DOCUMENT RESUME

ED 063 813 FL 003 171

AUTHOR Strevens, Peter; And Others
TITLE Science and Technology in a Second Language: Papers from a Seminar Held at the University of Birmingham from 27th to 29th March, 1971.
INSTITUTION Centre for Information on Language Teaching, London (England).
PUB DATE Dec 71
NOTE 82p.; CILT Reports and Papers 7

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Applied Linguistics; English; *English (Second Language); French; German; Language Laboratories; *Modern Languages; Rhetoric; Science Instruction; Science Teachers; Scientific Concepts; *Scientific Literacy; *Second Language Learning; *Teaching Methods, Technology

ABSTRACT

Papers presented at the University of Birmingham, England, focus on teaching of a second language for the explicit purpose of facilitating the study of scientific materials written in English, French, and German. Articles include: (1) "Alternatives to Daffodils," (2) "English in the Teaching of Science and Technology throughout the World," (3) "Teaching English to Scientists of Other Languages; Sense or Sensibility?," (4) "The Teaching of Rhetoric to Students of Science and Technology," (5) "Connection in Science Material," (6) "English for Scientists at the University of Zambia," (7) "French for Science Students: Objectives and Teaching Strategies," and (8) "A Language Laboratory Course to Teach German to Chemists." Appendixes contain information on current research and a list of participants. (RL)

CILT Reports and Papers 7

Science and technology in a second language

Papers from a seminar held at the University of Birmingham from 27th to 29th March, 1971

December, 1971
Centre for Information on Language Teaching and Research
for
British Association for Applied Linguistics

Published by the
Centre for Information on Language Teaching and Research
State House
63 High Holborn
London WC1R 4TN

Printed by Hanbury, Tomsett & Co. Ltd.,
Warner House, Warner Street, London EC1R 5ES.

ISBN 9500528 8 4

Price 65p., post free in the United Kingdom.

Foreword

The papers collected here are revised versions of those presented at a seminar arranged by the British Association for Applied Linguistics at the University of Birmingham from 27 to 29 March 1971. The thanks of the 44 participants are due particularly to Miss Vera Adamson of the University for the planning of the programme and the successful organisation of the meeting.

The general subject of the meeting was *Science and technology through the medium of a second language*. It is a topic which can be looked at in two different ways. Whereas the science teacher may be concerned with the constraints imposed on his subject by the use of a foreign language which is imperfectly known, the language teacher is interested in the problem of teaching a language expressly for its use in learning science. The seminar was principally concerned with the latter aspect.

Teaching foreign languages for science and technology is a major activity among what is often loosely called 'languages for special purposes'. In a sense, of course, anyone who learns a foreign language is likely to use it for special purposes afterwards (whether it be for the study of science or literature). But these purposes are sometimes not sufficiently clear to teacher or learner when the language is being taught. If they were clearer, teaching and learning might be more efficient and economical.

It is no accident that most of these papers refer to English. English is the language used in many developing countries for higher education and training; a major proportion of the world's writing in science and technology is in English; English has been the subject of more research in applied linguistics than any other language. But much of what is said here about English may apply, *mutatis mutandis,* to other languages when taught for use as media for science — particularly as to the criteria of choice of course content. Similarly the two papers on French and German teaching may be of considerable interest to teachers of English as a second language. In this context, different languages may have in science a common cultural basis which is internationally rather than nationally oriented.

The Centre for Information on Language Teaching and Research welcomes this opportunity to publish these papers on behalf of BAAL. They represent an increasing interest in the analysis and description of languages as used in defined areas of communication as well as in the techniques of teaching languages for vocational purposes.

G. E. Perren,
Director,
Centre for Information on
Language Teaching and Research

October 1971

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Alternatives to daffodils

or — Scientist thou never wert

PETER STREVENS

Among the many millions of people who have learned English as a second or foreign language, an ever-increasing proportion wish or need to use it in connection with science or technology. Yet they complain that having 'learned English', in the sense of having been through one of the standard routines for organised instruction in English at school or college, is largely inadequate for their needs.

The complaint is heard at all educational levels, from the research physicist to the trainee pipe-fitter, and it takes two main forms: either most of the English they were taught was irrelevant to scientific or technical work, or, more serious still, through electing to study or train in science or technology rather than in the arts, in very many cases they were thereby relegated to shorter or less thorough instruction in English, or even to no English at all.

Two questions arise: (1) how has this situation come about; and (2) are alternative arrangements possible that would enable the science and technology student to learn English appropriate for his work?

The present situation comes about because the teaching of English is organised on the assumption that English in school or college is an arts subject with general educational and cultural value, and that the most able learners will go on to study English literature at university level. The teachers of English are trained in literature; the syllabuses and examinations generally lead up to a literary or pre-literary training; the teaching is informed by the values and symbols of literature.

It is true that there are now available, particularly for adults, courses that set out to teach English for practical purposes of communication, and they certainly meet part of the need. But even where such courses exist they are almost always reductions from the orthodox humanities courses, rather than newly-planned syllabuses for new categories of learners.

The facts are not available that would permit an accurate description of the types of course commonly offered and the numbers of learners engaged

in each type. One would hazard a guess that the vast majority of the world's several million learners of English are enrolled for organised instruction in one of only three major types of course, and that the proportions are roughly as shown :

(i)	school courses, of a general and cultural value, for children and adolescents	80–85%
(ii)	courses of an equivalent type, for adults	10%
(iii)	special courses for adults, devised to meet particular special aims	5–10%

If this analysis is even remotely true, then we can say that in the typical case English is learned at school, as part of general and cultural education; the syllabus leads towards a humanities (and especially literary) orientation; the teachers are trained, at however low a level, in the traditions of the humanities and literature. Even where the twin procedures of the translation of semi-literary texts and the study and memorisation of grammar have been superseded by more modern teaching methods, much time is devoted to practices such as the writing of essays (which are required to conform to a sub-literary genre) and reading texts selected from a short list of accredited literary authors. Speaking and conversation are centred on the usage of the native English (or American) non-scientist.

If these 85% of the learners of English were going on to join the international community of educated non-scientists, their English would doubtless be relevant, and of course many of the 85% expect to do exactly that. But the reason for the complaint of the scientist and technologist abroad is that this 85% includes a great many of those children whose studies or occupations will turn towards science and technology. Supposing the eventual proportions to be roughly one-third into science or technology (and we should remember that 'technology' includes vocational training for trades such as welding, plumbing, electrical fitting, engineering, mining, forestry, horticulture, and a host of other occupations) and two-thirds non-science; and supposing the total number of the world's learners of English to be of the order of 6 million; then it seems likely that at the present time some two million school children who will go into science or technology are receiving instruction in English that will be of little use to them. To these must be added the unknown number who, because they did not choose an arts-oriented set of subjects, do not receive any significant instruction in English.

It will certainly be argued by some people that the pupil learning English at school who eventually turns to science or technology is not so badly served, in fact, because he can transfer his arts-based knowledge of English to the new subjects. There are two counter-arguments that seem to me to have weight. The first is that when subjects are not seen by the learner to be related, transfer of knowledge or skills from one to the other is minimal. It is difficult enough to ensure that a boy or girl who learns some 'everyday English' manages to transfer it into everyday life. To transfer school-subject English into the science class is an even more difficult task.

The second counter-argument concerns the attitudes which the science-inclined boy or girl encounters in the English class. It is unfortunately the case that many teachers of English, especially if they have received considerable training as English literature specialists, become openly anti-scientific. It is by no means rare for the English teacher in overseas secondary schools, as also in Britain, to contrast the 'cold, analytical, impersonal, soul-destroying' outlook of the scientist, with the 'warm, subjective, sympathetic, life-giving' attitudes of the literary man. Literature is held to be the only morally and aesthetically worth-while subject. Scientists are stated to be philistines, or at the very least 'uncivilised', and any activity that smacks of measurement or quantification is low-valued. Given attitudes of this sort on the part of the English teacher, even if they are rarely voiced, it is not surprising that those pupils who retain their orientation towards science can make little use of the product of their English classes. (And this kind of arrogance also entails a lot of un-teaching by the science teacher.)

Thus far we have been considering ways in which the teaching of English is unsatisfactory for those who go into science or technology, and some of the reasons for the present situation. Are alternative arrangements possible?

Provided one is clear about the aims of alternative courses, I believe they are both possible and desirable. But what are the aims? It is not very helpful to suggest that the aims are to create a bi-lingual science man, on a par with the bi-lingual arts man, because 'bi-lingual' is altogether too exaggerated a label for what happens at present. It is nearer the mark to say that one would aim to teach 'general, everyday English' together with English in the registers of science and technology. But this formulation is solely linguistic (i.e. oriented towards language), and it pre-supposes that teachers know what 'everyday English' and the English of scientific registers actually are. At present these concepts exist at a level remote from the primary and secondary school classroom, let alone the trade school or the technical college.

An alternative formulation would be to lean towards the use that will be made of the English once it has been acquired. The learner whose needs we are discussing learns English in order to do his work as a zoologist, or a capstan lathe operator, or a welder, or a ship's engineer, in English; to read such texts in his subject as are relevant (ranging from a minimum of public instructions like DANGER : EXPLOSIVES, or WEAR HARD HAT, to instruction manuals for new equipment, or textbooks on tropical diseases); to communicate in spoken English as necessary for his work; and to write in English such texts (perhaps just a chalk cross on a blackboard work-schedule, or a list of faults on an engine, or a summary of procedures to be followed by a team of lab. technicians, etc.) as may be required.

The task might be characterised as 'learning English as used in the universe of discourse of science or technology', in contrast to the present system, which teaches 'English as used in the universe of discourse of the educated non-

scientist and literary specialist'. Exploring this notion, we might consider some of the similarities and differences between English in these two universes of discourse.

Both share the whole of English *syntax*. The scientist and the non-scientist construct their sentences according to the same rules. If there is a difference at all, it lies in the existence of a range of rare and specialised sentence-types in literature ('Bird thou never wert' is an extreme example) which are not used in scientific discourse. In parallel with this difference one can observe a particularly high rate of using passive forms ('shims are inserted after the bearing shells have been dismantled') in technical English. These examples are intended to indicate kinds of statistical differences that occur, not to give a complete inventory of them. The important fact is that the rules for sentence construction are the rules for the language as a whole and do not vary as between scientific and non-scientific discourse.

Both share the whole of English *phonology*. But once again the science learner has a slight advantage of learning load, since unlike his literary counterpart he can ignore the complex phonological rules for rhyme and metre. There are scientists who have written verse, it is true, but on the whole poetry does not figure in scientific education and its special conventions can be ignored.

They share part of English *lexis*. However, in this area there are very large differences. It is not simply that there exist many technical terms, but rather that science and technology have a large number of concepts, some general to science as a whole and some specialised to particular parts of science, and these concepts entail words, expressions and usages that are crucially different from the discourse of the non-science man. The implication is that English must be taught with these words, expressions and concepts integrated within the teaching course.

The two universes of discourse have very little similarity of *context;* naturally, since the circumstances of use of language are essentially different. From the standpoint of teaching this suggests situations quite unlike those of the conventional course. Science is much concerned with observation, detailed factual description, quantification, analysis, explanation. (It is not true, as many arts-trained teachers suppose, that no use of the imagination is involved in learning science, but the use of imagination in science is of a different order.)

Finally in this brief résumé of similarities and differences, the two do not share the same *symbols*, sets of values, legends and traditions. Here, again, a course for scientists would use completely different texts and samples.

How might one construct an English course, e.g. for beginners, in which science was taught through English and English through science? There are very many possible answers. At the lowest level one has to ask whether one would replace 'This is Mr. Jones. He's a teacher' by 'This is Mr. Jones. He's a chemist'; or 'This is a book' by 'This is a pipe-wrench'. At first glance this looks like a ludicrous and trivial change. But if one is replacing non-

science contexts by science contexts, it may be advisable to start to do so from the very outset. The syntax being taught will be identical *(This is . . .* and *This is a . . .)* but the lexis will be differentiated and so will the situation.

It is in the exercises and drills, and especially in the activities that the intermediate and advanced learner requires, that some of the biggest changes will have to be made. A science-English course will entail the early teaching of measures, the use of calculations within practice material, the replication of experiments just for the sake of talking about them in English. The intermediate and advanced non-science student, after all, is required to carry out exercises and tasks that are activities of the arts man. When he reads poetry or novels, when he writes connected prose with conscious striving for style and effect, he is practising the language of his universe of discourse. The science or technology man has other activities, but they, too, entail the use of language, within a different universe of discourse.

As a science-English course becomes more advanced it will increasingly need to branch into different specialisations. These will relate to different sets of activities. At one end of the scale, exercises will refer and relate to cutting screw threads or milling different metals; elsewhere they will entail the use of the slide-rule, or the balance, or titration instruments, or electrical meters.

The teacher of English who embarks on a study of the needs of science students will find that science, like the humanities, has its popular and its classical literature, which can be exploited for teaching English. There are large numbers of popular science texts, as well as heavier works by heroes of the scientific community. And science, too, has its legends, its myths, its symbols, its moral and aesthetic attitudes. (The saddest feature of the anti-scientific arrogance referred to earlier is not that it exists, but that it is founded on ignorance of what science is, and how scientists actually think and feel.) There are many opportunities for using the accounts of early scientists — Galvani, Priestley, Lister — as practice material in English; while the descriptions of the events and the theorising surrounding such advances as the vacuum tube, penicillin, the transistor, the unravelling of the molecular structure of genes, and many others, provide material for expounding not only the facts but also the attitudes, the ethics and the morals of science.

It is not possible in a short paper to do more than sketch some of the implications of teaching English through science and science through English. And of course it is already being done, though still on a rather small scale, in a few places. But I hope I have indicated a belief that the science and technology student is not at present adequately catered for; that current English teaching practice is non-scientific and sometimes even anti-scientific; that an approach to teaching English for and through the universe of discourse of science and technology is entirely possible; and that such an approach might have certain particular characteristics. Perhaps 'Fair daffodils, we weep to see you haste away so soon', or 'The Loss of "The Royal George" ' will give way in some overseas classes to language work more relevant to the science student's eventual needs.

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English in the teaching of science and technology throughout the world

B. LOTT

It was said in the 1968/69 report of the British Council: 'English is the language most used for communicating facts, and so a main factor in scientific, technological and economic progress and the principal language of economic aid. Half of the world's scientific literature is written in it. It is the language of most computers; of nuclear laboratories in Brazil; of the Swedish ball-bearing firm SKF for its operations even within Sweden. It is the principal means of spreading ideas and values, the main language of salesmanship for Japan and Germany, and the prime language of debate in the United Nations.'

I propose to look in some detail at the world-wide situation adumbrated in statements such as this. First I would like to put forward a possible patterning of countries according to their use or non-use of English for these and similar special purposes. Second I want to say something about the suitability or non-suitability of English for the international communication of facts.

There can be disparity between (say) the claim of a certain country that English is the medium of instruction at all post-school levels and the realisation of that claim in the work one actually sees going on in the classroom or lecture hall.

A colleague of mine once had to stand in for a local teacher at an English class of young adults, and all he got by way of direction was that the class was working through some 'scientific texts' in English. He patiently expounded one of the given texts and then asked for questions. A student put up his hand and asked 'Please sir, what mean *hammer*?' There are countless students (so-called) today who are going through the processes of learning subjects through the medium of English who have only the dimmest notion of what they are supposed to be learning.

Bad learning, imprecision, lack of respect for a sharp outline, a clear idea outside the confines of rote repetition, are diseases endemic to education overseas, and need to be recognised and reformed. Ultimately success in this

must depend on the dissatisfaction of the student; only *he* can usefully tumble to the fact that he hasn't fully understood, that what the words symbolise has made no clear image in his mind. I am very deeply concerned at how badly science and technology must be taught through English as a second language because I know how people get by when they use a language not their own, and the imprecisions and misunderstandings which result.

There could be four categories of countries using English for special purposes :

Category I. Countries where education is carried on in English from the start or from just as soon as the school children have enough English for the purpose. Such countries use English for higher education, including education in science and technology. (There seems to be no instance of a state system which begins education in English as a second language and reverts later to a vernacular.) I subsume under this head not only many countries in Sub-Saharan Africa (e.g. Ghana, Zambia) but also countries where success in post-primary education evidently depends largely on the conversion of a pidgin or creole to something more nearly acceptable as an international medium, e.g. the Anglophone West Indies, Guyana and West Cameroon.

Category II is the converse of I, since countries in it evidence a movement away from, not towards, English for the communication of special subject-matter, especially for teaching within the educational system. For mainly non-linguistic reasons, these countries have abandoned English almost entirely in the lower reaches of the educational system, but wish to retain it as appropriate to the pursuits of higher study and more advanced technology. Terms such as 'study language' or 'library language' have been coined for this function; West Malaysia, Sudan, India, Pakistan, would be likely candidates for inclusion here.

Category III contains countries where the linguistic position is powerfully affected by overseas aid. Here the lines of demarcation are at their muzziest. Between II and IV (IV is the class of countries where English is not used as a medium for the internal communication of information, activities and ideas) there lies a group of countries which recognise English as more than a foreign language but less than a medium of instruction; perhaps the second language is essentially a vehicle for advancement in terms of economic development. I have in mind Turkey and Thailand as likely for inclusion in this category.

For internal purposes, Category IV countries normally do not need English for science or technology, but recognise it as *the* international language for these and other purposes. And they take steps accordingly, e.g. by assuming reading skills in English on the part of executives, and oral/aural skills on the part of those whose work affords international contacts in many subject areas, but especially science and technology because of the supremacy in these disciplines of the English-speaking nations.

Category I seems to be defined at its sharpest in countries where the use of English in higher institutions in the educational system goes unquestioned and unchallenged as in Ghana, for example. The integrated primary school syllabus gives, if well used, insights into number and elementary scientific concepts *through English;* and the language is learnt *pari passu* with other aspects of the syllabus, the medium going along with the message. By the end of the primary cycle the great majority of all children in Ghana will have left education, never to return. Many of them who finish then and there will have had only a glimmer of what has been happening in school for say 3, 4 or 5 years, especially if they come from rural communities. They will have been subjected to alien modes of reasoning in an alien language, and may never make an English-using contact again. The aspirations of the secondary pupils lie in the direction of exams, 'O' and 'A' level, which *assume* competence in English, and are moderated by the West African Examinations Council. The best pupils are likely to choose science (or law, or engineering, or medicine), these being the prestigious subjects that will get them to the towns. Others will go into a deutero-secondary educational system by training as primary school teachers, perhaps later for up-grading, perhaps into secondary science. By the end of university or other technical training the student will be ready to go into a profession where the use of English will be assumed as the most natural thing in the world. The calculations or miscalculations for the Volta Dam, the international aid given for its construction, the consumption of its superflux of electricity, are all things which have been and are being handled in English. And our concentration here on science and technology helps us to emphasise that we are not talking about English as a means of cultural contact with Britain or the USA. One of Ghana's chief engineers, A. K. Armah, is also her best-known novelist — and he writes of course in English, whether it is about love and war or nuts and bolts.

Categories II and III present the most intractable problems and are open to the gravest dangers. Here there is not just wastage but the grave danger of communication insufficient to further the precise exchange of information. Of course there are scientists, engineers and technologists to whom the language difficulty is nothing at all. Of course there are lecturers who do well and instil disciplines of study and planning and reporting into their students, so that these students are equipped to play their part in a worthy profession. But there are others who wage a depressing struggle with books they do not understand and lectures in a language they cannot follow with any satisfactory degree of precision. It often works out in these countries that books are prescribed but never bought, and passing or failing examinations depends on the ingestion and later regurgitation of the lecturers' duplicated notes, sometimes in English, sometimes in the vernacular. In India Hindi can replace English for many instructional purposes, not because it is especially suited to the task but because there are a sufficient number of students in the Hindi heartland and elsewhere to make a demand for materials in Hindi which is worth the attention of writers and publishers. Yet there is no journal dealing with any technological subject in Hindi, even though tens of thousands of students are studying these subjects in that medium. Skills in English, then,

are primarily for such trained people to further their professional activities, hence the 'library language', the 'window on the world' metaphor of Jawaharlal Nehru, and the provision for the continuing use of English in the Constitution of India.

Category III, the aid-dominated countries, I can exemplify best by Turkey. I would include Thailand and Taiwan in the group, though with not too much conviction. Such countries have been pushed by the stresses of aid and development into the world of modern technology. Traditionally their own indigenous languages were sufficient for their needs, even for training at comparatively high levels. But overseas aid for economic development is not in the nature of things made available in Turkish or Thai or Mandarin. (The Germans, the Swedes, the Swiss, of course, give their aid in English.) In this way English has become vitally important in these countries; school classes in English are preferred to those for other languages. In these countries the language needs did not therefore develop or evolve by slow changes; English became a necessity, and so did the study of western subjects to a high level in the school and post-school systems. The non-traditional subjects, especially science, could not easily be studied in the vernaculars because there were neither materials nor language resources for the purpose. But, much more important, a person's success in these fields is linked inextricably with foreign aid, and this is administered through English. The various governments concerned have taken to heart the messages of a technocratic world, and the later school years and post-school education have been made to toe the line. There are few books in the indigenous languages, certainly not enough to sustain school or college courses in these 'modern', practical subjects, and materials in English are therefore used. So Turkey teaches through English in the Technical University; Thailand uses much English in the school system. But, once again, it is not always clear what the medium is supposed to be — I referred earlier to this muzziness round the edges of the demarcation. If, as I fear so often obtains, the motions are in English but the learning is in Thai, Turkish, etc. the whole state is a sorry one : the learning difficulties in coping with a complicated subject are made two-fold by the need to handle a foreign language as well. Occasionally in these countries people who should know are sometimes not really sure what the language medium for study actually is, or is supposed to be. The up-and-coming native of the host country quickly latches on to the idea that profit lies in taking up the causes of the donor countries; and the profit motive can be relied upon to throw up excellent methods of second language learning. So English for science, technology, almost any 'special', practical purpose, is the door-opener to personal advancement; and so Category III countries are born. There are incidental advantages too; not by chance is the Technical University in Ankara *for the Middle East as a whole,* and the Institute of Technology in Bangkok for *all Asia,* at least in name.

As with Category I, Category IV offers comparatively few problems of characterisation. There is in these countries, typically west European, Latin American, Francophone Africa, and that well-known English language developing country, Japan, seldom any question of using English for the internal

communication of science, technology, etc. Books, materials, trained teachers for these subjects are available and have developed the vernaculars for the purposes they are called upon to serve. Of course this does not mean that vocabulary items from English (probably ultimately Latin and Greek) do not abound in such communication; they and their definition are the stuff of technological advancement, just as international sport is dominated by English, but national salesmanship, say, or military practice are not. When the science and technology of Category IV countries begin to turn outward, the course of events is different. People trained in these fields in Sweden or Italy or Japan know well that specialist communication with the world at large will in all probability be carried on in English. And here the commercial aspects dominate; Philips in Eindhoven have a whole translation service for work in English, BSF in Sweden have abandoned Swedish even for internal communication. And language instruction in schools and colleges is at least beginning to be geared to this sort of situation. I can't always say it is done well or in the quickest or most efficient way: there is the phenomenon of Category IV countries being *more,* not less, devoted to English philology (as in Germany) and English literature (Japan) than Category II and III ones. Does the academicism of much foreign language teaching in Category IV conditions lead to some competence in the passive skills (reading and auding) while falling short in the active ones (speaking and writing)? I noticed on a recent TV documentary that Concorde engineers when they met in Bristol and Toulouse talked in their own language (often racily and dialectally) but understood what was said in the other language, especially with the help of visuals (drawings, specifications, etc). It all seems a bit chancy and precarious, but at least they've got Concorde off the ground, at a price.

Another point of reference in any discussion of the place of English world-wide in the teaching of science and technology is the appropriateness or suitability of the language to hold the place it does. No one can believe, after seeing the confused patterning of such use in the world today, that English was a deliberate choice on the grounds that it was somehow better suited, better developed or more amenable to development for this purpose than another language. If it *is* any of these things, that is the luck of the draw; nevertheless, having reached its dominant position for these purposes, it will with use go on being better and better suited to the part it has to play as a teaching and general communication medium.

In some ways English seems exceptionally well fitted for the job, but in other ways not so. On the credit side I place first its amenability to assimilate and otherwise accommodate alien linguistic material. Hogben has shown that the language of Western science represents the most useful international auxiliary yet available to us. Its only likely competitor is the language of Western sport. Lying behind these resources in Western science is a Graeco-Latin vocabulary which began to be consciously exploited for new terms in Italian, English, etc soon after the fragmentation of the Latin-speaking

intellectual world at the time of the Reformation. As early as the 16th century, at the time of Galileo, Italians were beginning to write their science under the influence of a reforming group, the Lincei, and one senses that the task was not too daunting; the terms looked much the same in classical or low Latin, or the debased Latin which was what they thought their own language to be. As for English, when its time came, and Thomas Spratt guided the Royal Society into the adoption of English for their deliberations, Romance roots were comparatively dense in English writing, possibly more dense than at any time before or since. The watershed came to all appearances in the decade after 1687 — Newton published his *Principia* in that year, in Latin; his *Opticks* (1697) he wrote in English. In the following century there occurred a vast increase in Greek borrowings into English. This was especially necessary to meet the demands of taxonomy in scientific description, and such demands continue today as new techniques are discovered. Therefore, although English is by nature not quite so well equipped as Romance languages or modern Greek to assimilate words close to Latin and ancient Greek, it is because of its overtly hybrid nature more able to assimilate them than say German or Russian are and to assimilate them in such a way that their linguistic categories remain usefully revealed. Witness such useful and acceptable neologisms as *allergy* (which has an ending that English speakers will associate with abstract nouns such as *philosophy, irony, remedy, colloquy*); and *syndrome* which they can quickly associate in some way with *symphony, sympathy, syncopate* etc. Borrowings such as these, therefore, are not alien to the language; even *sclerosis* we can at a pinch just about manage, though the consonant cluster (*scl*) is distinctly unexpected.

All this has had remarkable advantages in history. To teach, or at least teach well, is to popularise. Humphrey Davy and his pupil Faraday were able to explain their inventions not just to their intellectual peers but to their inferiors as well, because they could use ordinary English for the purpose; hence the eager meetings of artisans who gathered to hear from Faraday's mouth something of the marvels of electricity and magnetism.

I doubt whether the same would or could have been done in German if Faraday had lived and worked in Germany. Certainly Scandinavian scientists used Latin for their learned papers well into the 19th century. Earlier Linnaeus relied on it and Greek for his classifications, carrying on a tradition which he inherited from mediaeval times.

Familiar and perennially useful links of this kind can be illustrated. The Latin ending—*osa* was deliberately selected in naming a chemical compound to show a larger proportion of the element indicated by the root than the ending —*ic* would do. This arrangement gave —*euse* in French, and —*ous* in English, as in *ferrous, sulphurous.* Similarly, —*ike* in Latin, —*ique* in French, —*ic* in English for a smaller proportion than that indicated by —*ous.* Once the usage was established it could be added to by the use of roots new to the language. Terms are readily brought into English and almost as readily shifted about, as for instance *algorithms* and *entropy* in our own field, neither

of which started its new life in linguistics. US writing in particular shows how readily English can throw up compounds transparently built up by bringing items together. Chemical nomenclature depends on this; German forms, e.g. *Stickstoff, Sauerstoff,* do not strike one as being very promising in this regard.

On the debit side is simply lack of precision. Fossilised languages such as Finnish show much redundancy in their inflexional systems and therefore express very clearly clause and phrase relationships; there is much precision and little 'hidden grammar'. English, with most of its case endings and gender identification long since discarded, lacks at least this sort of precision. *The Times* isn't above sentences such as this :

> 'The BBC's Panorama team have succeeded in obtaining a tape re-recording of George Jackson, one of the three "Soledad Brothers" awaiting trial in San Francisco, accused of murdering a white guard, reading extracts from some of the much publicized prison letters (published by Cape under the title *Soledad Brothers).*'

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Teaching English to scientists of other languages

Sense or Sensibility?

M. MACMILLAN

In the past twenty-five years there have been four main influences on the selection of material considered appropriate for the teaching of English to scientists and technologists. These influences have been (a) literature, (b) logic, (c) liberal studies, and (d) linguistics. The influence of literature, logic and liberal studies dominated a period when it was still believed that what was considered appropriate for native speakers of English was also appropriate for teaching English to speakers of other languages. The influence of linguistics contributed to the subsequent enlightenment which led to our current preoccupation with the specific problem of teaching English as a second or foreign language, and for special purposes.

In the late forties and early fifties our involvement in education overseas was directed mainly at the developing Commonwealth countries. The rapid expansion of education systems which followed the attainment of independent status was still in the future and the facilities for higher education in general, and for education in science and technology in particular, were limited. The language problems were neither on the scale on which they are today, nor indeed were they seen as the same problems which we now recognise. Those who were admitted to higher education were an intellectual élite and it was seldom suggested that their command of English was not adequate for higher studies. When, therefore, it was felt that there might be a need for English courses for scientists overseas it was for the same reasons as were being advanced to justify English for scientists in this country — the main reason being the need to remedy the narrowness of outlook engendered by early specialisation and to offer as a cure a background of general culture as an enrichment element in the curriculum at sixth form and university level. 'For every pupil who needs to be guarded from a weak excess of sensibility', warned C. S. Lewis, 'there are three who need to be awakened from the slumbers of cold vulgarity. The task of the modern educator is not to cut down jungles but to irrigate forests. By starving the sensibility of our pupils we only make them easier prey

to the propagandist when he comes.'[1]

It is not surprising that the enrichment of the education of scientists overseas was first sought through literature. English staff in the institutes of higher education were mainly literature specialists; their departments, modelled on English departments in British universities, offered traditional literature courses; and they were sympathetic, and therefore susceptible, to the influence of *The apple and the spectroscope*. T. R. Henn's lectures on poetry to science undergraduates at Cambridge in 1947, subsequently published under this title, are perhaps the best example of the literary influence on the teaching of English to scientists.

These lectures on, for example, Donne, Marvell, Pope, Blake, Wordsworth and Eliot, were intended not primarily to impart information but to stimulate a desire to acquire it in the hope, perhaps, that some budding Bronowski might no longer remain 'mute' and 'inglorious'. Although Henn was able to stimulate interest in *The Waste Land* not only because of the wide appeal of the poem but also because of the allusive technique that lends itself to quasi-mathematical explanation, many of those who tried to follow his lead were less successful and young scientists at home and abroad were generally 'sprayed with a dilute culture'. As a symbol of scientific paraphernalia Donne's 'stiffe twin compasses' went round in circles and usually failed to get very far; and Auden's *Night Mail* as a symbol of modern technology was often unable to cross the border between Snow's two cultures.

Some years later B. C. Brookes, writing from his experience as senior lecturer in the Presentation of Technical Information at University College, London, suggested the reason for this failure: 'Literature and science are wholly separated; there is at best a coolness between them. It does not surprise me therefore to find that most of the science and engineering students I have met in recent years have shown towards literature and writing an attitude that is usually resentful, sometimes hostile, often contemptuous. They refuse to accept that literature has any relevance for them either as scientists or as human beings. It seems to me that little can be done to make the teaching of English more effective for scientists until school teachers of English and literary critics begin to take a warmer interest in the characteristics which differentiate scientific from literary writing, and to study the problems of communication which are peculiar to the scientist.'[2]

Clear thinking being a prerequisite for effective communication, English for scientists was next influenced by the discipline of logic, the autonomous science of the objective though formal conditions of valid inference. Students were fed a fare of propositions, syllogisms and allied forms of inference, scientific method, probability and fallacies. They were encouraged, with the

[1] Quoted by T. R. Henn in *The apple and the spectroscope*. Methuen, 1951, p. v.

[2] Brookes, B. C., 'The teaching of English to scientists and engineers.' In: Quirk, Randolph, and A. H. Smith, editors, *The teaching of English*. Secker & Warburg, 1959, pp. 137, 138.

help of Susan Stebbing, to think to some purpose, and, aided by Thouless, tried to straighten out their crooked thinking. Again I must emphasise that this approach, often encouraged by the nature of examination questions in the general papers of Oxbridge Open Scholarship examinations, was considered as relevant overseas as in Britain and students of science and technology in tropical Africa were taught to explain that if many men wore braces and if many men wore belts it did not follow logically that many men wore both braces and belts.

The influence of logic, like that of literature, was part of a general emphasis on the enrichment of science students, a corollary to which was the argument that arts students were just as much in need of enrichment as science students, perhaps more so since the latter often have a fair idea of the outlook of the man reading arts whereas the scientist's whole manner of thinking, and, still more, his technical vocabulary, will often be quite outside the field of the arts student. The concept, therefore, of broad, liberal, studies, derived from the need to enrich the science student, spread to encompass the arts student and resulted in such teaching material as R. A. Close's *The English we use* (1961).

This is a particularly important book for a variety of reasons. In the first place it gave the student a range of reading passages, some literary in content, some scientific, and some of broader, general, interest. The literary passages, like the science passages, were intended to contribute to the enrichment of arts and science students alike. In this respect the book was like scores of others aimed at the liberal studies market in this country. *The English we use*, however, was intended as a textbook for overseas students whose knowledge of English was at the intermediate or advanced level. It appeared at a time when there was widespread questioning of the appropriateness, for use overseas, of teaching material for the native speaker of English. It appeared at a time, moreover, when the teaching of English in this country was being severely criticised. If unsuitable for home consumption, the product was even more unsuitable for export. University examining boards were experimenting with examinations designed to encourage, in the sixth forms, the serious study of the use of English, and demanding more than the kind of competence required for passing the GCE English Language examinations at Ordinary level. In 1960 the Secondary Schools Examinations Council set up a committee under the chairmanship of Sir John Lockwood, to look into the examining, in this country, of English language. This committee subsequently reported that the training necessary to pass the GCE examinations did not contribute enough towards teaching pupils to read intelligently and write well; that one reason for the low standard of English among those who passed was that the results did not depend sufficiently upon the ability to use the language; that the committee had come very near to advising the cessation of these examinations for educational reasons; and that it would like to see the foundations laid for the study, in schools, of some of the basic principles of linguistics, with English as the language of exemplification.

The passages in *The English we use* were not selected on linguistic principles but on the basis of subject matter 'which gives expression to the life and thought of the people whose language English happens to be'. The general foreign language teaching principle to which the book subscribes is that of exposure. In order to master English, writes Close, 'what is usually needed is plenty of practice in hearing, reading, speaking and writing authentic, correct and connected English in subjects of interest to an intelligent mind'. The students' language problems are 'incidentally' exercised through 'genuine usages in a real context'. Although in the science section attention has been given 'to vocabulary and syntax useful for scientific statements' this has to be seen in relation to the general aim of the book, implicit in all the passages being taken from *The Listener;* that aim is to expose overseas students to 'the broad zone in which spoken and written English coincide', and thus train them first in the accurate understanding of English speech, and secondly in the command of vocabulary, grammar, idiom and style in composition.

It is at this point that there was the shift of emphasis from 'sensibility' to 'sense' — a move away from correcting the supposedly harmful effects of specialisation, a move instead towards reinforcing specialist studies with material appropriate to the mastery of the particular characteristics of the language of those studies. The luxury of 'enrichment' could no longer be afforded in the recently-independent developing countries striving to make themselves economically viable, mortgaging their future by investing heavily in the expansion of educational facilities, and trying to prove to themselves and to the world at large that they were capable of standing on their own feet. This is the time when English began to free itself from the embarrassment of being the language of a colonial power and present a new image as a world language. And in no field is the internationality of English better seen than in the field of science and technology.

In 1967 a survey was conducted by Ewer and Hughes-Davies in the 13 departments of the Faculty of Physical Sciences and School of Engineering at the University of Chile. One of the objects of this survey was to evaluate the extent to which English and other foreign languages were necessary to the effective functioning of the institution as a centre of teaching and research. The survey showed that significant numbers of visiting lecturers (including Russians, Japanese, Czechs, Poles, and Israelis) used English as a lingua franca; that significant numbers of fellowships and travel grants were awarded to permit study in countries where English is a medium of instruction; and that the proportion of English language textbooks in the total reading assignments of students rose from an average of 44% in the first years, to 61% in the fifth year of undergraduate study, and reached 65% in the post-graduate courses. French, German and Russian (for which courses had previously been provided by the university) were found to play a very minor role; and realisation of the magnitude of the contribution of English in professional training led to a fundamental reorganisation of the language teaching programme of that particular institution.

But to return for a moment to the newly-independent countries and their need for English as a language of international communication. There was, unfortunately, another side to the coin. Accompanying the growing emphasis on the need to use English was a marked deterioration of the English attainment of school leavers. The reasons for this are well known and we need not go into them here. The point is that increased demand for proficiency in the use of English, coinciding with lower standards of attainment, served to stress the need for the teaching of English to be directed, wherever possible, to immediate and practical ends. From now on we can regard the materials for the teaching of English to scientists and technologists as being intended less and less to develop the sensibility of students and more and more to satisfy the dictates of common sense and serve severely practical purposes.

The English we use was soon followed therefore by *The English we use for science* (1965), and other similar books of reading passages selected as being relevant to the needs of foreign students of science and technology. 'The texts themselves' writes Close, 'form the important part of this book and my role has only been to exploit them for language practice.' To this extent, therefore, the book resembles its predecessor. The standard aimed at, however, is defined more explicitly as that required for the Science Texts paper of the Cambridge Certificate of Proficiency examination. There are three main assumptions underlying the book. The first is that the student's main concern with English is to understand modern scientific writing, 'carefully prepared statements for the record', for example, textbooks and professional articles. The second is that students of highly specialised sciences, learning English as a foreign language, will have time and attention only for those features of English that are strictly relevant to their needs. The third is that there are three stages in scientific English: (a) a foundation that could serve for any purpose; (b) a super-structure that could serve for any scientific purpose; (c) a later super-structure serving some special scientific purpose.

These three assumptions, and their implications, are crucial to the development of appropriate pedagogical strategies for teaching English to scientists and technologists. They must be considered in some detail because they help to establish principles upon which the preparation of teaching material can be based, and suggest criteria by which that material can be judged.

Implicit in the first assumption is the need for an early decision on what particular communication skills a textbook is intended to develop and on the particular circumstances in which it is expected that those skills will be exercised. Different circumstances will obviously lead to different conclusions regarding the aim and purpose of the materials. As a preliminary step, for example, to the development of a first year Scientific English course at the University of Khartoum, an analysis of students' needs in that particular institution led to the following conclusions: 'Because of the large numbers of students involved in first year science courses discussion or asking questions is rarely possible on any scale. Writing is confined to the taking of notes in lectures (and even these are often dictated or written on the board by lecturers)

and to the examination, where the standard of English is a minor consideration for markers. Students do have to listen to lectures in English and to read English and American textbooks. Sometimes summaries of a lecture are handed out to students afterwards. Textbooks are particularly important as the student must have recourse to them if he does not understand his lectures. Students' needs are therefore seen to be, in order of priority :

1. Understanding of written scientific English
2. Understanding of spoken scientific English (lectures)
3. Ability to write scientific English
4. Ability to speak scientific English.'

The second assumption, that students will have time and attention only for those features of English that are strictly relevant to their needs, is the mud-bank upon which the cause of enrichment sticks. This assumption begs two important questions : (a) What do we mean by scientific English? (b) What are the relevant features of what we choose to call scientific English? All I need say here is that scientific English embraces the levels of (a) popular science, (b) textbooks, and (c) learned articles; and that there are significant differences in the lexical and structural characteristics of these levels. The decision taken at Khartoum was that texts selected from popular science and learned articles were more or less irrelevant to any first year University course in science, and rarely provided an opportunity for development through the continuity of texts. If students were to be motivated by subject matter obviously related to their major studies and showing continuity and development in scientific content, this could best be done by the selection of passages from science textbooks. This limitation of the area of scientific English restricted the range of linguistic analysis necessary to decide what lexical and structural features could be exploited through the texts.

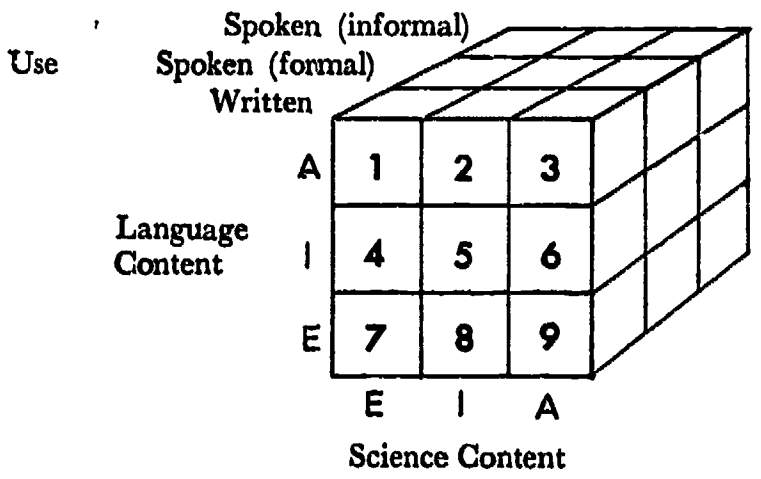
Some scientific English course books to which I shall be referring approach the problem in another way : a decision is taken first on the linguistic features of scientific English to be emphasised, and the teaching material is either selected, adapted or specially written to illustrate those characteristics — in which case a development in language content might be possible. In Khartoum we rejected this approach, however, after an error analysis had indicated that a logical order of teaching items for remedial purposes would be somewhat arbitrary. What is a logical order to the language teacher is not necessarily seen as a logical order by the student. This was a new course we were offering and we were very much aware of the need to motivate students for whom the course was an extra burden, to allay the suspicions of our science colleagues who feared that our aims would not be practical enough, and to bite off only what we felt we could chew in the 75 hours available for the course. It was for all these reasons, therefore, that we based our work on the English of science textbooks.

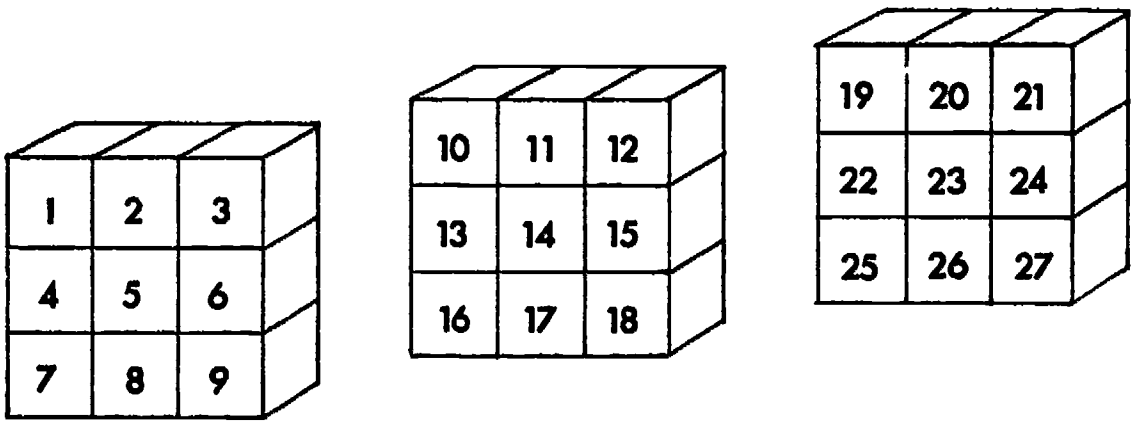
Close's third assumption was that there are three stages in scientific English. In most circumstances the foundation stage is provided by the normal school English course, which is not directed towards any special purpose; the

superstructure for general scientific purposes is usually required at sixth form or first year university level; and the later superstructure for special scientific purposes, either in the last years of a university course or in professional life after qualification. At Khartoum, for example, we could say that our concern was with students who had reached an intermediate stage both in their command of English and in their scientific education. Scientific language cannot be divorced from scientific ideas and difficulties arise therefore when command of English as the language of communication is out of phase with the scientific ideas which a person is capable of communicating. Perhaps one of the most urgent problems now facing us is the need to develop materials which are suitable for highly-qualified scientists and technologists who have little or no command of English — a situation more likely to be found, for example, in the developed countries of Europe than in the developing countries of the Commonwealth with which we have so far been principally concerned.

To sum up these comments on Close's assumptions, we can say that the relevance of material for teaching English to scientists and technologists has to be considered in three dimensions. Along one axis we can indicate the level of English language content — elementary, intermediate or advanced. Along another axis we can indicate the level of scientific content: here we can use the terms elementary, intermediate and advanced to represent a scientific content up to School Certificate standard, at sixth form and first year university standard, and, lastly, beyond that standard. And along the third axis we can indicate, for example, whether the material is directed towards a command of the written English of books and articles, the formal spoken language of the lecture, or the informal language of extempore scientific discussion. The whole concept can be illustrated (as in the diagram) by a cube, each dimension representing one of these three aspects of relevance, the whole figure consisting of blocks of scientific English.

Block 9, therefore, would represent material aimed at advanced scientists with an elementary command of English, who wanted only to be able to read scientific texts in that language. Blocks 7 and 16 would together represent material suitable for pupils beginning their study of science subjects in an English-medium school overseas. A book which tries to meet this need is H. F. Brookes and H. Ross's *English as a foreign language for science students* (1967) which 'does not assume any knowledge of English on the student's part or of science on the teacher's'. The Khartoum material to which I have referred fits into blocks 5 and 14, as does *The English we use for science* and indeed the majority of the scientific English courses currently available, including, for example, Brasnett's *English for engineers* (1968) and Hawkey's *English practice for engineers* (1970). Although 'engineers' is a slightly more precise term than 'scientists', both the language content and the engineering content are at the intermediate level. We can, in this way, indicate what need any scientific English course is trying to meet. How it tries to meet the need, and whether it succeeds or not, are other matters.





What I should like to do now is consider, briefly, a few of the scientific English courses published within the last ten years and show how the strategies that have been considered appropriate for this particular need have developed :

(a) G. A. Pittman's *Preparatory technical English* (1960) is an elementary course for foreign technicians rather than scientists or technologists. He identifies three areas of difficulty for foreign students : (i) the everyday language of the workshop and factory floor, (ii) technical terminology, and (iii) the 'elevated' language of technical literature. The emphasis in this course is on the vocabulary associated with technical terms not on the terms themselves, with prominence given to the vocabulary of description and definition, measurement, degree and proportion, development and processes. This vocabulary is presented through 'situations' and demonstrable in the classroom with the help of simple apparatus.

(b) G. C. Thornley's *Scientific English practice and easier scientific English practice* (1964) are simply collections of writing intended to provide students of science with suitable material for practice in the English language. Suitable material is scientific writing thought likely to interest students. The related language exercises are fairly traditional and unfortunately contain questionable statements such as 'Participles do the work of adjectives and go with nouns or pronouns. Verbal nouns are subjects or objects or obviously nouns of some kind'.

(c) G. Broughton's *First technical reader* (1965) is based on passages written by experts but directed at the educated layman. A wide range of material is presented 'moving the learner forward on a broad front and incidentally pointing to features of language which several technical subjects share'. The exercises which are the means of directing the students' attention to various aspects of usage are fairly conventional comprehension exercises which concentrate on scientific meaning but do little to emphasise the relevant structural characteristics of the language.

(d) Close's *The English we use for science* (1965), as we have seen, is more explicit. Students are given the chance to assimilate correct grammatical habits through imitation and practical application of constructions occurring in the texts, and to master useful grammatical and idiomatic patterns through mechanical repetition while they are concentrating on scientific meaning or on language specially relevant to their needs. The introduction to this book contains a discussion (to which I have already referred) on the special problems of English for students of science and technology, a brief account of some of the characteristics of scientific English, and useful suggestions to the teacher on how to make effective use of the book.

(e) Also published in 1965 was A. J. Herbert's *The structure of technical English*, illustrating a different approach to the problem. It is a practice book intended for foreign engineers or students of engineering who have already mastered the elements of English and who now want to use their knowledge of the language to read books on their own subjects. It is also a text-based book but the reading passages have been specially written to illustrate selected features of technical style. The emphasis is not on the comprehension of scientific writing but on the systematic practice of relevant structures. Herbert stresses that he has tried to describe the technical statement (i.e. the complete sentence) rather than the individual word. Nevertheless he recognises that for foreign students a difficulty of technical vocabulary lies in the semi-scientific or semi-technical words which have a range of meaning and are frequently used idiomatically (e.g. work, load, force), and in the rather formal words which are partly responsible for what he describes as 'the slightly fossilised appearance of the typical scientific statement'. A teaching unit in Herbert's book consists of (a) a specially written text, illustrated with diagrams, on a specific engineering topic; (b) a word study section emphasising the correct use of semi-technical vocabulary occurring in the text; (c) a section with substitution tables and exercises illustrating structural characteristics of the technical English incorporated in the text.

(f) In the following year (1966) R. Mackin (in association with Hawkins) published in his *English studies series* the first book in the series intended for science students. It contains extracts from a wide variety of scientific writing on topics relevant to physics, mathematics, biology and applied science. Again each passage is a feature of a teaching unit. A typical unit consists of (a) a passage taken from popular scientific writing, or a textbook, or from scientific literature — several of the passages are accompanied by diagrams, graphs, or statistical data since accurate scientific explanation relies to a large extent upon such visual aids; (b) copious notes dealing in detail both with the subject matter and the language in which it is expressed; notes on the subject matter include biographical data and are hoped to be 'of great interest' to students of science; the notes on the language of the texts deal with vocabulary and grammar — although the meanings given are only applicable to the words as they are used in the text, the same word or expression may be referred to in several texts so that a variety of uses is demonstrated and meaning shown to be the sum of the uses to which a word is put; (c) exercises, dealing with the comprehension of the subject matter and the ability to interpret and use 'the common vocabulary and patterns of scientific English'. Published separately is a collocational and pronouncing vocabulary of the important words used in the texts. Herbert had drawn attention to the difficulty of semi-scientific and semi-technical vocabuiary; Hawkins and Mackin recognise also the need for the student to note how scientific and technical words are pronounced, the grammatical patterns into which they can enter, and the other lexical items with which they normally collocate. They consider this information more important for the foreign student than a definition 'since the meanings of most of the words are self-evident and consequently the least of his worries'.

(g) A book of a very different kind is R. E. Price's *A reference book of English words and phrases for foreign science students* (1966). This is not a reference book on the lines, for example, of Flood and West's *Elementary scientific and technical dictionary*. The aim of this book is to help students write clear and concise English and understand the methods used by scientists in solving problems. It is this second aim which has determined the selection, arrangement and presentation of the material. The first section is concerned with science as observation and experiment and attempts to relate vocabulary to qualities (shape, composition, texture), to relationships (quantitative, spatial, temporal), and to actions (change, motion). The second section is concerned with science as description and explanation, and short discussions of illustrative passages from standard elementary texts are included. The author is not, however, an English specialist applying his professional experience of language teaching to the special communication problems of scientists, but a scientist, more precisely a lecturer in science method, trying to help foreign students find the correct words and phrases to describe their tasks and understand logical explanations of scientific terms and processes. Unfortunately it is obvious that he is not acquainted with even the most elementary principles of foreign language teaching or with any descriptive analysis of the characteristics of scientific English, and is completely unaware of what in fact constitutes the language difficulties of the students he is trying to help.

(h) The effective preparation of material for teaching English to scientists requires co-operation between the science specialist and the language specialist. An outstanding example of effective co-operation is the course prepared by Ewer and Latorre (1969). It is perhaps unfortunate that the title, *A course in basic scientific English*, sounds somewhat Ogdenish and revives memories of earlier attempts to graft scientific English onto Basic English. This course, which embodies the best of what had gone before, is concerned with Close's second stage of scientific English — a superstructure that could serve any scientific purpose — 'the sentence patterns, structural words, and any structural vocabulary which are common to all scientific disciplines and form the essential framework upon which the special vocabulary of each discipline is superimposed'. The material incorporated in the course was selected from a scrutiny of some three million words of modern scientific English ranging from popular writings to learned articles, and graded according to both frequency and complexity. The course is intended to serve a broadly educational purpose as well as its specific linguistic one and to this end it is designed 'to stimulate the critical thought and foster the habits of clear exposition and the impartial examination of evidence' and 'to encourage students to take an active interest in their own discipline and its relationship with other sciences and with society as a whole'. To this extent therefore the course reflects three of the four influences I mentioned earlier — logic, liberal studies and linguistics. The concept of the teaching unit has been extended and each unit comprises a specially written reading passage, a comprehension section, a word study section, a structural study section and a discussion and criticism section. Additional material includes :

(i) an introduction outlining the purpose and scope of the course and offering library suggestions to encourage the English teacher to acquire a sympathetic insight into the scientific point of view;

(ii) a supplement of extracts from current scientific literature;

(iii) appendices of prefixes and suffixes in common use in scientific vocabulary, grammatical forms of the regular verbs most frequently used in scientific English, abbreviations and symbols in common scientific use, Anglo-American weights and measures (with approximate metric equivalents) and, for good measure, a blank colour chart to be completed by the student and diagrams illustrating parts of the human body and of a tree;

(iv) a two-part dictionary of basic scientific English, Part I giving explanations and meaning, Part II giving an illustrative context for each word and grouping the words, as far as possible, according to their functions (indicating position, movement, quantity, time, frequency, degree; or introducing result, modification, condition, hypotheses, emphasis);

(v) an index of the grammatical structures dealt with through the passages;

(vi) a separate teacher's book with suggestions on how to handle the units.

(i) Finally, I must mention the television series of 13 films *The scientist speaks,* made by the B.B.C. and the British Council under the supervision of B. C. Brookes. These films and the book which accompanies them are intended to show the English language at work in science and technology. The book is in two parts. The 13 chapters of Part I provide scientific texts, the subject matter of each text corresponding with the scientific subject of one of the films: they do not repeat the dialogue of the films. The films illustrate the way in which scientists and engineers talk; the texts illustrate the way in which they write. Each of the 16 sections of Part II deals with a sentence pattern or a point of syntactical detail featured in the films and also in the texts of Part I. This course does not attempt to be as comprehensive as Ewer and Latorre's: many detailed aspects of the English of science are not mentioned and when a pattern or expression is described as common or normal in the English of science it is not implied that it is the only pattern or expression which an English-speaking scientist would use in given circumstances. The question the course tries to answer is not 'How does an Englishman say this?', but 'How would an English-speaking scientist normally say this when he talks or writes as a scientist?'

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The teaching of rhetoric to students of science and technology

H. G. WIDDOWSON

In this paper I want to bring into focus a number of problems associated with the teaching of English as a second language, and by implication any other second language, in scientific and technical education. I make no pretence at being able to supply solutions. I do not myself believe that it is the business of applied linguistics to supply solutions to pedagogic problems, but only to provide some of the means by which they may be solved. It seems to me that the aim of applied linguistics is to clarify the principles by which the language teacher operates, or by which he might consider operating, if he is not alienated by arrogance.

The clarification which applied linguistics provides comes about as a result of relating the language teacher's beliefs about and attitudes to language and language learning, as they are revealed by his pedagogic practices, to the linguist's and psycholinguist's discoveries about language and language learning by means of theoretical and experimental investigation. It is particularly appropriate that applied linguistics should be concerned with English for science and technology because it happens to bring into prominence, as 'general' English teaching does not, a question which is one of the principal issues in linguistics at the present time: that is to say, the nature of language as communication. It is fairly rare that a shift in orientation in language teaching and a shift in orientation in linguistics should involve a coincidence of interest, but this, I believe, is now happening.

Let us begin with some obvious and general observations. First: what do we imagine we are doing when we are 'teaching a language'? We speak of developing skills, of making habitual the ability to compose correct sentences. We stress that the primary need is to inculcate in our learners a knowledge of the language system, and we devise drills and exercises to bring this about. At the same time, we do not wish to make our learners into automatons, mechanically repeating sentence patterns and so we insist that pattern practice and the manipulation of the language structures which are taught must be meaningful. We take pains to ensure that language is presented initially in

situations which give meaning and point to the language which is being acquired. The general pattern is : situational presentation to make the language meaningful followed by exercises in repetition to make it habitual. What precisely are we teaching? We are, of course, teaching something quite abstract : we are teaching the language system : *langue*. This is not to say that we neglect *parole*. You cannot teach *langue* directly since it has to be realised in some way or another, so we use *parole* in our initial presentation and we use it in our exercises. But it is an odd kind of *parole* when you think about it : it is pressed into service to exemplify *langue*. It is the language system which dictates which elements of usage are introduced. This, of course, never happens outside a language teaching classroom. Normally *parole* only occurs as a result of some kind of social interaction : usage is not dictated by linguistic rules but by social conventions.

There is an important distinction to be made, then, between the *use* which is made of language to exemplify linguistic categories and the *usage* of language in the business of social communication. When we make use of expressions like 'This is a red pencil' or 'This is a leg' or 'He is running to the door' this is language use not language *usage* : it exemplifies but does not communicate.

I think is is true to say that the use of language in the classroom for what is known as situational demonstration or contextualisation is meant to indicate what I will call the *signification* of linguistic elements. Thus expressions like 'This is my hand', 'That is his foot', and so on, are meaningful as sentences because they indicate the signification of grammatical items like the possessive pronoun, and lexical items like 'hand', 'foot' and so on. Sentences like these are exemplificatory expressions and are meaningful as projections, as it were, of the language system or code. They are, of course, quite meaningless as utterances. It is difficult to see how they could possibly represent any message in any normal communication situation. They are meaningful as 'text-sentences' (to use a term of John Lyons') but meaningless as utterances because they have no *value* as communication.

It seems to me that it is important to stress this distinction. Language can be *used* in the classroom in the form of text-sentences which exemplify the language system and thus indicate the *signification* of linguistic items. This is not the same as language *usage*, which is the use of sentences in the performance of utterances which give these linguistic elements communicative *value*. In the classroom, expressions like 'This is a red pencil' are sentences; expressions like 'Come here', 'Sit down' are utterances because they have a communicative import in the classroom situation, which provides a natural social context for their occurrence.

Attempts are very often made to bestow communicative value on the language items which are introduced into the classroom, by the use of dialogue for example. But it is done in a somewhat *ad hoc* and incidental way, and what I have in mind is something more systematic. Even where there is an attempt to give communicative point to the language being learnt, it is generally left

for the learner himself to work out the value. His attention is drawn to the grammatical rather than the communicative properties of the language being presented to him, and the focus is on signification rather than value. I shall return to this point later. For the moment I want to stress that the primary aim of the language teacher is at present directed at developing in his learners a knowledge of the language system, *langue*, using as much *parole* as is necessary to exemplify and establish it in the learner's mind.

I have been using the terms *langue* and *parole*. I think this distinction of de Saussure has provided theoretical sanction for the language teacher's notion as to what is involved in teaching a language. I want to question the validity of the distinction and its relevance to language teaching, and to suggest that the distinction, as de Saussure draws it, is misleading; and that in consequence the language teacher has been misled.

To begin with, though the distinction seems clear enough, when one traces it back to its source in the *Cours de Linguistique Générale* one finds it difficult to pin it down in any very precise way. Lyons[1] says that it is intended to remove an ambiguity in the word 'language' which can refer both to potential capacity and to the realisation of this potential in actual speech, and, of course, we can see what, in general, de Saussure is getting at. But although he succeeds in removing this particular ambiguity, a necessary consequence is that he introduces other ambiguities. These have recently attracted the attention of linguists; largely, I believe, because their critical faculties have been stimulated by the similar but less equivocal distinction between competence and performance introduced by Chomsky. The precision of Chomsky's formulations have the happy effect of forcing his critics to be precise as well. The ambiguities of the *langue/parole* distinction are pointed out by Hockett:[2]

> 'Wittingly or unwittingly, Saussure had packed two intersecting contrasts into his single pair of terms: some of the time *langue* means "habit" while *parole* means "behaviour", but at other times *langue* means "social norm" while *parole* means "individual custom".'

Householder provides his own gloss on these remarks:[3]

> 'Hockett remarks quite correctly, as others have too, on the Saussurean confusion of two possible contrasts in the *langue-parole* distinction. He puts it a little differently than I would: contrast (a) makes LANGUE mean "habit" and PAROLE "behaviour", (b) makes LANGUE equivalent to "social norm" and PAROLE to "individual custom". I would tend to say rather that (a) equates LANGUE with "grammar" (i.e. "competence grammar") or "system" or "structure" while PARCLE is "utterance" or "performance", while (b) says LANGUE is the "common grammatical core" of a social group, while PAROLE is the "idio-

[1] John Lyons, *Introduction to theoretical linguistics*. CUP, 1968, p. 51.
[2] Charles F. Hockett, *The state of the art*. Mouton, 1968, p. 15.
[3] F. W. Householder, review of Hockett's 'The state of the art'. *Journal of Linguistics*, vol. 6, no. 1, 1970, pp. 129-134.

lect" or "individual grammar". Thus what is LANGUE under (a) may be PAROLE under (b). Of course there may be social groups of many sizes, so that in the (b) sense PAROLE is the LANGUE of a social group of one (if the limiting case is allowed).'

The confusion which is revealed by Householder's remarks hardly needs commenting upon. From the social point of view, the distinction between *langue* and *parole,* which on the face of it seems so clear, disappears altogether. Both Hockett and Householder invoke the idea of social norms and such an invocation is fatal to the neat distinction which de Saussure is making. Once one places language in its social context, it becomes apparent that the notion of a common homogeneous system is a figment of the imagination. The paradox in the *Cours de Linguistique Générale* is that *langue* is represented as a social fact which is in some way independent of social use. As Labov points out :[4]

'. . . the social aspect of language is studied by observing any one individual, but the individual aspect only by observing language in its social context'.

Once one becomes aware of the manner in which language functions in society as a means of interaction and communication, it becomes apparent that a description of language in terms of some homogeneous common system is a misrepresentation. One must accept that the linguist idealises his data in order to do any linguistics at all, and there is nothing objectionable about this as a heuristic procedure. It could be argued that at the historical moment at which de Saussure was presenting his views the essential problem was to establish some methodological principles upon which linguistics could proceed as an autonomous discipline, and this problem he succeeded in solving and linguistics has been able to develop as a result. But the linguist's area of concern as defined by de Saussure does not necessarily coincide with the areas of concern of other people involved in the study of language. The idealisation represented by the *langue-parole* distinction happens to leave out of account those very aspects of language with which the language teacher must primarily be concerned.

Householder, as we have seen, glosses the *langue/parole* distinction by reference to the notions of competence and performance. I want now to have a closer look at these notions because it seems to me that they are responsible for the change in the orientation of linguistics which is now taking place.

First of all, it is clear that the competence/performance distinction is not just *langue/parole* writ large : if it were, there would presumably be no point in coining the new terms. *Langue* is represented as a concrete social fact whereas competence is represented as an abstract idealisation : the perfect knowledge of the ideal speaker-listener in a homogeneous speech community. A linguistic description as an account of competence is therefore represented as a well defined system of rules. The difficulty with an idealisation upon which

[4] William Labov, 'The study of language in its social context'. *Studium Generale* (Springer Verlag, Heidelberg), vol. 23, 1970, pp. 30-87.

such a description depends is that it cuts the description off from empirical validation. Chomsky and his associates postulate the grammatical rules which constitute the system of the language by reference to their own intuitions. As for doubtful cases, they are prepared, they say, to let the grammar itself decide. As Labov has pointed out, however, it turns out that there are more doubtful cases than Chomsky imagined. This is because there is no such thing as a representative set of intuitions.

Once again, then, we run into difficulties as soon as we look at language from the social point of view. The concept of competence is meant to remove all the complications which are associated with social considerations but the result is that it also removes the possibility of what Firth called 'renewal of connection' with language in actual use. The system of the language as formalised in a generative grammar is thus cut off from the facts of usage, and anomalies arise as a result : the ill-defined phenomena of human language, for instance, are represented as a well-defined system of generative rules.

The more explicit definition of competence, compared to the ambiguous definition of *langue* makes apparent the limitations of a linguistic description which depends on the abstraction of some elemental system isolated from, and unaffected by, language in use as a social phenomenon. This is not at all to belittle the achievements of generative grammar over the past two decades, but only to suggest that the depth of insight into linguistic form has been achieved by a narrowing of focus which has excluded many features of language which must somehow be accounted for in a total description. The problem is that many of these features are those with which the language teacher is principally concerned, and this is why generative grammar, as Chomsky himself points out, has such small relevance to language teaching. What exactly is excluded is indicated by Katz and Postal.[5]

> 'We exclude aspects of sentence use and comprehension that are not explicable through the postulation of a generative mechanism as the reconstruction of the speaker's ability to produce and understand sentences. In other words, we exclude conceptual features such as the physical and sociological setting of utterances, attitudes, and beliefs of the speaker and hearer, perceptual and memory limitations, noise level of the settings *etc.*' (my emphasis).

All of these features are bundled together under *performance*. The very heterogeneity of such a collection suggests that in fact this is a covering term for everything which cannot be conveniently accounted for in the proposed model of description. Performance is, in effect, a residual category containing everything which is not accounted for under competence. The suggestion that it subsumes everything about language which is imperfect or irregular, all systematic features being accounted for within competence, which is the repository, as it were, of the speaker's knowledge of his language. But it is

[5] J. J. Katz and P. M. Postal, *An integrated theory of linguistic descriptions*. MIT Press, 1963, p. 4.

clear that some of the features listed under performance are also systematic and form a part of the speaker's knowledge of his language (in any normal sense of knowledge), and should also therefore be considered as part of his competence. It is part of the speaker's competence to be able to use sentences to form continuous discourse, as Halliday points out; it is part of his competence that he should know how to use sentences to perform what Searle calls speech acts, Lyons calls semiotic acts, and I call rhetorical acts. In brief, knowledge of a language does not mean only a knowledge of the rules which will generate an infinite number of sentences, but a knowledge of the rules which regulate the use of sentences for making appropriate utterances. An utterance is not just the physical realisation of an abstract rule of grammar : it is also an act of communication. 'This is his nose' is not an utterance. 'Come here' uttered in the appropriate circumstances, is. To know a language means to know how to compose correct sentences *and* how to use sentences to make appropriate utterances.

It seems to me that a revolution is taking place in linguistics against a conceptual order which derives from de Saussure, and which, indeed, served as the very foundation of modern linguistics. There is an increasing recognition of the need to pay as much attention to rules of use, the speaker's communicative competence, as to rules of grammar, his grammatical competence, and that an adequate linguistic description must account for both. Here is where the interests of linguistics and language teaching converge. So long as our concern is with the teaching of 'general' English without any immediate purpose, without knowing in any very definite way what kind of communicative requirements are to be made of it, then the need to teach language as communication is not particularly evident. Once we are confronted with the problem of teaching English for a specific purpose then we are immediately up against the problem of communication. Teaching English as a medium for science and technology must involve us in the teaching of how scientists and technologists use the system of the language to communicate, and not just what linguistic elements are most commonly used. A common assumption seems to be that if you teach the system, usage will take care of itself: that once you teach, say, how to compose a declarative sentence then the learner will automatically be able to understand and make statements of different kinds, will be able to define, illustrate, classify, qualify, describe, report — will, in short be able to perform rhetorical acts and recognise the rhetorical acts of others without much difficulty. In my view, the communicative competence which this presupposes does not come of itself, especially not to those learners outside the European cultural tradition. Rules of use have to be taught with as much care as do rules of grammar.

I am suggesting, then, that what I see as a revolution in linguistics thinking should be matched by a revolution in language teaching methodology in order to cope with the kind of challenge which English for science and technology represents. In both cases there is a need to shift our attention away from an almost exclusive concentration on grammatical competence and to give equal attention to communicative competence. Knowledge of a language

involves both, and whether we are concerned with the description or the teaching of language, we must concern ourselves with both.

How do we set about teaching the rules of use? Rules of use are rhetorical rules: communicative competence is the language user's knowledge of rhetoric. Traditionally, rhetoric has been represented as a set of prescriptive rules related to impressionistic norms, in much the same way as traditional grammar was represented. Rhetoric is concerned with appropriacy and grammar with correctness, and the reason why the latter has achieved academic respectability whereas the former has not is probably only a matter of historical accident, and probably has something to do with the relatively recent development of the social sciences. There seems to be no reason why rhetoric as the description of communicative competence should not achieve similar standards of precision as grammar has in the description of grammatical competence. Whether the two can be incorporated into the same model of linguistic description is a matter for speculation, but it seems clear that developments in linguistics at the present time are moving towards a rhetorical revival. I should now like to review one of these developments and to indicate in a rather programmatic way what relevance it might have for the preparation and presentation of teaching materials.

The impetus behind the movement towards rhetoric has come from two main sources: social anthropology on the one hand and linguistic philosophy on the other. From social anthropology has come the notion of the speech function; and from linguistic philosophy has come the notion of the speech act.

We owe the notion of the speech act to the Oxford philosopher J. L. Austin, though I suppose it can be regarded as a development of the whole 'meaning is use' movement in philosophy. Briefly, Austin pointed out[a] that when we issue an utterance we perform some kind of act over and above the composing of a linguistic form. Thus when I utter the expression 'I'll come tomorrow' I am committing myself to a promise or an undertaking of some kind, and if I utter the expression 'Come here' I am performing the act of command, and so on. Promises, orders and so on are what Austin called 'illocutionary acts'. One can discover what kind of illocutionary act is being performed by making the act explicit by what he called a performative verb. Thus 'I'll come tomorrow' can be established as a promise or undertaking because one can use the performative verb *promise* and make the utterance explicit: 'I promise I will come tomorrow' or 'I undertake to come tomorrow'. Similarly one can provide a performative verb to make an order explicit: 'I order you to come here'. And so on with other performative verbs.

Certain linguists, among them Thorne, Ross and Lakoff, have made use of this insight and have postulated a deep structure in which the performative verb figures in a superordinate sentence which dominates the rest of the deep structure configuration. Thus we get deep structures roughly paraphrasable as 'I promise you I come tomorrow', 'I order you to come here'

[a] J. L. Austin, *How to do things with words*. OUP, 1962.

and so on. There are two difficulties about this procedure. Firstly, one has to accept that a sentence like 'I order you to come here' and 'Come here' have the same illocutionary potential, that is to say are used to perform the same act of ordering. But it seems obvious that the circumstances in which one would utter one of these are different from those in which one would utter the other. The second difficulty is related to this. In many, perhaps most cases, one cannot tell what act is being performed in the uttering of a certain sentence unless one is provided with a context. To take a simple example: 'I'll come tomorrow' may be a promise or a threat or a confirmation. 'You sound just like your mother' may be an insult or a compliment or neither.

This kind of difficulty points to the principal problem we are faced with in the study of speech acts. What other ways are there of indicating what act sentence counts as apart from the use of the explicit performative verb. Certain linguistic features serve as signals, but they are not to be trusted: the context of utterance and the conventions of use associated with particular types of discourse very often over-ride the linguistic indicators. One might imagine, for example, that the imperative mood is an unequivocal indicator of the act of commanding. But consider these instances of the imperative: 'Bake the pie in a slow oven', 'Come for dinner tomorrow', 'Forgive us our trespasses', 'Take up his offer'. An instruction, an invitation, advice and prayer are all different acts, yet the imperative serves them all; — and need serve none of them: 'You must bake the pie in a slow oven', 'I should take up his offer', 'Why don't you come to dinner tomorrow?', 'We pray for forgiveness of our trespasses'. But one might suppose, nevertheless, that though there are several different kinds of act that can be performed by the imperative, when an order is to be given it is always the imperative which is used. But this, of course, is not the case either. Just as one linguistic form may fulfil a variety of rhetorical functions, so one rhetorical function may be fulfilled by a variety of linguistic forms. But the forms which can serve this function are dictated by the conditions which must be met if an order or a command is adequately performed. Here we can turn to the work of Labov for illustration.[7]

Labov points out that the conditions which must be met in making a command are as follows: when A commands B, B believes that A believes that at a time T:

1. X should be done
2. B has an obligation to do X
3. B has the ability to do X
4. A has the right to ask B to do X

Labov takes the situation of a teacher asking a pupil to do a piece of work again because it is unsatisfactory. The teacher — A — may frame his order in any of the following ways corresponding to each of the conditions:

1. This should be done again
2. You'll have to do this again

[7] William Labov, *The study of non-standard English*. National Council of Teachers of English (USA), 1969, pp. 54-56.

3. You can do better than this
4. It's my job to get you to do better than this

Or, making use of what Labov calls 'modes of mitigation and politeness', the command can be couched in interrogative terms :

1. Shouldn't this be done again?
2. Don't you have to do neater work?
3. Don't you think you can do better?
4. Can I ask you to do this again?

Labov also shows how the response to the command can fix upon one of the conditions, and can also be mitigated by the interrogative form.

From a different point of view, Searle[8] also has established conditions on the performing of speech acts like promising, thanking, congratulating, requesting, warning and so on. There is, then, a good deal of progress being made in the description of rules of use and the characterisation of different rhetorical acts.

Let me now indicate what bearing I think this has on the teaching of English, and in particular on English for science and technology. What people like Austin, Searle, Labov and others are now trying to pin down in terms of rules and conditions is precisely what language learners need to know if they are to cope with English as communication. I see no reason why the limitation stage of the language teaching process should not be a selection of rhetorical acts rather than of linguistic elements and vocabulary items. There seems no reason at all why we should not, for example, say 'For this course we will select undertakings, promises, warnings, definitions, classifications' and so on rather than 'For this course we will teach the simple present tense, present continuous, count and mass nouns' and so on. In fact, on the face of it, there would seem to be a very good reason for focusing on the former. Teaching rhetorical acts like promises and orders necessarily involves the teaching of different linguistic elements and vocabulary items, which are taught meaningfully because they are given a definite communicative import. You do not necessarily teach rhetorical acts when teaching linguistic elements and vocabulary items, as we all know, and what communicative competence the learners do acquire tends to be picked up incidentally. Once we accept the teaching of communicative competence as our prime objective, and once we can see — as I believe we now can see — how communicative competence can be described, then the logic of basing the preparation of teaching materials — limitation *and* grading — on the rhetorical units of communication rather than the linguistic units of the language system seems inescapable.

This approach seems to me to be of especial relevance in the preparation of English for science and technology teaching materials. I mentioned earlier that the conventions of use associated with particular types of discourse very often over-ride linguistic indicators of rhetorical acts. Scientific discourse can be seen as a set of rhetorical acts like giving instructions, defining, classifying,

[8] John R. Searle, *Speech acts*. CUP, 1969.

exemplifying and so on, but the manner in which these acts are related one with the other and the manner in which they are linguistically realised may be restricted by accepted convention. There are many ways of linking different acts to compose larger communicative units like, for example, a report or an exposition or a legal brief, and there are, as we have seen, several ways of performing the same basic act. My guess is that the best way — perhaps the only way — of characterising different language registers is to discover what rhetorical acts are commonly performed in them, how they combine to form composite communication units, and what linguistic devices are used to indicate them.

As Labov has said :[9] 'It is difficult to avoid the common-sense conclusion that the object of linguistics must ultimately be the instrument of communication used by the speech community; and if we are not talking about *that* language, there is something trivial in our proceeding'.

I think it is possible that in language teaching we have not given language as an instrument of communication sufficient systematic attention. We have perhaps been too concerned with language system, taking our cue from the linguists, and in consequence there has often been something trivial in *our* proceeding. Now that we are turning our attention to the teaching of English for special purposes, and in particular to English for science and technology, we must take some principled approach to the teaching of rules of use, and restore rhetoric, in a new and more precise form, to its rightful place in the teaching of language.

[9] William Labov, 'The study of language in its social context'. *Studium Generale* (Springer Verlag, Heidelberg), vol. 23, 1970, p. 33.

— 5 —

Connection in science material

A proposition about the semantics of clause relations

E. O. WINTER

The distinction between inner and outer clause relations

The discussion of connective items in science material will be confined to the use of connectives between sentences since the purpose of this paper is to discuss the area of semantic relations between sentences (the outer-clause relations) and to comment on its implication for the teaching of English as a foreign language, especially for the teaching of factual statement of which science material is only a part.

It will first be necessary to demonstrate the difference between outer-clause relations (the connections between sentences), and inner-clause relations (connection by *subordination*). An example of an outer-clause relation is given in 1(a) below, where the relation is made explicit by the sentence connective *By this time* :

1(a) Mr. Wilson took the chair for the resumed meeting.
By this time, relations were prickly.

In this example, what is offered as 'new' to the reader is two quite separate pieces of information. *Mr. Wilson took the chair etc.* and *Relations were prickly by this time.* That is, the two pieces are semantically equal.

Now let us look at the actual context from which the above example was made up, and see how the grammar has changed and why.

1(b) Sub-title of section : *'Bogged down in argument'.*
He (Mr. Wilson) had not got to bed until 3 o'clock that morning and he was reported to be in low spirits. Relations were prickly *by the time he took the chair for the resumed meeting.*
Hitherto he had been bland in the face of criticism; now he grew quickly irritable and quarrelsome . . .

(A newspaper report on Mr. Wilson's Commonwealth conference about Rhodesia)

In this example, we see that what is offered as 'new' to the reader is only the piece *Relations were prickly* with the piece *Mr. Wilson took the chair etc.* being taken for granted. The pieces are now semantically *unequals* in other words, the point of interest is on the piece, *Relations were prickly* with the other serving as a time marker. Here we have one function of subordination, which is to remove the information of its clause from a direct sentence relation so that it does not impede the outer-clause relation of its main clause with the first sentence of the paragraph.

We also observe that the two sentences of the 1(a) paraphrase cannot replace its subordinated form in the 1(b) context. This becomes more apparent if we make explicit the implicit outer-clause relation between the first and the second sentence of 1(b) by means of the sentence adjunct *so* in its meaning of *for this reason.* The connection by *so* is clearly between the *Relations were prickly* and the preceding sentence and this meaning is impossible if we force the two sentences of 1(a) into this context. To allow the second sentence of 1(a) to have this meaning, we would have to subordinate the first sentence to it : that is, we would have to change the outer-clause relation *(By this time)* to an inner-clause relation *(by the time he took the chair for the resumed meeting).*

I hope I have made clear the distinction between outer-clause relations (relations between sentences) and inner-clause relations (the relation between main and subordinate clause), as such a distinction provides a justification for confining our discussion to the use of connectives between sentences like the *so* postulated for the example 1(b) above. At this point it will be convenient to define what is meant by clause relations since it will apply to both inner- and outer-clause relations : a clause relation is the way in which the information of one clause is understood in the light of the information of the other clause.[1]

In any continuous discourse, it is the outer-clause relations that provide the semantic structuring whereby its individual sentences are understood : that is, the understanding of the information of one sentence depends in some way on the understanding of the other individual sentences which form the outer-clause relation. A study of what constitutes these relations is therefore important. Although these relations are largely left implicit it is convenient to begin by examining those outer-clause relations which have been made explicit by means of sentence connectives.

In discussing these connectives, we will be limiting ourselves to sentence adjuncts like *so* etc. This ignores the lexical connection by paraphrase equivalents where the item 'says' what the relation is (e.g. the item *caused* in : 'The plant was grossly overloaded. *This caused* it to break down prematurely.').

[1] This is a broadening of the earlier definition of the concessive relation by R. Quirk : 'Perhaps the most satisfactory statement to use as a working guide is simply that the concessive relation may be said to exist between parts of an utterance *when one part is surprising in view of the other.*' (*The concessive relation in old English poetry.* Yale University Press, 1954, p. 6).

The sentence connectives found in the OSTI report 'Sentence and clause in scientific English'[2]

We will now briefly examine the categories found statistically significant in the above report. In illustrating these categories, there will be other examples taken from non-science material in order to offset the bias towards science material and to provide a wider range of reference in discussing the semantic relations between sentences.

Since I am supplementing work which I have already done in the OSTI report, I shall not repeat anything which can be found in it, except for my present purpose of commenting on aspects of teaching which arise in the first four of the five most frequent sentence connectives in the material examined for the report. Instead of the term sentence connective, the term sentence adjunct will now be used since this is the term used in the report.

The following items have been taken from chapter 14. With the exception of category (3), all the items make explicit particular clause relations, some of which may have subordination paraphrases. The selection criteria used are not essential to the present paper and can be found in the OSTI report. They are not essential here because each category can be exemplified by various items.

A semantic analysis of the five most frequent sentence adjuncts in the science material

Category	*Semantic Relation*	*Percentage*
(1)	Logical sequence (e.g. *Thus, therefore* etc.)	33%
(2)	Contrast (versus non-contrast) (e.g. *However, in fact* etc.)	23%
(3)	Doubt/certainty (e.g. *Probably* v. *certainly* etc.)	16%
(4)	Non-contrast (versus contrast) (e.g. *Moreover, similarly, also* etc.)	9%
(5)	Expansion of detail (non-contrast) (e.g. *For example, in particular* etc.)	8%
	Total occurrences	89%

For the purpose of discussion, I will grossly simplify the statistics of these sentence adjuncts by noting that there was roughly one of these for every eight sentences separated by fullstops. If we assume that every sentence adjunct accounts for the sentence to which it refers anaphorically, then for every four possible clause relation pairs, one is accounted for in terms of its outer-clause relation. A problem in teaching now arises : how do we teach

[2] *Sentence and clause in scientific English,* by R. D. Huddleston, R. A. Hudson, E. O. Winter and A. Henrici. The report of research project 'The linguistic properties of scientific English'. Published by the Communications Research Centre, Department of General Linguistics, University College London, May 1968.

sentence connection for the remaining three out of four sentence pairs, or how do we account for the fact that implicit outer-clause relations are the rule rather than the exception? In contrast, inner-clause relations are largely explicitly connected by co-ordination, subordination or by other dependency grammar. Not surprisingly, traditional grammar, from which so many textbooks for foreigners have been derived, has always concerned itself with such explicit features of connection as subordination, but this has been largely vitiated by being divorced from the explicit outer-clause relations which it so often directly paraphrases. An example of such a paraphrasing of the clause relation is that of *reason* (a logical sequence relation). In (A), we have inner-clause relations, and in (B), we have outer-clause relations :

(A) *Because* she was disappointed, she complained./*The reason why* she complained *was that* she was disappointed, etc.

(B) She was disappointed. *So* she complained./She was disappointed. *This made* her complain, etc.

We could approach the question of what these outer-clause relations are by looking at the semantic classification of the most frequent sentence adjuncts in turn. This will give us some idea of what is often implicit in a clause relation. The sentence adjuncts are merely *one* way of making a clause relation explicit. In looking at these items, we will consider some of the problems of teaching which arise.

(1) The sentence adjuncts of logical sequence

These are called logical sequence adjuncts because in all cases their sentences must be in a particular time sequence or deduction sequence for them to be used in making their relation explicit. This is all the *logic* in logical sequence means. The frequencies show the pre-occupation of the science texts with the *instrument* relation *(thus)* and the *deduction* or *reason* relation (*therefore*) :

128 — *thus* (largely in *instrument* meaning)
96 — *therefore*
46 — *then*
43 — *hence*
43 — *so*

356 = *96%* of the total occurrences

On the face of it, the semantics of the most frequent items look useful from a teaching point of view, but this is only if you are interested in the teaching of formal written English. What about the teaching of informal spoken English, which is the most extensive part of English to teach?

There is worse to come; the distinctions between formal and informal language may be blurred in a lecture situation where there may be a drastic change from formal to informal language *when giving explanations.* We are all guilty of this in some way or other, whether with native or with foreign

students. This is bad enough for the weak native student, but it could be disastrous for the foreign student who may have been taught English in a combination of literary and formal English.

Now in spoken English the above frequencies of sentence adjuncts might look very different; the items *then* and *so* might be in first and second places. The foreign student studying in England is likely to be exposed much more to informal English than to the formal English of the better quality lecture or of his textbooks, and this means he will be more exposed to these items than to the textbooks' *thus* and *therefore.*

What is there that is awkward about an item like *so*? Firstly, there is the painful fact that this item, like the other frequent item *then,* has at least seven different meanings, some of which are syntactically very subtle indeed. Secondly, 'adverbs' of this kind are almost completely ignored by the textbooks. There are, however, two works which deal with these items :

Adverbial positions in English by Sven Jacobsen, (Sweden, 1964).

Studies in English adverbial usage by S. Greenbaum, (Longman, 1968).

(Jacobsen cites his examples in a dictionary lay-out. Greenbaum has a very different approach and deals with items like these much more thoroughly and interestingly, and has had the benefit of this earlier work. I would recommend both works as valuable sources of teaching material on sentence adjuncts.)

Let us take a closer look at some of the meanings of the item *so,* as this will illustrate some of the difficulties in teaching it to foreigners.

In example 2 below, we have an instance of syntactic subtlety where the position of the adverbial of place *(there)* affects the meaning because it is in its marked position in the clause :

2(a) She said, 'Let's stop here.' *So there* they stayed.
2(b) She said, 'Let's stop here.' *So* they stayed *there.*

(Jacobsen)

In 2(a) we have a blend of meaning : *a matching of actions in place* and *for this reason,* whereas in 2(b) we have only one meaning : *for this reason.*

A notable semantic feature of *so* is that it can replace both *thus* and *therefore* :

3(a) The hovercraft terminals can be sited away from the main ports, and *so* relieve overcrowded dock systems.
3(b) The hovercraft terminals can be sited away from the main ports, *so* relieving the overcrowded dock systems.

(Science example)

In 3(a) and (b), *thus* can replace the *so.* A subtle syntactic feature of the *so* in 3(a) is that the meaning of instrument depends on a deletion of the subject in its clause. If we have an explicit subject, the meaning changes to that

of *reason* as in 4 below :

4(a) For the Boxers, Christianity was the odious foreign doctrine subverting the established order, and *so* they attacked missionaries; for the Red Guards, it is revisionism, and *so* they provoke incidents and demonstrate outside the Russian Embassy.

(Newspaper report)

4(b) Any errors will cause very great damage to our reputation, *so* we ought to be exceedingly careful in our calculations.

(Letter)

In 4(a) and (b), we could replace *so* with *therefore*.

5(a) He got drunk, I was not *so* foolish. **(Made-up)**

5(b) I thought she was going to cry. She looked *so* upset. **(Made-up)**

In 5(a), there is the anaphoric use of *so* which means I was not *as* foolish *as that*. Contrast this with 5(b) where the *so* is not anaphoric and is clearly the resultative *so* in *so that*. The difference in the two uses of *so* can be seen in the different explicit connection which they allow :

5(a) He was drunk. I was not so foolish, *however*.

5(b) I thought she was going to cry *because* she looked so upset.

Example 6 is a very different use of *so* again; the thematic use of *so* in the substitution clause *does so* :

6(a) One of the major British myths has been that President de Gaulle stands between us and Europe. *So* he does, *but* he is not the only obstacle. Our own attitudes themselves create barriers.

(New Statesman)

6(b) Moreover the servicemen are Government employees and the Government must presumably set a good firm example to other employers. *So* it should, *but* not if it means dishonouring an agreement.

(The Guardian **editorial***)*

In 6(a), the relation of the first to the second sentence is *remote* (as explicit in the lexical item *myth*) to *real* (as explicit in the use of thematic *so*). The paraphrase meaning of the *so*-theme could be 'It is true that he does'. The semantic strength of this construction makes it a first member of a contrast *(but)*, a feature which is also seen in 6(b).

Example 6(b) is different from 6(a) in its paraphrase meaning, which appears to be : 'It's only right that it should'. These are subtle differences to have to teach the foreign student. In spoken English, these constructions would be responses by speaker B to speaker A.

Finally, example 7 is one everyone in Britain could place in its chronological context, just after the election in June 1970 :

7 *So* Mr Heath won the election after all !

I have ignored the other important uses of *so,* the *so* in *so that* (purpose), the *so* in *if so,* the *so* in *even so,* the *so* in *so do the Germans,*the *so* in *I think so,* and so on. I have, however, given at least six meanings of *so* in examples 2, 3, 4, 5, 6 and 7. It would be equally illuminating to do a similar review of the other most frequent item *then*. The point here is that no foreign student can begin to be fluent in his understanding and use of English unless he has, at least, a mastery of *all* the anaphoric meanings and functions of these two important sentence connectives.

(2) The contrast sentence adjuncts

These items make explicit a contrast or an incompatibility between their clauses. Their frequencies are as follows :

147 — *however*
25 — *in fact*
15 — *yet*
14 — *nevertheless*

201 = 75% of the total occurrences

Of these, the sentence adjunct *however* is statistically the most important; the disproportion between it and the remaining items in the table may be due to their more specialised meaning of contrast. Here the question of mobility arises. The item *however* is one of the most mobile of the sentence adjuncts; in comparison, the item *yet* must be syntactically fixed in front position if it is to retain its contrast meaning. Both *however* and *yet* are alternative choices to *but* in modern English at least, whereas the items *in fact* and *nevertheless* may co-occur with the diffused meaning of *but* to add their own special contrast meanings to it.

With a mobile adjunct like *however*, the inevitable question of focus arises, the focus being on the item immediately preceding it. Let us look at example 8 below :

8 Here Mitchell (1963) found that the soft parts of the prey are eaten and most of the hard parts are left. It may be that, *however,* the digestion of food by mid-gut juices entering the crop is efficient enough to render proventricular trituration unnecessary. **(Science example)**

This example is ungrammatical because the sentence adjunct *however* in this position must have something to focus upon. If you now place the adverbial adjunct *in some species* inside the *that*-clause immediately in front of the *however*, the example becomes acceptable, as it was in the original example. It will be seen that because of the focus by *however* the adjunct *in some species* has semantic emphasis.

This syntactic position of focus on an adjunct in front position distinguishes *however* from most other sentence adjuncts. In example 9(a) below,

the focus is on the *when*-clause in the front position :

9(a) It will be recalled that, because these molecules are homo-nuclear, they are non-polar, and consequently do not exhibit pure vibrational spectrum. *When* electrically excited, *however,* they revert to the various vibrational levels of the lower electronic state, and thus show a vibrational structure in the electronic band.

(Science example)

Where *however* focuses on the subject of the clause, there must have been a change of subject so that the new subject is being contrasted with the subject in the preceding clause, as in example 9(b) below :

9(b) He liked the French visitors. She, *however,* would have nothing to do with them.

(Made-up)

Questions of syntactic position and focus for *however* and other similarly mobile sentence adjuncts like *nevertheless, in fact, in any case* etc. are perhaps less of a problem than the much more awkward question of trying to teach the student when to choose *however* and when to choose *but*. The same problem arises with the even more difficult distinction between the non-contrastive *moreover* and *and*.

It will suffice to note an easier point of difference in the syntactic behaviour of *however* and *but,* the point that *but* is fixed and *however* is mobile in the clause. As soon as *however* is moved away from the front position, we have an element of surprise because of this postponed grammatical choice of the contrast.

(3) The sentence adjuncts of doubt and certainty

There are two sets of sentence adjuncts under this heading, those of doubt and those of certainty. Here are the more frequent items in these categories :

Doubt	*Certainty*
43 — *probably*	25 — *of course*
14 — *apparently*	16 — *clearly*
14 — *perhaps*	16 — *actually*
10 — *presumably*	
81	57

Total 138 out of 185 occurrences = 75%

These sentence adjuncts are non-anaphoric and, as already mentioned, they do *not* make explicit a particular clause relation for their sentence, but can strongly predict a contrast relation for it. What they *do* make explicit is a subjective attitude of doubt or certainty, and it is this subjectivity itself which can predict a contrast relation by provoking a counter-subjectivity. For

convenience we could regard the predicted contrast relation as an intellectual balancing of statements where tentative is balanced by certainty, or certainty by tentative. This balancing happens to coincide fairly neatly with the semantic features of the contrast relation.

The predictive power of these sentence adjuncts depends on where they are placed within a given relation. If, for instance, one of these items is the second member of a contrast relation, it cannot predict contrast. In example 10 below, the adjunct *of course* occurs in the second member which is co-ordinated by ***But*** :

> 10 That the skin survives these daily torments is a remarkable tribute to its toughness. ***But*** age and decades of indignities do, *of course*, take their toll.
>
> **(Science example)**

In this example, the subjectivity signalled by the marked sentence structure (the *that*-clause subject in front position) and, perhaps by the lexical item *remarkable*, can be said to predict the contrast by ***But***. Here we see the sentence adjunct *of course* having a different effect: when placed in the second member of a contrast relation, it *weakens* the semantic force of the counter-statement by making explicit an attitude which can be paraphrased as : 'it cannot be denied that' or 'it has to be admitted that'.

Where these adjuncts are not already part of a contrast relation as in example 10 above, they can be said to predict contrast. Such a contrast may be interrupted by a number of other clause relations.

In example 11 below, the sentence adjunct *Certainly* in the second sentence predicts the contrast for its sentence by ***But*** in the third sentence. The contrast relation itself is interrupted by a non-contrast relation made explicit by the item *neither* :

> 11 What goes in a parabola? *Certainly* not the point on the corner of the block, because that is jiggling about; *neither* is it the end of the wooden stick, or the middle of the wooden stick, or the middle of the block. ***But*** something goes in a parabola, there is an effective 'centre' which moves in a parabola.
>
> **(Science example)**

In example 12 below, there is a different function of the sentence adjunct *of course*. Here it does not predict contrast for its clause. Its presence in a statement of opinion (it is *unfair* on the police) anticipates a *certainty* in the reasons upon which it is based. The second and third sentences provide these reasons. The presence of ***But*** makes explicit the strong incompatibility of the reasons, both of which favour the police. The *of course* could be said to predict the contrast in the reasons which follow it.

> 12 It is, *of course*, unfair on the police simply to compare one year with another. The police are becoming more efficient, not less. ***But*** they are also asked to protect the public and its property

under conditions which favour the criminal more and more and the police less and less.

(New Statesman)

In example 13 in category 4 below, the sentence adjunct *Of course* in the first sentence predicts the contrast for its clause by *However* in the second sentence. The contrast relation is interrupted by a logical sequence relation made explicit by the sentence adjunct *therefore*.

(4) The sentence adjuncts of non-contrast
(formerly termed *combination* adjuncts)

These adjuncts are the semantic converse of the contrast items in category 2. They make explicit a relation of non-contrast or compatibility. There are much fewer of these occurrences:

19	— *moreover*
17	— *similarly*
14	— *Also*
14	— *indeed*
11	— *in addition*
75	—=73% of the total occurrences

The proportion of non-contrast to contrast adjuncts is 1 to 2.6. A likely explanation for this proportion is that the proportion of *and* to *but* is an average of 3.9 to 1 for all strata of the material in the OSTI report. We could regard the co-ordinator *and* as being the diffused semantic equivalent of all the items in the above table. For the foreign student, as indeed for the native speaker of English, the choice between *moreover, similarly, Also, in addition, furthermore* is a much subtler one than that between *however, nevertheless, yet, in any case* etc.

The particular point of interest for this paper is the sentence adjunct *Also,* shown with a capital letter to distinguish it from the cohesive adverb *also*. The latter item can co-occur with the other sentence adjuncts in the table, notably with *moreover* and *in addition*. Foreign students, as we all know, easily confuse the two *alsos*. In examining their differences of function, we can teach the student how to distinguish between them.

In example 13 below, the sentence adjunct *Also* connects the third sentence to the second sentence. The sentence adjunct *However* in the second sentence connects this non-contrast unit to the first sentence.

13 *Of course,* minor stomach disorders occur commonly under other circumstances and therefore it may be difficult to relate with any degree of certainty the symptoms of any individual husband to the fact that his wife is pregnant. *However,* when a large enough group of fathers-to-be is compared with a group of men whose wives are not pregnant, both groups being of comparable age and occupational class, the fathers-to-be are shown to suffer

more frequently from the symptoms than can be explained by chance. *Also,* the patterns of onset and loss of symptoms differs in the two groups.

(Science example)

The sentence adjunct *Also* is fixed in the front position and once it is shifted away into the clause itself it becomes the cohesive adverb *also.* The correction of the Norwegian example in 14 below consists of shifting the *Also* into the position between the subject (I) and the verb (want) :

14 I want to know when I try my best it's the best I can reach. *Also* I want to know that when I am not doing my best I am to be blamed.

(Norwegian student teacher of English)

Before we can differentiate between *Also* and *also,* we must examine how a cohesive adverb operates semantically on the preceding sentence. Look at the example below, and decide what word to fill in the blank space shown in the sentence to which the *too* refers :

15 When Wolfgang Amadeus was not playing, he was composing; when he was not composing, he was ..... . And his father was a good correspondent, *too.*

(Book review in *The Observer*)

The actual word deleted was the rather unusual, epistolating. The point here is that even if the foreign student had not known this word, he would have known from the presence of *too* in the next sentence that it meant corresponding or writing. An important semantic function of these cohesive abverbs is to enforce a contextual synonymy between the item on which it is focused (a good correspondent) and the item to which it refers in the earlier sentence (epistolating). This semantic relation is thus between *parts* of clauses and is only possible where there is a high degree of repetition.

We are now in a position to differentiate between the two *alsos.*

Unlike the cohesive adverb *also,* the sentence adjunct *Also* refers as *a whole* to the two clauses of its relation. Its message is that in spite of the apparent difference of the words, the sentences are non-contrastive or compatible. We see this in example 13 above. If the foreign student had written this passage, there would be no question of moving the *Also.*

Example 14 above presents a special difficulty in correction since presumably the student intended the contrast between praise and blame to be seen as a non-contrast to her. To achieve this, she must use some form of explicit connection which 'says' so. I will simplify the construction and remove the *Also* so that this need for connection can be more readily seen :

I want to know *the best.* I want to know *the worst.*

The high degree of repetition (I want to know the x) means that we cannot use the sentence adjunct *Also.* We can shift it so that it becomes the cohesive adverb *also* to show the intended compatibility in the contrast :

I want to know the best. I *also* want to know the worst.

We can achieve much the same objective by using *and* alone in its expectancy function to show that the contrast is an expected one :

I want to know the best, *and* I want to know the worst.
(in spoken English, the *and* would be stressed).

If, however, we wish to show that the compatibility is not expected, we are forced to make the compatibility explicit with either *also* or *too:*

I want to know the best, *but* I want to know the worst, *too.*

— 6 —

English for scientists at the University of Zambia

P. G. WINGARD

Needs

The University of Zambia takes in students at 'O' level for a four-year degree course. All students admitted have credit in English Language in the Cambridge School Certificate or the East African School Certificate.

Nevertheless, it has been felt by a majority of staff that a Use of English course is necessary and since the University opened in 1965 there has been a general Use of English course for nearly all first year students, in either the School of Natural Sciences or the School of Humanities and Social Sciences. This course consisted mainly of lectures on language and its use, reading comprehension exercises and essay writing exercises. Attendance and morale were generally poor.

It was decided to provide a separate Use of English course for science students to begin in March 1970. A planning committee including science, education and English staff was set up under the chairmanship of the Professor of English. The enthusiastic participation of three science staff was, I think, a vital ingredient. They all did a little teaching on the course, and did an enormous amount to 'sell' it to their science colleagues and students. The course was re-classified as a course *in* the School of Natural Sciences and this also helped sell it to the students. In the short time available for planning, a small amount of research was done to find out how science staff saw the language needs of their students. Questionnaires were sent to all science staff, and informal discussions held with all subject heads. Opinions differed, and some views expressed showed little grasp of linguistic reality or of what could be achieved in the three hours a week allotted to the course. Certain points stood out. It was felt that training was needed in listening and reading comprehension, note-taking from lectures and from the printed word, and the ability to write clear scientific prose. The ability to talk and discuss fluently on scientific topics, and to read more widely and more quickly, were also emphasised. It was decided to follow very closely this general brief. The committee was strongly aware of the need to concentrate on a few key aims, if anything tangible was to be achieved. It was decided to exclude the improvement of pronunciation as an aim. It was decided that it was *not* the business of the

course to continue the development of literacy in the broadest sense. It was *not* a General Studies course intended to interest scientists in the humanities or the social sciences. On the other hand it *did* aim to continue the development of *scientific* literacy in a wide sense: to interest scientists in the broader implications and applications of science and technology. But its main goal was simply to develop the linguistic competence needed for successful science studies at university level.

In trying to define this main goal more closely, it was important to remember that the students would have been using English as the medium of education for ten or more years prior to university entry. Thus an approach from grammatical structure, as found in many 'English for science' textbooks, or in the film series *The scientist speaks,* for example, would be too elementary as well as probably uninteresting to students. This did not mean that one should not take sentences to pieces when necessary and examine their structure in relation to their meaning. But it precluded an attempt to base whole units of instruction on particular grammatical structures thought to be important in scientific English. Certainly a drill approach, as used, for example, in English Language Services Inc. *Technical tape library* would be inappropriate.

Thus we cut ourselves off from the start from an approach deriving from a linguistic analysis of scientific English, and decided on an approach through the less-clearly defined 'skills' of language use. For many reasons I think this was the only sensible decision. But it raised a host of difficult questions.

What *are* in fact the needs — in terms of linguistic competence in a broad non-technical sense — of first year science students in Zambia? Much will depend on the demands made by particular science teachers, their style of teaching, their own use of English, which is a foreign language to many of them. Undoubtedly many science teachers in the University do make great efforts to adapt their teaching to the needs of their students, especially in the first year. Many provide handouts which make it unnecessary for students to take notes at lectures. However, most science staff appear to take the view that students *will* require the skill of note-taking from lectures, at least in the later years of their courses, and that handouts are in the long run no substitute for assimilating knowledge by making one's own notes.

It may also be wondered whether listening to lectures is as important in science courses as in other subjects. The Hale Report on University Teaching Methods in the UK (UGC 1964, HMSO) found that lectures *were* important in science courses. When we look at the percentage of total class-hours spent in lectures, we find that this was about half for pure science students and about two-thirds for arts students. But when we look at the number of hours per week spent at lectures we find this was actually higher for pure science students than for arts.

The following table will make this clear. It should be noted that at the University of Zambia all first year scientists are in science or move over to applied science in the Schools of Medicine, Engineering and Agriculture.

Class-time of British university students
(Based on *Hale Report*, UGC, 1964, HMSO)

	Arts		Pure Science		Applied Science	
Lectures	67	6.8	48	8.3	55	10.7
Written exercise classes	4	0.4	2	0.3	6	1.1
Practicals	5	0.5	45	7.7	35	6.9
Tutorials and seminars	24	2.4	6	1.0	5	0.9
TOTALS	100	10.1	101	17.3	101	19.6
	Per cent of class time to nearest whole no.	Average class-hrs. per week in term time.	Per cent	Hours	Per cent	Hours

These figures of course tell us nothing about possible differences of style in lecturing between science teachers and arts teachers, which might have a strong bearing on skills needed by students.

It is partly because of the lack of firm agreement as to the skills actually needed by students pursuing university courses in a second language, that English proficiency testing designed to establish levels of competence for this purpose has so far proved rather disappointing. This came out very clearly in the work of Frank Chaplen (Ph.D. thesis, Manchester University, 1970), who found a very wide variation in the standards of English expected of overseas students by teachers in the same university department, by teachers in the same subject in different universities and by teachers in the same university in different subjects. These differences in expectations were so wide that Chaplen concluded that it would be inadvisable to draw up expectancy tables or establish firm cut-off points in connection with his English proficiency test for overseas university students.

Organisation

Because only three class-hours a week were available it was decided to concentrate on a particular group of skills at a time. It was felt that this would have a stronger impact and give more of a sense of novelty and progress as the year went on. It would also make it easier to evaluate the popularity and the effect of particular parts of the work. The whole course was regarded as experimental, so every part of it would have to justify itself if it was to be retained in future years.

It was decided to have three major segments, to correspond with the three university terms. These would be centred on listening and note-taking, reading and note-taking, and writing scientific English. Though the work in any term would not be *confined* to one of these headings, there would be a very strong emphasis indeed on that skill. Each term's programme would be planned and co-ordinated by a different tutor.

It was decided to take listening and note-taking first. It was considered to be the activity most urgently in need of development at the start of the students' university career, and the one in which their university work would differ most strongly from their previous school work. Students of previous years stated that it took them about a term to settle down to listening to the variety of speakers and styles, and above all to gain some ability in taking notes as they listened.

Another reason for taking listening and note-taking first was that this sort of work would be novel for the students, and would help to overcome their initial expectations of boredom and irrelevance by challenging them to improve in a field where they had probably had little previous training, and where they felt vulnerable.

It was decided to centre the second term on reading and note-taking, and the third on writing scientific English. Practice in speaking would be carried through all three terms by means of a programme of lecturettes by students.

A course of this kind has special requirements in time-tabling and staffing. The number of students was about 240. Strict economy of staffing was necessary. Certain activities — some listening, for example — could be carried out with the whole number. Others would require a class-size of thirty or forty (we actually had to go to fifty, which was much too big). If speaking and writing were to be practised and taught adequately, it would be necessary to meet in groups of say ten at most.

One would like to experiment with a self-teaching, programmed learning type of approach, though the needs in terms of software and hardware would be formidable. No attempt was made to do this. But, as the whole nature of the course was experimental, and the tutors varied greatly in experience, it was decided to have a strictly centralised organisation with common teaching material and teaching notes for all tutors. It was found essential for all tutors to meet weekly for an hour or more to review progress and receive briefing on the next week's programme.

It was decided *not* to attempt to stream students, both because there were no adequate criteria for doing so and because it was considered bad for motivation and morale. They were divided randomly into six classes of forty. Each class was to have its own tutor, who would also teach it in four groups of ten. The approximate ratio of class-time would be :

Plenary sessions	:	(240)	$\frac{1}{6}$
Class „	:	(40)	$\frac{1}{2}$
Group „	:	(10)	$\frac{1}{3}$

As the plenary sessions would be followed up immediately in class sessions, the six tutors would all have to attend them. Thus each tutor would be in class six hours a week, and the total teaching time involved would be thirty-six hours per week.

It was planned that the English department would provide four tutors from its full-time staff. In fact, one of these failed to arrive till the end of the first term, so it was necessary to reduce the number of classes from six to five, which made the classes much too big. One of the two remaining two tutors was a Zambian staff development fellow in humanities, who had little teaching experience. The other was a part-time English tutor who was a highly-qualified physicist. In planning a course of this kind, one must often face a situation where staff with relevant training and/or experience are in short supply. None of the six tutors on this course had received specific training for teaching English as a second language. Only one had studied science beyond the School Certificate level which the students had reached. One was new to teaching. One was new to the second language situation. The three English specialists regarded themselves as primarily specialists in literature.

This may sound like a recipe for disaster, but I do not see it in that light. What it does mean is that there needs to be a measure of central expertise and a strong team spirit. The teaching material and methods must be such that the tutors gain confidence in their ability to deal with them, and there must be adequate time for regular staff consultation as well as for careful preparation before each class.

The participation of science staff in planning and execution also seems extremely desirable. In the first term of this course two plenary sessions were taken by science staff. Students greatly appreciated this participation by their science tutors, and would, in fact, have liked them to play a larger part. Apart from this, plenary sessions were generally not popular; one would ideally not have wanted to have them, but a course of this nature makes very heavy staffing demands.

It was found that a programme emphasising training in listening faced grave difficulties, when classes were necessarily large, from bad acoustics and from the high level of background noise on a campus in course of construction.

To standardise presentation and to provide practice in listening to a variety of accents and voices, it had been decided to present all exercises on tape. It is, of course, far more difficult and strenuous to listen to a tape recorder than to a live voice. Experience suggests that, while at five feet distance one can listen comfortably to a tape recorder, at fifteen feet attention tends to be easily distracted, even if volume is adequate. Thus a class of forty or fifty proved very large for continuous listening to a tape recorder, unless the furniture of the room made very close grouping possible. The longest continuous listening exercise was only fifteen minutes, and most were far shorter; but even fifteen minutes was probably too long in the circumstances. Experience and the students' views suggest that we should have done better to rely less heavily on the tape recorder and more on the life voice.

A difficult question with regard to such courses is who should be required to take them? When the question of exemptions was put to students in a questionnaire, sixty-one per cent thought that no student should be exempted. In discussion, exemption was suggested for the very small numbers who either were native speakers of English or had post-School Certificate level qualifications. These small groups hardly affect the problem. If other students are to be exempted, on what basis could this be done? To use School Certificate results would be unwise in view of the low correlation between these results and success in first-year university study. The use of any other available criterion is likewise open to doubt.

However, if such courses are to be given to all entrants, the staffing commitments implied are very difficult to meet. The problem cannot be solved by mass teaching or by further dilution — in fact it would be highly desirable to have a greater proportion of staff trained in, and committed to, second language teaching. In the University of Zambia the situation is made more serious by the current extremely rapid expansion. In 1970 there were 240 first-year science students. In 1971 there are expected to be 400. It has been decided that the English for Scientists course can be mounted only for the same number as last year. Plans to remodel the non-scientists' Use of English course have had to be shelved, and financial and recruiting problems make it difficult to maintain the impetus of the new developments.

Thus, the future of English for Scientists is by no means secure. However, experience has suggested that the type of help given by the course is needed by, and of benefit to, most first-year students. It has an important contribution to make towards maintaining and raising academic standards generally and to the production of graduates who are genuinely educated and capable of lifelong professional and personal development.

Material and methods: listening and note-taking

Although accustomed to listening to English of various kinds in secondary school, students are exposed in the University to a greater variety of speakers, native and non-native. They probably have to take in longer stretches of speech, though probably no science lecturer talks for fifty minutes on end. Staff vary enormously in the extent to which they appreciate and adapt to students' language problems. What students say they find most difficult — and staff confirm this — is taking notes as they listen.

Thus the listening component aimed to provide training in comprehension of different speakers, different types of material within a broadly scientific field, stretches of speech varying in length, speed of delivery and density of ideas. Further, it aimed to provide training in the ability to take notes on the most important points, rapidly and comprehensively.

Students who have not received such special training say it takes them about a term to settle down to this sort of note-taking. They are probably over-optimistic about the skill they attain in it. To find out what really happens would demand prolonged research. All that was possible before this course was a small amount of visiting of science classes by tutors, in addition to the canvassing of the views of science staff which has already been referred to.

The task of selecting teaching material for this part of the programme, preparing the necessary recordings, student handouts and teaching notes, and co-ordinating the instruction was undertaken by the writer of this report. Some of the material was his own, but for the greater part he was indebted to the assistance of colleagues at Manchester University and to L. A. Hill's *Note-taking practice* (Oxford University Press).

In an attempt to provide some variety, six types of exercise were included. They are discussed briefly below in order of student popularity as shown by a questionnaire at the end of this part of the course.

(a) *Student lecturettes*

These were rated highest for both usefulness and interest. Each student gave a ten-minute talk on a scientific topic, speaking but not reading from his own notes. The listeners took notes, and were then given the opportunity to ask questions or make comments, to which the student lecturer could reply. Students were expected to do some reading and reference in preparing their lecturettes and were recommended to seek help and advice from their science tutors. They could select from a list of topics offered, or propose a topic of their own. All topics were of a scientific or technological nature. This work occupied about six hours out of the total thirty hours available. It was done in groups of ten.

Students were given the following suggestions for topics, but were invited to propose any other topic they wished :

uranium
smoke
meteorites
semi-conductors
titanium
drinking water
Zambia's new oil refinery
Mars
cotton
termites
radio-active isotopes
cheese
a musical note
tsetse control
soya beans
soap
the Kafue dam
copper
blood groups
Victoria Falls
cassava
castor oil
sugar

(b) *Sessions run by science staff*

These were rated second in both usefulness and interest. They were given in plenary session, but each was followed up by a further hour's work in classes of forty. There were to have been three sessions but only two were given. One was a chemistry lecture with strong visual illustration, the other a physics session including a film. The third was to have been on a mathematical topic. These sessions were intended to present the students with the sort of listening situation, with a need for aided and structured note-taking, which they would find in many of their normal science classes, with an immediate follow-up hour in classes of forty for discussion of their attempts and further training.

(c) *Selection and reduction exercises*

These were basically summarising exercises. The name 'selection and reduction' was chosen to de-emphasise any preconceived notions as to the necessity for students to use their own words. About a quarter of the students rated them very interesting and very useful, while a further half found them useful and interesting. This is a rather favourable verdict in view of the difficulty and length of these exercises, of which there were three, each receiving two successive class-hours in classes of forty. In addition, there was a pre-test and a post-test of this type.

Most of the exercises consisted of a fifteen-minute lecture on tape, on a scientific topic. The topics were :

anthropods	helicopters and hovercraft
geology	the human brain and speech
how television works	

The students were asked to take notes of the most important points. Except in the tests, the passages were played in sections, with classroom discussion between sections, and specific instruction on selection of points, presentation, abbreviation, etc. For each exercise the students had a duplicated sheet of diagrams. Duplicated notes for tutors went into a good deal of detail both as regards procedure and as regards particular linguistic and other points. Among other matters, attention was given to markers indicating important relationships in the continuity of the discourse. Examples from one exercise are :

(*A*) *if you like, but* (*B*)=I agree that (A) is true, but (B) is also true.
(A) *were it not for the fact that* (*B*)=(A) but (B)
what is most relevant is (*A*)=something important coming (A)
(A) *And they do this . . .*=*This* refers back to (A)
(*A*) *that is to say* (B)=(A)+explanation of (A)=(B)

At the end of the session, students were given in duplicated form both a tapescript of the passage and a suggested set of outline notes. They could thus follow up the work in private study if they wished.

The chief problems of this type of exercise arose from the difficult and unremitting nature of the work. Two successive class-hours on a single passage, though permitting greater depth of study, were found heavy going at times. While the basic approach seems viable, one would in a future attempt seek more variety of presentation. But it is clear that the students found they were being presented with problems of real relevance to their needs.

(d) *Popular science exercises*

These, a somewhat lighter type of fare, were rated about equal in popularity to the selection and reduction exercises. The passages used lasted only two or three minutes, and presented some scientific or technological topic more or less in layman's language, in a style reminiscent of the *Reader's Digest*. It was intended that this work should be somewhat less demanding and less intensive than the selection and reduction exercises. It would practise a different skill from that of making a skeleton outline. Here the emphasis would

be on noting facts, supporting data, etc., and getting down a much larger proportion of the material. Both approaches are needed in the lecture-room.

Although in real life we do not normally hear lecture material more than once, a method suggested to tutors was to play a piece through two or three times, telling the students beforehand that this will be done. The students are instructed to get down as much as possible the first time, but leave gaps in their notes where they think they could usefully have added more. The next time through, they should concentrate on filling the gaps. A third hearing would only be provided if the students felt it useful and would probably be used mainly for review.

The total time given to this activity varied somewhat from class to class, but was commonly only about two class-hours. One, two, or even three passages would be used in one class-hour. Detailed teaching notes, tapescript and suggested outlines were not provided, and the tutor was left much more to his own devices in handling this type of exercise. The recorded passages available for tutors to select from were on the following topics:

the Australian nickel rush	angina pectoris
ultrasonic energy	quality control
spilt oil	diabetes
space-ships for Mars	bigger brains
	sealing teeth

(e) *Anticipation exercise*

To follow a lecture, a student needs to carry in his mind a clear idea of its trend, and to anticipate to some extent what is coming. This he does by interpreting a whole range of types of information such as discourse markers of different kinds, the arrangement of clauses, stress, intonation, pausing, the succession of ideas, etc., etc. In order to give specific practice in this essential if complex process, a passage on tape was played, and the tape stopped at about twenty specified points. The students were asked 'What do you expect to come next?' or some similar question. Material with a clear logical structuring is desirable. The passage used was one on 'The idea of statistics' from a TV series by Bronowski. The passage showed the use of basic statistical concepts in the step-by-step breaking of a code.

Only one exercise of this kind was tried, taking two successive class-hours. It was relatively unpopular, only sixty per cent of students considering it useful and interesting, but it seems worth further experiment.

(f) *'Whodunit' exercises*

In view of the rather heavy nature of most of the programme, it was decided to experiment with one lighter type of exercise using non-scientific material, but still requiring something of the same types of skill. Each exercise consisted of a dramatised detective story on tape, lasting three or four minutes. The students were asked not to take ordered notes, but to jot down, as they listened, what seemed to be significant clues. Class discussion and attempted solution followed. Although not intended to be taken too solemnly, these exercises were intended to practise careful listening for significant detail,

accompanied by short-term memorisation and quick thinking of a deductive nature. It was thought likely to excite discussion giving practice in the use of the passive voice, conditionals, 'might have' and other elements of grammatical structure used in scientific discourse. About three class-hours were devoted to exercises of this type. They did not prove very popular with the students, more than half not considering them useful or interesting. They were perhaps a bit too easy, and it may be that the students did not take kindly to the idea of non-scientific light relief in the course.

Evaluation and assessment

Students' views on the course were collected at the end of the listening and note-taking sector of the course, that is, after one term, in a session devoted partly to completing a questionnaire and partly to unstructured discussion. Seventy per cent of the students felt that Use of English courses should be held for first-year students, and eighty-three per cent that there should be a special course for science students. Seventy-two per cent thought the course so far had been useful or very useful but only sixty-one per cent thought it had been interesting or very interesting. To the question how many hours a week such a course should occupy, students' answers averaged 2.3 hours as against the three hours actually given. This figure suggests the heavy pressure students are under in their whole study programme, and also perhaps an unrealistic estimate of the time required for substantial improvement of language skills. But in general results of the evaluation procedure confirmed the impression throughout the course of a highly serious and responsible attitude on the part of the students, and a moderate satisfaction with the course.

A pre-test and post-test were given in an attempt to evaluate the improvement, if any, in the skills being taught. It was realised that improvement might be due to other factors besides instruction, but it was not possible to have a control group. The pre-test and post-test were selection and reduction exercises. An attempt was made to standardise marking, and to set a standard on the basis of the performance of competent native speakers of English. Detailed analyses will not be presented here, but the results showed highly significant improvement from pre-test to post-test.

Course assessment on the former Use of English course had been entirely by final examination. This was a test of language skills which could often be passed by a student whose attendance had been very poor. The same examination was used at the beginning of the year as a screening device on the basis of which a small number of students were exempted from the course. These arrangements seem to have caused widespread dissatisfaction and to have encouraged absenteeism, especially among the better students.

It was, therefore, decided to make a conspicuous break with previous practice by grading students entirely by course assessment. It was decided to assess as many separate pieces of work as possible. Including the pre-test and post-test, each student was assessed about twelve times on the first term's work, using a five-point scale. Students seemed to prefer the new method of assessment, and absenteeism was certainly greatly reduced.

Materials and methods : terms 2 and 3

No attempt will be made here to describe in detail the later stages of the programme, but a few words of general explanation must be given.

The second term's work was centred on the skills of reading and note-taking. There was some consideration of the nature of scientific English as compared with other types. Students' attention was drawn to the nature of different types of reading skill. Most of the time was spent on the practice of these skills on carefully-chosen passages. Some exercises involved tracing the structure of a passage in a way somewhat similar to the selection and reduction exercises of term 1. Practice was given in the omission of inessentials, in criticism of inadequate reasoning, in inference, and in the interpretation of material containing diagrams referred to in text. As in term 1, the students were required throughout to make open-ended written responses — no multiple-choice questioning was included. To encourage the growth of scientific literacy in the broadest sense, a programme of reading was started in term 2 and continued to the end of the year. Each student read six books of scientific interest, ranging from science fiction to scientific biography and works on the social and political implications of science and technology. There was a small amount of lecturing on some of these by tutors, after the students had read them. But the major part of the class discussion of these books was carried on in small groups of about ten students, and initiated through student lecturettes on various aspects of the books.

There was no special concentration on reading speed, as some doubts were felt as to whether this was a high enough priority to justify the heavy expenditure of time that would be necessary to secure an appreciable increase. It was also considered doubtful whether non-scientists could satisfactorily train science students in the use of reference materials in their field, and training of study and reference skills was therefore not specifically tackled.

In term 3 the course was centred on the practice of various kinds of scientific writing. Attention was first given to the writing up of experiments, with study of actual examples of students' laboratory book notes as well as of model examples. Practice was given in making written observations of visual presentations, such as short filmed sequences, series of slides, etc., with emphasis on accuracy of description. A further problem studied was the integration into a continuous prose account of non-verbal material such as diagrams, figures, tables and graphs. Students were introduced to the nature and elements of a good scientific paper. One feature of immediate relevance to students was practice in the writing of examination essays. In this, as in some other parts of the course, there was participation by science tutors. One further topic dealt with was communication between the scientist and the non-scientist. Students were given practice in explaining their scientific concerns to non-scientists such as politicians, civil servants and members of the public.

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French for science students

Objectives and teaching strategies

MARGARET HILTON

J. L. M. Trim states: 'The first pre-requisite of a national learning system is a clear formulation of objectives and priorities'.[1] I would add to this another condition — perhaps so obvious that it is assumed — and that is that we should define to ourselves as clearly as possible not only the linguistic, but also the extra-linguistic situation of the subjects at the beginning of any course we offer. Unless we do so, we are in danger of falling into the error — always a grave professional risk — of underestimating students' capacity to infer meanings; we may waste our own time and theirs struggling to discuss technological processes that they will learn next day from someone of genuine competence; we may fail to exploit their knowledge of and about their native tongue. A common knowledge of English is of course the major factor constituting the difference between the teaching situation in which I find myself and that which confronts the teacher of English to heterogeneous groups of foreigners here, or the French nationals teaching science students who go to study in France.

A course given here (at the University of Birmingham) in order to impart a reading knowledge of French in the shortest possible time must be mentioned first. The students have either come here from abroad, or have gained admission to the University after spending the middle years of their secondary schooling in a school which offered no second language instruction. Post-graduate students coming here from West Africa may need, for the purposes of their research, to scan or decode written texts. Again as Trim put it: 'Neither activity requires the user to have internalised a grammar of the language which would enable him to produce well-formed sentences. There is undoubtedly a threshold value of knowledge below which problem-solving will not occur . . .'.[2] To meet these needs I have composed a programme directed at subjects who have a knowledge of English, providing reading

[1] 'Linguistic considerations in the planning of language courses', *CILT Reports and Papers, 1: Languages for special purposes,* 1969. p. 18.
[2] Ibid. p. 21.

practice to accompany each step, and testing those parts of the system which are information-carrying and at variance with English. This programme can be used for self-instruction by a learner who has already done systematic work on another foreign language, but needs the collaboration of a teacher if he has never previously tackled any language work — and this in spite of the fact that no grammatical terminology is unexplained and nothing is assumed. It has been my concern to include mention of such linguistic generalisations as will illuminate the tactics and progression for a lively learner, who is likely to be of high intellectual competence in fields other than that of language; at the same time I have tried to exclude any but the operative points of morphology and syntax, and so cling closely to that threshold to which Trim refers.

The progress of students has been extremely rapid, and motivation remains high because they are conscious of this themselves. This has led me to wish to experiment with a reading-method for subjects who wish ultimately to add active skills; and recognising that some students may in any case wish later to learn to listen and speak, I have recorded all the reading examples on tape and added a pronunciation guide lest wrong habits should have to be eradicated later on. I look forward to directing students who already read without hesitation the imperfect subjunctive used in a conditional sense, to the beginners' course of *Voix et images de France* or Fernand Marty's *Foundation course.*

The problems of another group of scientists I meet are more intricate. These are the undergraduates whose degree course is Double Honours in Mechanical Engineering and Economics. Engineering training dominates in the early years, and economics becomes more important in the latter part of this four-year course. A course in French or German or Russian ensures three hours a week of students' time in each of the four years, and is weighted as one seventh in final degree classification. There is also provision for an intensive oral course of 40 to 50 hours' work taken at the end of the first session, a 4-weeks' vacation course in France, and in the second and third long vacations students are required to work as *'stagiaires'* in industry or commerce in a French-speaking country. On admission to the Department of Mechanical Engineering the students have, of course, only 'O' level French.

What are the objectives? The highest priority was accorded by the Engineering Department to the need for fluency. But acceptable educated speech cannot be produced in adults without the support of reading and writing, and it was agreed that the aims should include the four skills. These students are also reading in the social sciences, and reading and written composition bear mainly on this sphere. Fluency is successfully achieved, and to a degree which many find surprising in technologists, whose public image is that of the rude mechanic. Present vagueness on standards and testing makes it impossible for me to define an aim in oral work more nearly than to say that we would wish them to perform acceptably in conversation not only on a practical and social level but also on matters of general, professional and business interest, with Frenchmen of the education and background of, say, a diploma in engineering or H.N.C.

In France engineering training is very general in the early years of diploma course, branching only belatedly into a specialism, and some have held that it is excessively theoretical. In our own universities a mechanical engineer spends most of his time on mathematically-based theory. My students must do some physics, some electronics, some metallurgy, and even concern themselves with factory safety regulations, industrial relations, accountancy and law: various branches of knowledge, in fact, which the name of their degree obscures from us lay people. What is more, when the student goes to a traineeship in France, he may be called upon to deal with the mechanical parts of the equipment of an oil-refinery, or tell workmen how to mend a milling-machine, or put together electronic parts to produce bits of a computer, or contribute to the computerisation of the accounting system. He cannot read the French of all this in advance; the best he can do is, on learning where his *stage* is to be spent, to prepare himself as a special project, using library resources. His work here in England must in the main be general, and in the study of the language as in other things, his course should contribute to an education 'which equips the learner with inner resources and tends to generalisation, so that the internalised resources may be available for a wide variety of tasks many of which cannot be foreseen at the time of learning'.[3] In the sphere of language-learning, he must be prepared to learn by observation and by ear and he must develop a good verbal memory; but he must also be able to ask competent questions when comprehension fails, to define his difficulties and to use words of reference. He must have had the experience of operating within the foreign medium when discussing some areas of technology, and be prepared to draw on this experience in order to extend his range to others if required. In directing students who are to acquire this 'sample' of technology in French, what can research and teaching-practice in France offer one by way of guidance?

French linguists of course pay particular attention to vocabulary studies. The teaching of French to foreign students is organised on a unified and systematic basis, so that it is easier to find out what goes on in their universities than it is in our own. France is fighting for prestige status for French as a language of science, and the reaction against language-teaching policies of the 'Daffodils' tendency has been roughly parallel to our own. It is not surprising today to find that Guiraud's little book *Les mots savants* accords that status to items of the scientific and technical vocabulary. Interest is evinced by linguists, by excellent old-fashioned grammarians, and by officialdom. Monsieur Le Bidois in *Le Monde* of 7.2.71 drew attention to the fact that in January 1970 some twelve commissions were set up to eliminate confusions in technical parlance, and the Director General of the nationalised gas industry has chaired since 1954 a committee for the study of technical terms, attempting to reduce the number of foreign borrowings, to launch derivatives that are *motivés* and to *'charger un mot usuel d'une signification nouvelle. Ainsi, bien que le mot anglais 'pattern' ait un assez grand nombre d'équivalents dans notre langue (schéma, modèle, dessin, etc.) on le trouve*

[3] Trim, op.cit. p.22.

tel quel dans certains textes français. Le Comité a proposé alors de lui substituer le mot 'patron' (dont 'pattern' est d'ailleurs dérivé) dans les rares cas où les équivalents habituels ne pourraient pas être utilisés.' Business concerns consult the Committee and accept its suggestions as to how to name their products and describe their qualities. It may well achieve substantial results, but it would require the mounting of an expensive research project to find out.

The relative weakness of modern French in forming neologisms may turn out to have been exaggerated. The truly fascinating study by Louis Guilbert of *Le vocabulaire de l'astronautique* (Publications de l' Université de Rouen, 1967) lends some support to this surmise. M. Guilbert examined the vocabulary of space flights in 1961, 1962 and 1963. He listed vocabulary items used in the news reports of fourteen daily papers and eighteen weeklies. All will have derived from *Agence France Presse,* which in turn relied on either Tass or American Associated Press or United Press. The evidence shows that the first resource of journalists obliged to cope with new matter in their own language — sometimes within a matter of hours — was to draw on related spheres of activity such as navigation or ballistics, and the findings of Wexler on the creation of the vocabulary of railways[4] over a century before therefore receive fresh confirmation. Both semantic and morphological series sprang up. *Alunir* had been formed by anology with *atterrir* and *amerrir* before these flights; *weightlessness* had already been variously recorded as as *apesanteur, non-pesanteur, impondérabilité, agravité.* Synonymy and metaphor reduced rapidly as knowledge on the part of the newspaper-reading public could be assumed — and so incidentally did the journalistic lyricism *(conquérant du cosmos* etc.*)*. However, it is important to remember — and it has been observed in their studies — that even scientists, long after the absorption of a new discovery, indulge now and then in bad poetry, or even good poetry; a foreign scientist cannot be sure of understanding articles on the sciences if he recognises technological vocabulary alone! Only half a dozen americanisms implanted themselves in the French of space exploration. *Count down,* incomprehensible when first cited, needed explanation. *'Count down s'applique aux ultimes opérations de vérification numérotées dans l'ordre décroissant jusqu'à zéro et la mise à feu.'* But thereafter it was more usually called *le décompte* or *le compte à rebours.*

To enjoy M. Guilbert is not to wander quite irrelevantly from the matters we have in hand if he brings out points about technical vocabulary and its characteristics. Likewise Lavoisier and his colleagues, when they laid the basis of modern chemistry, had to confront language problems and put forward the ideal of an internationally defined, consistently elaborated, and internationally comprehensible code. What they had to say raises so many points of interest in psychology, philosophy, science and linguistics that it is worth quoting at some length from the Lavoisier introduction to the *Traité élémentaire de chimie (1789):*

[4] Wexler, P. J., *La formation du vocabulaire des chemins de fer en France (1778-1842)*. Droz, Genève, 1950.

'Je n'avais pour objet lorsque j'ai entrepris cet ouvrage, que de donner plus de développement au Mémoire que j'ai lu à la séance publique de l'Académie des Sciences du mois d'Avril 1787, sur la nécessité de réformer et de perfectionner la Nomenclature de la Chimie.
C'est en m'occupant de ce travail, que j'ai mieux sorti que je ne l'aurais encore fait jusqu'alors, l'évidence des principes qui ont été posés par l'Abbé de Condillac dans sa Logique, et dans quelques autres de ses ouvrages. Il y établit que nous ne pensons qu'avec le secours des mots; que les langues sont de véritables méthodes analytiques; que l'algèbre la plus simple, la plus exacte et la mieux adaptée à son object de toutes les manières de s'énoncer, est à la fois une langue et une méthode analytique; enfin que l'art de raisonner se réduit à une langue bien faite. Et en effet, tandis que je croyais ne m'occuper que de Nomenclature, tandis que je n'avais pour objet que de perfectionner le langage de la Chimie, mon ouvrage s'est transformé insensiblement entre mes mains, sans qu'il m'ait été possible de m'en défendre, en un Traité élémentaire de chimie.

L'impossibilité d'isoler la Nomenclature de la science et la science de la Nomenclature, tient à ce que toute science physique est nécessairement formée de trois choses: la série des faits qui constituent la science, les idées qui les rappellent; les mots qui les expriment. Le mot doit faire naître l'idée; l'idée doit peindre le fait: ce sont trois empreintes d'un même cachet; et comme ce sont les mots qui conservent les idées et qui les transmettent, il en résulte qu'on ne peut perfectionner le langage sans perfectionner la science, ni la science sans le langage, et que quelques certains que fussent les faits, quelques justes que fussent les idées qu'ils avaient fait naître, ils ne transmettraient encore que des imprécisions fausses, si nous n'avions pas des expressions exactes pour les rendre.

. . . j'ai désigné autant que je l'ai pu les substances simples par des mots simples, et ce sont elles que j'ai été obligé de nommer les premières. On peut se rappeler que nous nous sommes efforcés de conserver à toutes ces substances les noms qu'elles portent dans la société: nous ne nous sommes permis de les changer que dans deux cas; le premier à l'égard des substances nouvellement découvertes et qui n'avaient point encore été nommées, ou du moins pour celles qui ne l'avaient été que depuis peu de temps, et dont les noms encore nouveaux n'avaient point été sanctionnés par une adoption générale; le second lorsque les noms adoptés soit par les anciens, soit par les modernes, nous ont paru entraîner des idées évidemment fausses, lorsqu'ils pouvaient faire confondre la substance qu'ils désignaient avec d'autres, qui sont douées de propriétés différentes ou opposées. Nous n'avons fait alors aucune difficulté de leur en substituer d'autres que nous avons empruntés principalement du Grec . . .'

Already Lavoisier admitted the necessity of basing himself on the natural language of men. Where he built further, basing new words on new

experimental knowledge on a system *motivé* by science rather than by language, he was not always right. He thought *oxygen* an unimpeachable term because he believed that it alone was capable of engendering acids, and in this he was mistaken. With problems that lie in this area international committees still grapple in trying to reach conventions on words and establish glossaries. The concepts and the words still refuse to fall neatly into 1 : 1 relationships.

Where Lavoisier divided his science into things, ideas and words, French linguists today are obviously more empirical and less prescriptive. It is generally thought that there are rather several levels to be considered. Guiraud thinks in terms of three levels:

(1) Ordinary language
(2) Scientific language
(3) An intermediary language used in popularised science.

André Phal on the other hand ('De la langue quotidienne à la langue des sciences et des techniques), *Le français dans le monde,* no. 61, décembre, 1968) insists on distinguishing between :

(1) Fundamental science (say, geology)
(2) The technical applications (say, in prospecting)
(3) Science as it is *taught,* and popularised
(4) The specific lexis belonging to a particular branch of science and technology.

At a meeting at St. Cloud in 1965 in *L'initiation des étudiants et chercheurs étrangers à la langue scientifique et technique* (CREDIF, Ecole Normale Supérieure de Saint-Cloud, 1966) he had declared his conviction that the system of scientific language is not substantially different from that of ordinary language, and had drawn attention to the need for a wide *vocabulaire usuel* and to the different degrees of specificity in scientific terminology. In an article he has written in conjunction with Jean-Luc Descamps ('La recherche linguistique au service de l'enseignement des langues de spécialité', *Le français dans le monde,* no. 61, décembre, 1968) further subdivisions are suggested :

(1) that there is an extremely esoteric vocabulary which is not scientific but which adheres to certain trades and applied techniques;
(2) that the words of highly specialised science are sometimes common and banal, but used in senses peculiar to the subject;
(3) that much of the vocabulary of science is borrowed from non-technical spheres (i.e. the *teeth* of a gear-wheel the *wings* of an aeroplane etc.);
(4) that learned words derived from Greek and Latin form only a part of scientific language;
(5) that it is appropriate to regard technical vocabulary as specific to a given technology.

These rough analyses were based on personal judgments and were made before they could be supported by statistical evidence, but they are

probably none the worse for that. On looking at mechanical engineering in this spirit, I hazard a division into :

(1) A general language of science and reasoning, including space and time relations
(2) An intermediary area of applied science to which belongs the terminology of force, stress etc., as does that of the behaviour and characteristics of metals
(3) The language in which engines and cars are described to the wider public
(4) The specific vocabulary, which includes workshop tools, a long list of machine parts, bearings, gears etc.

Such a break-down can serve as a rough reminder of the levels at which it is useful for students to gain language experience. Section (4) should perhaps be sub-divided, as two very disparate elements are here involved: the workshop tools are accessible to those of us with a knowledge of ordinary French, because we know already that things can be held in a vice etc., but the machine parts represent an area in which comprehension and accuracy are most difficult to acquire.

The project of listing a *Vocabulaire Général d'Orientation Scientifique* was undertaken at CREDIF with the object of identifying the common vocabulary necessary to all the sciences. The corpus worked over has been :

(1) 1,800,000 words from secondary school textbooks of mathematics and the natural and physical sciences
(2) 2,000,000 words from textbooks used in first-year studies in science faculties
(3) 2,000,000 words from encyclopedias, learned reviews and research reports.

The publication of results is still awaited. Work is proceeding in collocations and phraseology — particularly on the language peculiar to geology. The extension of interest beyond isolated items and to the grouping of words holds out the promise of very valuable materials for teaching in the future. Monsieur Phal speaks now with confidence of the definition of *la langue du raisonnement*. Michael Holland's report on 'Deficiencies in the written French of first-year university students' in *Post-O-level studies in modern languages*, edited by C. V. Russell, Pergamon Press, 1970, diagnoses an absence of this language of discussion. I will not be alone in saying that I and my colleagues in Birmingham give the phraseology of cause, consequence, proof, hypothesis, dissent and so on more earnest attention, conducting our own little forays into texts likely to illustrate well the use of verbs and connectors characteristic of this system. It is much to be hoped that CREDIF will release findings from V.G.O.S. and publish them in bits, without waiting for the completion of a large body of findings, as the needs are urgent in this sphere. In science, valuable analysis of stylistic objectivation is forthcoming.

Of course the English when learning French have little need to make a special study of learned prefixes and suffixes, so close are our two languages, and the work French experts are suggesting on *arborescences* will be of less utility here than in Asia[5]. It may be partly for the same reason that persistent warnings that words may take on a new meaning in a science context seem somewhat superfluous. *('Opération' n'a pas le même sens en arithmétique, en science économique, en chirurgie.)* For if science generally — like space-travel — borrows from other familiar spheres of experience, is it not because the figure, the metaphor, is an almost universal resource? And in that case, cannot the foreign student, as well as the national, cope with the vocabulary usage so generated, provided he has sufficient knowledge of the *ordinary* language? Some enquiry of a psycho-linguistic nature might be able to help teachers teaching their own language to gauge more accurately what an intelligent foreigner's capacity for inference is likely to be. There is shortly to be published a manual composed by M. Jacques Masselin, under the auspices of the *Ministère des Affaires Etrangères,* which will offer a series of ten lessons in the French of scientists suitable for learners who have little knowledge beyond the level of *Voix et images de France.* M. Masselin has broken with the 'personalising' tradition, and with the predominantly oral approach, of CREDIF, believing that the language of science belongs first and foremost to the world of literate communication. In composing this work he had access to the analysis of the word-counts done for V.G.O.S. on school textbooks, and we can expect to find here materials which will be the result of exemplary thoroughness and fine co-operation.

There is a source of help issuing from France which is of quite another type. I am thinking of the schoolbooks and textbooks used by young French people themselves. If the language my students need to acquire is learned by the French schoolboy in the course of his secondary education then the manuals prepared for secondary schooling are a reasonable place to seek for models, whether or not a frequency-count has been effected on them. It is held by Piaget, I believe, that we begin to perform what he called 'opérations' as we begin our secondary-school training. New concepts and new operations are introduced in conjunction with the language that can communicate them. If this is so, schoolbooks offer us a means of discovering *la langue du raisonnement* in a gently progressive manner. However if the language is new to our students, the matter of such manuals is already familiar to them, so that on reading them they can use inference as a means to comprehension and rarely need to punch a dictionary.

Similarly for the acquisition of a basic technological vocabulary I have made use of *Sciences appliquées* (Orieux et Evernère, Classiques Hachette, 1958) intended for boys in *Cours complémentaires.* The density of unknown vocabulary items in the sections on machine tools and the internal combustion engine is very high. Nevertheless, the familiarity of the material and the ample diagrams and illustrations make it readily accessible. Nor must it be

[5] A. Phal et J.-L. Descamps, op.cit.

forgotten that there is, alas, something rebarbative about the genus 'manual', however well prepared the materials may be, and foreign learners respond more eagerly as soon as they feel they are being brought into direct contact with the authentic. Popularisation intended for adults can be similarly used at a later stage, and once a sufficient language standard is reached a student can dip into the textbooks used by his opposite numbers, the students in France who are covering the same ground. Only at an advanced stage however should they use a foreign textbook to break new ground in a technical subject, unless their teacher is also a technologist and is able to control their work closely.

I know of only one manual published in France which aims to teach the language of engineering in English: Pierre Naslin's *Leçons d'anglais scientifique et technique,* Dunod, 1956. As it gives French equivalences to the English text it can be used by us in reverse, but it mainly provides me with short texts which I can ask students to explain and define — in the manner of the journalist defining a count-down, and it is above all the *general* scientific language that is being practised in such an exercise.

A branch of science which calls heavily on mathematics and symbols presents students abroad with problems of verbalisation. My students and I have had to call in French-speaking engineers and ask them to dictate on to a tape recorder pages of symbolic writing. Need I add that I have then to trust the students to acquire what skills they will from the tape and graphic prop? There is a point where a member of the Faculty of Arts ceases to try.

I would not relish the task of presenting even a few samples of technological French to students who were not simultaneously pursuing a study of the language in other directions, and learning to compose in writing on a variety of topics, to understand perfectly by ear, and to converse. It is when general competence exists that a *langue de specialité* can be assimilated, and without it the *langue de specialité* cannot be handled with intelligence. And then what we all desire is that young people should go abroad to further their education or experience with a sound *tronc commun* of the foreign language at their command, ready to enrich themselves by acquiring more ideas and new language to go with them at one and the same time.

— 8 —

A language laboratory course to teach German to chemists

W. GRAUBERG

At the University of Nottingham the Department of Chemistry has for many years demanded from all its single Honours students the ability to understand a passage of German taken from a contemporary source. Since October 1970 the attainment of a satisfactory standard is no longer a necessary qualification for a single Honours degree; however the German examination is now considered to be one component of the Part II examination. The number of students each year has been high, rising to 80 in recent years; more than half of these have had no previous German language instruction. The Chemistry staff responsible for the course were dissatisfied with the traditional approach, in which a number of passages was simply translated in a large class with insufficient student involvement. They therefore sought, in co-operation with the Director of the Language Centre, to evolve a more satisfactory and efficient course, which should:

(i) teach a technique for studying German rather than limit itself to practice in translation;
(ii) be as efficient as possible by selecting the most important features of German grammar and vocabulary to be found in chemical literature and introducing them, where necessary, in a new order;
(iii) be realistic in its aims by seeking to develop both the ability to grasp the main ideas of a longer passage without translating and the ability to translate where necessary;
(iv) involve students by stimulating individual effort and giving them a sense of progress by utilising the principles of programming.

After various approaches had been tried (a combination of lectures and language laboratory sessions, a branching programmed course in booklet form) a new course was devised for the 1968-69 session and given to 64 second year students in the spring term. Although minor changes in the arrangement and expression have been made each year, the content and form have remained unaltered since then.

Three members of the Chemistry staff, with some assistance from the present writer, have been responsible for the writing of the course. They all have a good knowledge of German, and they know what kind of material a chemist may be expected to read today and where he would find it. Thus they have been able to choose passages of the right nature and standard, drawn from contemporary sources. Their familiarity with German chemical writing has helped to determine the order of presention of grammatical structures. (Thus the past participle is introduced first with the passive and only later with active compound past tenses.) Through their own double competence they can show a student how he may draw on his knowledge of chemistry to understand the German text, and how he can use formulae and equations to assist him in the interpretation of verbal information.

The choice of the language laboratory as the main place and medium of instruction needs some explanation. There is no attempt to promote oral skills, although the German texts are read by a native speaker and the student is often asked to repeat a German sentence. Nor is the language laboratory used for drills, as is customary in much foreign language teaching. The main reason for using the language laboratory is that teaching in a large class is thus replaced by intensive individual work in a booth. The student listens to the explanation of new concepts on the tape and tests his understanding of them step by step, through recognition of grammatical features, through translation and, at a later stage, through inference of meaning and short summaries. He still has his fellow students around him and he can turn for further guidance to the lecturer at the console, but the emphasis has been shifted from teaching to learning.

The need for active learning efforts is made all the more urgent by the shortness of the course. It lasts for one term only and consists of only nine one-hour classes, supplemented by fifteen to twenty hours of homework devoted to lesson preparation and to reinforcement exercises. Seven classes are given in the language laboratory, the last two, before the final examination, take place in the classroom. Students are expected to buy a reference grammar and a dictionary suitable for chemical German, and they receive, as supporting material for each lesson on tape, the text of the examples used, together with a vocabulary, a summary of the grammar covered and follow-up exercises.

The course presumes no previous knowledge of German. Each lesson sets out to teach some major grammatical features, using as basis and illustration groups of model sentences. At first these are short and simple, then longer and more complex sentences are introduced, and finally paragraphs and passages are used. In a group of perhaps three model sentences, the first would serve for the analysis and explanation of a new structure, the next two for practice and consolidation.

As an illustration, the first two model sentences in the first lesson may be quoted, designed to show how the subject-object relationship is indicated by the case system.

The student hears the first sentence: *'Der Kolben enthält den Stoff'* and is told that it means 'the flask *(der Kolben)* contains *(enthält)* the material *(den Stoff)*'. Then the sentence is analysed in detail as follows:

> 'The verb comes from the infinitive *enthalten* = to contain, *enthält* is the third person singular form and means "contains". *Der Kolben* — *Kolben* is a masculine singular noun meaning "flask"; *der* is nominative singular in front of a masculine noun. So *der Kolben* is nominative and must be the subject of the sentence. Note that verb and subject are both singular — they must agree in this way in every sentence in both German and English. *Den Stoff* — *Stoff* is a masculine noun meaning "material"; *den* is the form of the definite article used in front of a masculine noun in the accusative case, so this must be the object. Translation: "The flask contains the material".'

Then the student is expected to analyse and translate a similar sentence with the help of his vocabulary notes and a reference sheet containing the required grammatical information. He hears sentence 2: *Der Trichter enthält den Niederschlag.* Then the tape proceeds:

> What are the genders of the two nouns in sentence 2?
> (20 seconds gap for the student to record his answer)
> *They are both masculine.*
>
> Now look at sheet 1 to remind yourself what are the inflected forms of the article for masculine nouns. Stop the tape until you have done so, now. Which of of the two nouns is in the nominative case and so must form the subject of the sentence?
> (20 seconds)
> *Der Trichter.*
>
> What case is *den Niederschlag?*
> (20 seconds)
> *Accusative or object case.*
>
> Translate the sentence.
> (20 seconds)
> *The funnel contains the precipitate.*

Then the tape goes on to deal with sentences where the object is at the head of the sentence, i.e. where the word order is different from English, proceeds to the complement after the verb 'to be', to the genitive — stressing that 's' is not a marker of the plural as in English, but of the genitive singular of masculine and neuter nouns — to some prepositions and finally to singular personal pronouns, starting with the indefinite subject pronoun *man.*

In all, fourteen sentences are used for analysis and guided translation and four more examples, including one of some length, are given in the student text for further practice at home.

The approach, as the ilustrations from lesson I have shown, is by grammatical analysis of the sentence structure, followed by translation.

(Very few students have any difficulty with the grammatical terminology.) Attention is also drawn to those cases where context rather than structure reveals meaning, but, in the main, the questions in the early lessons seek to give the stuent confidence in his analysis procedures, show him how to avoid hasty conclusions, provide him with recognition devices to distinguish, for example, a preposition from a separable prefix, or a relative pronoun from a definite article of identical form, and indicate how punctuation marks can serve as aids to interpretation.

As the course progresses the scientific writing to be studied is more complex, and the problem frequently becomes one of distinguishing variously embedded clauses. A whole lesson is devoted to the adjectival phrase, where the article and its noun may sometimes be separated by half a line of print, as in example 64 :

> *Der Vergleich der Spektren mit* ***den*** *früher von uns an verwandten Komplexen* ***gemessenen*** *erlaubt eine eindeutige Zuordnung sowohl der Centralionenbanden wie der Ligandenbanden.*

Gradually the amount of help given to students in the printed text decreases, and greater reliance on the dictionary and on reference grammar is expected. From the seventh lesson onwards the skill of scanning is developed, i.e. the ability to read longer texts and to gather the gist of the information contained in them without a full translation. Students are given a text of about 300 words, and are invited first to read through the comprehension questions that accompany the text, then to look at the passage with those questions in mind. The tape helps the student to tease out the meaning of the passage by reminding him of earlier language acquisitions, pointing out clues provided by formulae and equations and even encouraging some intelligent guesswork. Finally the tape returns to the comprehension questions and suggests in what part of the passage some of the answers may be found. The examination that students sit in the tenth week of their course, often taken from a current research article, similarly contains four or five comprehension questions, followed by a translation question.

It will be seen from this description that in this course translation constitutes the starting point although it is not the final objective, and grammatical analysis is regarded as the key to understanding. The clearly defined aims of the course, the scientific outlook and training of the students and the strict limitation of time imposed by a very full timetable have all contributed to the selection of this particular approach.

The results achieved so far have been satisfactory. Students have responded well to the course, and the standard achieved in the final examination has risen. Several students choose to carry out in their third year projects that involve the consultation of German sources.

The experience gained with the present course should prove of value in the preparation of a new course with the same aims, but produced both in a form suitable for class teaching in a language laboratory and in

a form appropriate to self-instruction. This project is supported by the Office for Scientific and Technical Information (OSTI), and it is hoped that the courses, when completed, can be made available to other institutions and interested individuals.

APPENDIX I

Current research

The following extracts from CILT's Research Register describe research in progress in Britain on the teaching of languages to specialists in other subjects. A list of research on *The description of special uses of language,* which includes some work not mentioned here, is to be published in *Language-Teaching Abstracts,* vol. 5 no.1, January 1972.

580 S. Craven, Department of Modern Languages, University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET. *Associate:* J. Stagg.

The preparation of a language laboratory German course, to supplement and coordinate with advanced studies in German. The work at present forms part of the degree course in communication science and linguistics (German, philosophy and mathematics), but it will be equally adaptable to any similar undergraduate course, such as the University's 'combined honours' course comprising a science and a foreign language. The materials aim to promote (by laboratory and audio-visual aids) aural comprehension of, and oral facility in, high-level contemporary language in its manifold aspects: conference and documentary language, colloquial idiom, specialist technical terminology etc. Oral translation techniques are being developed. *Date begun:* October 1966. *Progress reported* : 1971 : basic materials completed; supplementary materials are being developed.

880 J. Adams, 23 Mount Avenue, Outlane, Huddersfield, Yorkshire. (Research at : Huddersfield Polytechnic, Queensgate, Huddersfield, Yorkshire.) *Associates:* Mrs. O. Haigh, J. - C. Arragon.

Drawing up of registers of language used in the marketing of textiles in France. The sources are advertisements, pamphlets and correspondence. The registers will be broken down into sub-sections (silk, wool, cotton etc.) and according to processes (weaving, dyeing). The purpose is to incorporate the most frequent expressions in course material used in the college for the textile marketing degree course (CNAA). *Date begun:* September 1968. *Progress reported* : 1971: word-count still in progress.

883 M. G. Thomas, Languages Division, Thurrock Technical College, Woodview, Grays, Essex. *Associates:* R. Heidemann, A. Nuss. *Sponsor:* Nuffield Foundation, through Committee on Research and Development in Modern Languages.

Preparation of export marketing courses in French, German and Spanish. Courses in French, German and Spanish designed for advanced students in these languages; the subject taught is the technique of face-to-face selling, using the foreign language as the teaching medium. Method: language laboratory and classroom-based training. For publication. *Date begun:* September 1967. *Progress reported*: 1971: validation of completed course in progress, for completion in 1971.

887 Professor R. E. F. Smith, Department of Russian Language and Literature, University of Birmingham, PO Box 363, Birmingham B15 2TT. *Associates:* N. F. C. Owen, J. Mullen, L. Ross and 3 other associates. *Sponsor:* Department of Education and Science, through Committee on Research and Development in Modern Languages.

Language laboratory course in Russian for social scientists. The aim of the course (about 75 hours) is to give social science students a passive knowledge of Russian by means of a taped language laboratory course supplemented by booklets. The course is intended for self-instruction, as well as for use with a teacher, by students of the social sciences; it will branch into three sections: sociology; political science and economics; and possibly, if time allows, into engineering, mathematical economics and the computer. *Date begun:* September 1968. *Progress reported*: 1970: article published in *ATR* Occasional Papers, vol.4 no.1, 1970; 1971: the course is virtually complete; the project has been extended for a further year to test the materials that have been produced.

935 Dr Veronica M. Du Feu, Language Centre, University of East Anglia, Norwich NOR 88C. *Associates:* Mrs D. Boulton and 5 other associates.

Computer-aided grammatical study of written French, German and Russian texts in several disciplines. The aims are: a) to adapt and extend techniques and notation devised for the Contemporary Russian Language Analysis Project (University of Essex) to cover only written texts in French, German and Russian, and to include some morpheme analysis; b) to apply the analysis and notation to texts in chemistry, history, and history of art and music; c) to evaluate, with computer assistance, the frequencies of occurrence of items; d) to produce purpose-built courses for students of the disciplines concerned. *Date begun:* October 1969. *Progress reported*: 1971: analysis code finalised; work held up temporarily for lack of computer programme.

944 M. G. Thomas, Languages Division, Thurrock Technical College, Woodview, Grays, Essex. *Associates:* R. Heidemann, A. Allpress, A. Nuss. *Sponsor:* Ford (Dagenham) Trust.

Preparation of a conversion course in German for industry. The course will be designed to make the transfer from a general working knowledge of the language to its commercial and technical applications. *Date begun:* September 1969.

948 S. Hind, 34 Windsor Road, Formby, Liverpool. (Research at: Liverpoo. Polytechnic, Byrom Street, Liverpool L3 3AF *and* University of Nottingham.) *Associates:* Professor W. E. Yuill, Dr. R. R. K. Hartmann (University of Nottingham), tutors.

A lexicometrical analysis of German vocabulary in the field of heavy electrical engineering. The aim is to discover which are the most useful words to teach English electrical engineers, and to what extent the specialised vocabulary is intelligible with a basic knowledge of German. The vocabulary used in the 1970 and 1971 issues of the two journals of the Verein Deutscher Elektrotechniker is to be examined with the help of a computer; the tapes used for type-setting have been donated for this purpose. For degree of MPhil. *Date begun:* September 1968. *Progress reported*: 1971: awaiting completion of computer programme.

982 Dr J. Jelinek, Centre of Japanese Studies, University of Sheffield, Sheffield S10 2TN. *Associate:* F. C. Stork (Language Centre). *Sponsor:* Office for Scientific and Technical Information.

Development and evaluation of an intensive course of scientific and technical Japanese. Specialists are to achieve a reading knowledge of texts on their specialism in an 8-week supervised course, and to improve by further independent practice, or by following an unsupervised self-teaching package with controlled interim results. The course will be programmed, comprising lecture-type instruction followed by drilling with feedback and supervised application of acquired material. An automatic analyser developing into a set of manual auxiliaries is used in place of traditional grammar teaching. Instruction is limited to a reading knowledge of the technical and scientific style of Japanese; no speaking skills are to be developed. Two pilot courses have proved successful; the supervised course is available annually at the University from 1972. Intended for eventual publication. *Date begun:* September 1969. *Progress reported*: 1971: research continues on development of unsupervised version.

995 H. G. Widdowson, Department of Linguistics, University of Edinburgh, Adam Ferguson Building, George Square, Edinburgh EH8 9LL.

An applied linguistic approach to discourse analysis. An examination of discourse analysis as a basis for the preparation of teaching materials, with special reference to the analysis of texts of scientific and technical English, and the preparation of materials for people learning the language as a service subject. For degree of PhD. *Date begun:* January 1969. *Progress reported*: see pp.31-40 and *English Language Teaching*, 1972.

1027 Dr L. Schonfelder, University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET. *Associates:* S. Craven, adviser; Mrs L. Johnstone.

Preparation of a language laboratory French course, to coordinate with post-'O' level studies, up to final honours degree level. The material is to be used in a new course called 'combined honours' (one science option, or mathematics, and one foreign language). The aims of the project are very similar to those of the research project already in progress in German (no. 580). *Date begun:* early 1969.

1033 C. A. Milner, Department of Social Sciences and Economics, Loughborough University of Technology, Loughborough, Leicestershire.

The collection of language laboratory material for the degree course 'Languages, politics and economics of modern Europe'. Recordings are made by French nationals talking informally about their professional activities. The aim is to collect material interesting both in terms of the vocabulary used and of the light it casts on French institutions. *Date begun:* January 1969.

1127 P. T. Culhane, Language Centre, University of Essex, Wivenhoe Park, Colchester, Essex. *Associates:* P. Frank, D. Lane, A. McAuley.

The preparation of Russian text materials in specialist disciplines using a computer for analysis of vocabulary. Material has been collected and punched dealing with two aspects of sociology (marriage and the family, and social stratification), economics (collective farms and collectivisation) and political history from 1856. The total corpus is 150,000 to 200,000 words. This will lead to publication of a series of readers for university students. *Date begun:* 1969. *Progress reported*: 1971: lists of common non-cognate lexical items in political texts and in sociological texts prepared.

1128 Dr M. F. A. Dove, Department of Chemistry, University of Nottingham, Nottingham NG7 2RD. *Associates:* C. S. Butler, research officer; W. Grauberg and 2 other associates. *Sponsor:* Office for Scientific and Technical Information.

Preparation of a course in German for chemistry students. No previous knowledge will be assumed. The aim is to develop an experimental language laboratory course for teaching chemistry students (and graduates in chemistry) to read German chemical literature, primarily for comprehension but also for translation; then to compare and evaluate this course; and finally to develop a fully programmed form for self-instruction. Publication intended. *Date begun:* August 1971 (earlier work 1968).

APPENDIX II

Participants

Miss V. Adamson, *University of Birmingham*
D. Adshead, *University of Birmingham*
F. E. Bell, *Bell School of Languages, Cambridge, and Concord College*
Dr. G. Bezzell, *University of Birmingham*
M. G. Butler, *University of Birmingham*
A. Butterworth, *University of Birmingham*
R. H. S. Cook, *University of Edinburgh*
J. Cooper Rudd, *Summerfield College of Education*
Dr. M. Coulthard, *University of Birmingham*
Dr. M. F. A. Dove, *University of Nottingham*
Dr. A. Fedosienko, *Tcheljalinski Politechnical Institute*
I. Forsyth, *University of Birmingham*
W. Grauberg, *University of Nottingham*
W. G. Hermann, *University of Birmingham*
Mrs. M. Hilton, *University of Birmingham*

Miss V. Huggins, *British Broadcasting Corporation*
T. M. Hunt, *Longman Group Ltd*
Dr. N. F. Ilynski, *Moscow Power Institute*
R. Jarvis, *University of Edinburgh*
Miss L. L. Keane, *Longman Group Ltd*
Miss M. King, *Office for Scientific and Technical Information*
Miss G. Llewellyn, *Birmingham Polytechnic*
Dr. B. M. Lott, *British Council*
R. Mackay, *University of Newcastle*
M. Macmillan, *British Council*
P. Morby, *University of Birmingham*
A. J. Mountford, *University of Edinburgh*
S. C. Murison-Bowie, *Oxford University Press*
R. E. Norris, *University of Birmingham*
G. E. Perren, *Centre for Information on Language Teaching*
A. R. Pester, *Wolverhampton Polytechnic*
Dr. L. Seiffert, *University of Birmingham*
P. J. Seccombe, *British Council*
M. Short, *University of Birmingham*
Professor J. M. Sinclair, *University of Birmingham*
Mrs. J. Susilvorn, *Longman Group Ltd*
N. Townsend, *University of Birmingham*
J. Voracek, *University of Birmingham*
J. S. W. Whitely, *University of Leeds*
H. G. Widdowson, *University of Edinburgh*
J. Wight, *University of Birmingham*
D. A. Wilkins, *University of Reading*
P. G. Wingard, *University of Manchester*
E. O. Winter, *Hatfield College of Technology*
M. E. Wydall, *University of Birmingham*