. Similarly, outlines could be developed for reports on muscle-powered airplanes, streamlined cars, engine turbochargers, anti-skid brakes, inertial navigation systems, air cargo terminals, rapid-transit systems, crop spraying, and so on.



STUDENT REPORT FLOWCHART  
Figure 4

But it would be just as effective and appropriate to outline the focal-plane shutter of a camera, the overhead-cam valvegear of a motorcycle engine, the keel of a yacht, the transmission of a combine harvester or the heat-storage system of a solar-powered house. All are technical subjects to which adequate references can be found.

The important thing is that the student should be really interested in the report topic. Not only will this make the report more satisfying, but it will be simpler to research because some information will already be in the student's mind from previous reading.

### Entente Cordiale

Last year, a special aspect of teaching technical communication to aerospace engineering students came up. The École d'aérotechnique of the Collège Edouard-Montpetit at St. Hubert, near Montreal, consulted us at Ryerson.

They have a mandate to teach technical writing in English to French-speaking aerospace students because English is the 'lingua franca' of aerospace engineering. Indeed, English is the world language of all engineering, not just aerospace--just as French is the accepted international language of diplomacy and cuisine.

This was not always so for English, but since World War II this language has become dominant, not so much that English-speaking salesmen dominate world markets, but that if Japanese, Swiss, Swedish, Brazilian, Netherlandish, Russian, Chinese, Indian, Pakistani, Israeli and Arabic engineers meet at the Paris Air Show they all understand technical English. Not only is it widely understood, but it has very precise meaning. And if these same people have to write lecture papers, articles, sales brochures or instruction manuals, then English is the language which is most useful internationally.

The ironic thing is that some very basic aircraft terms are French words because much of the pioneering in the early days of aviation was done in France. That is why we use such words as aileron, empennage, longeron, monocoque and canard for parts of airplanes. And we use such everyday words as debut, surveillance, reconnaissance, rendezvous, reconnoitre, manoeuvre, chassis, rapport, detente, technique, denouement, brochure and rapprochement.

For technical examples there are plenty within the first letter of the alphabet--absorption, accident, action, admissible, adsorption, aerodrome, agent, aide, air, altitude, ampere, amplification, aspect, assemblage, asymptote, attention, attitude, attraction, and axial. I'll take the rest of the alphabet as read!

It is best to avoid "franglais" because this is open to interpretation. It can mean both the use of English words in a French context and the use of an English word modified to have a French-sounding ending, often changing a noun into an alleged verb. The reverse is true in English.

The reason for use of English technical words in a French context is simply that the words invariably are shorter than the equivalent French terms, and that most of the developments in aerospace during and since World War II took place in English-speaking areas. France was neutralized early in the War in terms of aeronautical development. After the War, most of the Germans who had led in many aeronautical areas went to the United States, as did many from the United Kingdom. Also, since they had no free countries to return to, many Poles, Czechs, Hungarians, East Germans and others moved to the US.

I hope you will agree that it is equally bad to say "C'nez mon windshield, eh?" or "Nous partirons pour le weekend avec le tente pour le camping". Similarly, to say that a new airplane has "debuted" or that friends have "rendezvoused" may be understandable, but shouldn't be written.

Finally, in consideration of similarities and differences between English and French, there are--happily--many words that differ slightly in spelling or pronunciation, but are immediately understood--as in Concorde, with or without the 'e'.

It should be noted in passing that there are many words in English that have different meanings in different contexts, and that there are many examples of completely different words being used to mean the same thing. Excluding local dialects, the main difference here is between American and British English. (George Bernard Shaw once said that the United States and Britain were "two nations divided by the same language".) There are a few aerospace terms in this category, but the meaning is usually clear, with the result that English-speaking engineers on both sides of the Atlantic soon learn the quirks of the other's vocabulary. However, the French-speaking aerospace student may take longer to learn that, for example, "slat" in the UK means "vane" in the US. (Likewise, "carcase" is spelled "carcass" in the US; "air intake" is "air inlet" in the US; "undercarriage" becomes "landing gear" in the US; "tailplane" becomes "horizontal stabilizer" and "fin" is "vertical stabilizer" in the US; "graph" is "curve" in the US, no matter how angular the plot; "setsquare" is "triangle" in the US just as "trammel" becomes "beam compass", and so on, and so on.)

## Epilogue

As you now realize, I have used the specific aerospace case as a model for teaching technical communication to all engineering students, with emphasis on report writing.

It is not the mission of teachers of technical writing to give basic instruction in composition, but to hone students' skills in descriptive and analytical writing. If we impart to them the realization that writing is--with mathematics and physics--a basic tool of engineering, then we do well.

We have, I hope, moved through Keats' "Mansion of Many Apartments", and lightened the dark corridors of students' apprehensions until the "Chamber of Life" has been entered.

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