THE ACT OF EXPLANATION IN A CLASSROOM CONTEXT

AND LEARNING

WITH PARTICULAR REFERENCE TO THE TEACHING OF SCIENCE

by

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ABSTRACT

The thesis is concerned with the act of explanation in classroom contexts, with emphasis upon secondary teaching particularly in science. Over one hundred explanations in eight subjects (Mathematics, Physics, Chemistry, Biology, English, History, Geography, Foreign Languages) are analysed and some fifty teachers, teaching more than one thousand pupils, are involved in studies which are cross-sectional, analytic and descriptive, utilising four instruments, namely, rating sheets, experiments, typologies and models to investigate the concerns of ten hypotheses.

The rating sheets used with teachers and pupils in relation to Hypotheses H1 and H2 reveal explaining as the most central and important activity of teaching and learning, especially in science.

Typologies employed for Hypotheses H4, H5 and H7 reveal respectively:

relationships between question type, concept type, communicated meaning and subject origin of an explanation,

understanding by pupils of their teacher's explanation shows wide variety and ranges from satisfactory to fragmentary.

Experiments conducted in relation to Hypotheses H6 and H8 give results that show respectively:

the gap between intended meaning and received meaning to be wider than teachers realise,

unfamiliar, non-technical terms block pupil understanding.

Models used in analysis for Hypotheses H3, H9 and H10 reveal respectively:

two-thirds of explanations given by teachers meet philosophical conditions for deeming them to be such,

contextual features influence the success of an act of explanation,

conceptual features influence the success of an act of explanation,

and unfamiliar non-technical words as blocking pupil understanding.

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1.0 INTRODUCTION

1.0 INTRODUCTION

Educational theory is normally in advance of general professional practice but given a period of change of the order experienced over the past forty years and it is impossible not to come across in schools resources and practices of one kind and another that were not in evidence at the beginning of the period. The reverse is also true. There are things that occur but rarely now, if at all, that were once common practice. To assess the influence upon day-to-day teaching and learning at this time is a difficult task. In the first place, the period of change is an extensive one and though there are signs that the rate of production of new theories and methods is slowing down there is something of a backlog of schemes and innovatory ideas that it is only just catching up with many schools. At the same time, a substantial number of schools have tried out some of the innovations and are either continuing with them or, having found them wanting, have discarded them.

One change that schools have in common, regardless of an individual school's response to change in general, is their willingness to admit as 'teaching' a much wider range of activities than was the case forty years ago. This is not to say that individuals necessarily make use of all or any of the newer activities in their own teaching. There is still great variation among teachers over what they accept and reject in relation to their own organisation, methods and performance.

The focus of this thesis is explaining, but the context in which it is examined is that of teaching and learning. Therefore, it is necessary and potentially useful to consider the characteristic behaviours that go to make up the activity of teaching with the object of revealing the position of explaining within teaching. It is likely that not all the activities of teaching are seen by teachers to be of equal importance and that some consensus of opinion exists concerning which activities are perceived as central, irrespective of ideological persuasions. These matters will be discussed within the context of teaching behaviours with the object of establishing explaining as one of the central activities. It will also be necessary to examine the features that teaching and explaining have in common and to identify distinctions. This task is more difficult because of the range of activities that are covered by the term teaching and the fact that explaining and explanation are not straightforward concepts.

Teachers are concerned both with the activity of explaining and with the communication of ready-made explanations. It is therefore necessary to define the verb 'to explain' and make clear how it is used in teaching. It is also necessary to identify the different kinds of explanations that teachers will be expected to handle and justify the choice of explaining something to someone as being the most relevant for teaching and learning. Examination of the conditions necessary for deciding that explaining something to someone is taking place will be undertaken and because the activity is being considered in the context of teaching and learning it will involve the discussion of philosophical and pedagogical factors.

There is all the difference between obtaining a set of conditions that account for explaining something to someone and achieving the objective of an explaining episode, which is understanding for the receiver of the explanation. The problem of understanding and the associated problem of the communication of meaning will demand discussion in the light of philosophical consideration and theories of language use and communication. Even so there may be other factors that are not covered by these theories which are influential in relation to accounting for the gap that can exist between a teacher's intended meaning and that which is received by the pupils.

An associated problem that needs to be included in a discussion of the 'gap' concerns differences among teachers in respect of their effectiveness in explaining something to their pupils. Certain research findings will be cited that reveal a variety of variables from categories that are broadly linguistic or strategic in character. These and the conditions identified from philosophical and communication theory will be used as a foundation for converting the questions that the thesis seeks to answer into hypotheses to be examined through a number of practical studies. The questions arise from the three major issues of the theoretical discussion, namely, the extent to which explaining (rather than telling) is a central activity of teaching; the nature of the gap between a teacher's intended meaning and the pupils' received meaning and, finally, the dentification of some of the features that cause confusion of meaning and others that appear to facilitate understanding.

C H A P T E R 2

1.0 THE ACTIVITIES OF TEACHING

Teaching is essentially a practical activity and, in attempting to arrive at conclusions about what is involved in it, it is useful to observe the behaviour of teachers as they go about their normal every-day work. Among the information gained in this way will be many items that can be eliminated because they occur when the teacher is not engaged in teaching. Those items that do occur during teaching sessions will be unequal in respect of their generality and of variable importance from one session to another.

1.1 The Concept of Teaching

Green (1971:4) in an analysis of the activities of teaching suggests three major categories into which the acts of teaching may be placed, namely, logical acts, strategic acts and institutional acts. He offers an expanded version of each category as follows:

The Logical Acts	The Strategic Acts	The Institutional Acts
1. Explaining	1. Motivating	1. Collecting money
2. Concluding	2. Counselling	2. Chaperoning
3. Inferring	3. Evaluating	3. Patrolling the hall
4. Giving reasons	4. Planning	4. Attending meetings
5. Amassing evidence	5. Encouraging	5. Taking attendance
6. Demonstrating	6. Disciplining	6. Consulting parents
7. Defining	7. Questioning	7. Keeping reports
8. Comparing		

For the purpose of this work it is not necessary to take account of institutional acts and, indeed, Green himself (ibid:5) states that 'there is no inconsistency in the idea that teaching may go on even when the institutional acts of teaching are not going on.' As a major concern of the thesis is with explanation, the activity of 'explaining', which Green places at the head of his logical acts, will be discussed in relation to other items included in this category and also with reference to 'questioning' which appears under the head of strategic acts. Presumably, Green's choice of the strategic category for questioning is informed by the use teachers make of the activity as a strategy for eliciting a range of distinctive responses from pupils, which include the giving of reasons or explanations. However, questioning is more closely involved with explaining than is suggested by its categorisation as a strategic act. The relationship has to do with the notion that contained within the concept of explaining (and, indeed, explanation) is the implication that there exists some underlying question that has set the activity in motion and to which the explainer addresses himself. Furthermore, the question need not be formulated explicitly before, during or after the explaining episode. This view, which is popular with philosophers concerned with explaining and explanations, will be given fuller discussion in the next chapter.

Although Green (ibid:6) does not see the institutional acts of teaching as essential for believing that teaching is going on he takes up a different position in respect of the logical and strategic acts. The absence of either would, he believes, 'count heavily against the view that teaching was going on' while, in the absence of both, it would seem 'impossible to maintain that we have considered a case of teaching.' He suggests that differences do exist between the logical acts and the strategic acts of teaching which are largely to do with their evaluation. He maintains that the 'performance of the logical acts of teaching is appraised on logical grounds' and that in the case of strategic acts of teaching, it is appraised by its consequences for learning. Thus, a logical act of teaching, such as giving reasons, can be evaluated independently of its result for the learning. It can be deemed well done even though no one learns, because the criteria for appraisal are to do with the subject to be taught, the ways of knowing and the laws of thought. Strategic acts of teaching on the other hand are concerned with succeeding in getting someone to learn and thus demand of the teacher an understanding of human development, motivation and learning theory. In practice, the distinctions between logical and strategic acts of teaching are not apparent. This is because logical acts rarely appear other than in the context of some teaching strategy.

There is support for Green's view that teaching need not necessarily entail learning in the writings of B. Othanel Smith (1969:108) who contends that 'just as one can learn without being taught, one can be taught without learning.' Smith (ibid:109) takes the view that teaching is everywhere fundamentally the same and that a theory of teaching will consist in:

(a) a statement of the variables comprizing teaching behavior,

(b) a formulation of the possible relations among those variables, and

(c) hypotheses about the relations between the variables comprizing teaching behavior and the variables descriptive of the psychological and social conditions within which teaching behavior occurs.

He is at pains to point out that when using the term teaching he is not thinking of it as an activity that can be carried on without talking nor as one that can be described through reference to books on methods. He views teaching as 'a system of action involving an agent, a situation and an end-in-view.' Within the 'situation' he identifies two sets of factors - one set cannot be controlled by the agent (for example, size of classroom, age of pupils, etc.) while the other set can be modified by the agent with respect to the end-in-view. (For example, asking questions, giving homework, etc.)

The sets of factors under the control of the agent are the means whereby the end in view is reached. Smith (ibid: 109-10) claims that the means consist in two types of factors. Type (a) which he identifies as subject matter and instructional paraphernalia, he calls material means and type (b) which are ways of manoeuvering type (a) factors, he calls procedural means.

This division may appear to be similar to Green's logical and strategic categories and, indeed, Green's strategic acts and Smith's procedural means are concerned with activities that are of the same kind. However, logical acts and material means do not match up readily. Most items classified under logical acts would qualify as procedural means. Smith does not engage in a full discussion of what he means by material means, his investigations being solely concerned with procedural means.

In his discussion of procedural means Smith (ibid:110), like Green, makes use of the term 'strategy'. For him, it is a large-scale manoeuvre, which he distinguishes from the smaller tactical elements of strategies that he calls 'episodes'. He expands the meaning of the term strategy with a statement about it referring to a 'pattern of acts that serves to attain certain outcomes and to guard against certain others' and identifies a number of general objectives towards which a strategy may be directed. Among these are:

> to ensure that certain learnings will be acquired in as brief a time as possible; to induce students to engage in exchange of ideas; and to minimize the number of wrong responses as the student attempts to learn a concept, principle, etc.

Smith further agrees that strategies are often used by teachers to ensure the attainment of certain content objectives and are not confined to ways of thinking or open-ended discussion. Episodes are described as 'pedagogically significant units of classroom discourse' consisting of two or more utterances, where an utterance is what an individual says at a given time. The simplest form may be A asks a question of B, B responds with the answer and A acknowledges the response. In short, episodes are verbal exchanges involving at least two persons and this distinguishes them clearly from monologues which are solo acts. The example of an episode, given above, involves two persons (A and B) who are alternately responding to one another; this kind of episode Smith (ibid:111-12) refers to as a reciprocating episode. Where the episode involves more than two people, response is to the entry rather than to one another so that the responses are co-ordinated, which gives the unit the name of co-ordinating episode. He suggests that from a psychological standpoint an episode represents 'a gap to be filled with information.' A subject is offered, or a piece of information given at the opening of the episode - or entry - in which some specific outcome is more or less implicit. The behaviour that is stimulated by the entry fills the gap between the entry and the closing of the episode.

Smith (ibid:113) contends that it is possible for episodes to be viewed as logical operations because of their similarity to ideal logical operations whose performance is rule-guided. From his studies of teaching behaviour he identifies twelve logical operations as follows:

> defining, describing, designating, stating, reporting, comparing and contrasting, substituting, classifying, opining, valuing, conditional inferring and explaining.

A comparison of these operations with Green's logical acts (see p.12) finds half of Green's items (explaining, inferring, defining, comparing) present in Smith's list. Furthermore, seven items cited by Smith but absent from Green's analysis (describing, designating, stating, reporting, substituting, classifying, opining) and three items in Green's logical acts not identified by Smith (concluding, giving reasons, amassing evidence), appear to be activities of the same order.

Two discrepancies are present that are worthy of further examination. In the first case, demonstrating is not identified by Smith as a logical operation. This may be because on many occasions the activity will involve non-verbal behaviour when, for Smith, all episodes are defined as verbal.

However, there are numerous instances in teaching when demonstrating is verbal and rule-governed, and thus would qualify as a logical operation and its non-appearance in Smith's list may be nothing more than an omission of the kind that commonly occurs when attempts are made to identify and categorise all the behaviours that qualify for inclusion in a complex activity such as is the activity of teaching. The same point can be made in respect of Green's logical and strategic acts and, indeed, he makes no claim that either list is exhaustive.

The other discrepancy is found in the categorisation of valuing and evaluating. If we take them to be different terms for the same activity, Smith categorises the activity as a logical operation and Green as a strategic act. Examination of the use of evaluation suggests that categorisation under both heads is justifiable. The reason for this is that the function of evaluation varies, as does the subject to be evaluated.

A teacher evaluating an argument in support of a contention, the force of a theory, or conflicting interpretations of a problem arising in a specific subject area is engaging in rule-bound activity, or in Green's terms, a logical act, requiring a knowledge of the methods of knowing, the performance of which will be appraised on logical grounds. On the other hand, if the teacher is using evaluation to place pupils (placement evaluation) [1] obtain feedback for himself and the pupils (formative evaluation) [2] identify gross learning problems (diagnostic evaluation) [3] or to attest a pupil at the end of a course (summative evaluation) [4] he is engaging in a strategic act that will be appraised by its consequences for learning.

(1-4) The terms are those used by Airasian P.W, and Madaus G.F. in their paper 'Functional Types of Student Evaluation' in Mehrens W.A. (ed) (1976) Readings in Measurement and Evaluation in Education and Psychology.
Holt, Rinehart & Winston. New York.

Before passing from attempts to analyse the activity of teaching to closer examination of certain operations within this activity one further example of a classification is worthy of note. Komisar (1969:73) from a standpoint that distinguishes teaching from non-instructive activities by viewing it as 'an end-chasing performance, takes learning as the end being chased.' He (ibid:76) distinguishes between intellectual acts and teaching acts, as follows:

Intellectual Acts		Teaching Acts
introducing	proving	vindicating
demonstrating	characterising	interpreting
citing	justifying	indicating
reporting	explicating	instancing
hypothesising	defining	questioning
conjecturing	rating	elaborating
confirming	appraising	designating
contrasting	amplifying	comparing
explaining		

For the performance of an intellectual act to count as teaching, the teacher is committed to putting and keeping the learner in 'a perceiving - and - learning - able state and rendering the subject matter teaching - comprehend.'

Although this model offers many items that appear in the two already examined (see p.12 and p.16) and the similarity between Komisar's intellectual acts and the logical acts and operations of Green and Smith is marked, the comparison needs to be made in the light of an important distinction that lies in Komisar's contention that intellectual acts do not automatically count as teaching acts simply because they are addressed to the learners. The qualifications he makes with regard to the <u>state</u> of the learners and the treatment of the subject matter come close to offering support for the notion that teachers cannot be said to be engaged in teaching unless learning is going on as a result of the activity. If it does not do quite this there is no dodging the implication that teachers are to be held accountable for their performance as well as for the subject matter they choose to teach.

The attempts of Green, Smith and Komisar to arrive at an adequate description of the activity of teaching are of use primarily because they draw attention to the number and variety of acts that pass as teaching, through their 'lists'. They further attempt to impose some order upon the items included by categorising them on the basis of defining attributes that have to do with the nature of the act. This is also helpful, as far as it goes, but it leaves unsolved the problem of interpreting the exact nature of an act. The finer the categories become, the more difficult interpretation becomes, until in cases where there is a high degree of similarity, for example, 'explaining' and giving reasons, it becomes a matter for personal judgement. It is also true that the lists offer no information about the status of any one act compared with another in the same category.

The discussion of the concept of teaching attempted here is, of necessity, nothing more than a brief introduction to the factors involved but already it can be seen that teaching is best understood as a 'family' of activities certain of which are central and highly significant, while others are peripheral and of less importance.

1.2 The Status of Explaining as an Activity of Teaching

It has been suggested although teaching is best understood as a family of activities, some activities occupy a more central and important position than others. The comparison of the categories of Green, Smith and Komisar reveals certain activities that are common to each analysis within the category of logical acts. An activity of which this is true is that of explaining, a revelation that probably would come as no surprise to members of the general public who regularly offer evidence of their belief that school learning involves explanation and that they expect teachers to be involved in explaining as and when the need arises.

Teachers also appear to recognise the central position of explaining in teaching and learning. The evidence obtained by the present writer from an exercise in which some sixty teachers were asked to rank a combination of Green's logical acts and Smith's intellectual acts(1) in order of importance as activities of teaching found that over three-quarters of the sample placed 'explaining' first in the order and no teacher placed it lower than third position. Pressed to give reasons for their selection, most perceived explaining as giving answers to questions, clearing up perplexities, resolving uncertainties of the sort that pupils would be unlikely to settle for themselves. As one put it, 'explaining removes the blocks to understanding.' While we could argue that certain of the other activites included in the list have a similar function it is true that the relationship with understanding is very clearly marked in the case of explaining.

1.3 The Relationship of Learning with Teaching and Explaining

Teaching as a concept has a special status in education although it can equally well apply in more informal contexts, involving parents and children, friend and friend, specialist and group sharing a leisure interest.

It is also possible to identify the prime objective of all teaching as a quest for understanding which provides the strongest link with the concept of learning. Indeed, some writers discuss teaching and learning as though they are inseparable elements of the same concept. There are weaknesses in this position for, as has been mentioned earlier, teaching can occur without promoting learning and learning can occur in the absence of teaching. Attempts to define teaching come up against its characteristic conceptual vagueness - a problem that does not occur in defining learning.

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(1) The combination used is as follows: defining, describing, designating, concluding, classifying, comparing and contrasting, explaining, demonstrating, inferring, opining, reporting, stating, amassing evidence, valuing.

However, once the behaviours that qualify as teaching are agreed its overt nature ensures that there are no difficulties associated with deciding when it is taking place. This is not so in the case of learning where it is necessary to identify a change in behaviour as evidence for deciding that learning has occurred.

Their conceptual independence is suggested further by what Green (1969:12) refers to as an inability to discover in the concept of learning 'any principles sufficient to distinguish those kinds of learning aimed at in teaching from those which are not.' It seems reasonable to interpret the notion of 'learning that is not aimed at teaching' as including: (a) learning desirable and otherwise that may be acquired within the school or elsewhere but which is not perceived of as a goal towards which teaching is directed, and (b) undesired learning outcomes in which the learning interpretation of a teaching episode has been confused, idiosyncratic or erroneous.

Both desired and undesired learning outcomes may owe their genesis to an explaining episode. These episodes, which are much in evidence within subject teaching throughout the child's education, have as their goal, understanding, which in turn is normally a necessary outcome in the process of learning. In the case of desired outcomes it can be argued that as learners become involved in tasks that are more demanding in respect of their complexity, conceptual level and the range of cognitive activity called for, the more crucial to effective understanding is the act of explaining. Pupils appear to be well aware of this for among studies of their perceptions of the 'good' teacher are those who find 'the ability to explain things well' as the most frequently identified characteristic, many ranking it higher than affective qualities such as fairness, warmth and friendliness.

Teachers show awareness of their pupils' expectations for without exception the sample used to assess the status of explaining within the activities of teaching, interpreted explaining as a 'task' verb.[1] Many view the task as among the most challenging for the teacher and admitted that by implication there is no guarantee that understanding and, thus, learning will follow an act of explaining. This position is helpful when looking for reasons for the appearance of undesired learning outcomes from an explaining episode and, when appraised on logical grounds, meets the criteria satisfactorily. To use the distinction drawn by Green (1971:6) the performance as a logical act of teaching can be deemed well done but it has failed as a strategic act of teaching because strategic acts are concerned with getting someone to learn. In real life the situation is rarely as simple as this. More often a teacher will perform satisfactorily in a logical sense while explaining something to a class but the understanding and subsequent learning that arises out of the episode shows considerable variation from one pupil to another. Some of the possible variations (and the list is not intended to be exhaustive) are as follows:

acquires a sound understanding of the kind intended by the teacher;

will acquire a sound understanding with the addition of a small amount of information to clarify certain points;

acquires understanding of part of the explanation but has a distorted perception of the remainder of which he is unaware;

interprets the entire explaining episode inadequately and attempts to proceed on the basis of a false premiss;

makes no contact with the reasoning contained in the explaining episode, thus inhibiting the codifying and storage of information coming in to a degree that may result in total loss of the message.

With this small but distinctive range of outcomes in mind it is anything but a simple task to evaluate the performance of a teacher engaged in explaining something as a strategic act of teaching. Indeed, it appears unlikely that

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(1) 'Task' refers to Gilbert Ryle's distinction between task and achievement verbs, which will be discussed later in this chapter.

anyone would wish to defend a position where a necessary condition for judging a performance successful is that all pupils receiving the explanation understand it.

In the main teachers do show some awareness of the discrepancy between the result desired from an explaining episode and what occurs in reality. It is important to bear this in mind when attempting to interpret the kind of expectations teachers have of the responses they will receive from pupils in answer to what could be described as 'checking up' questions posed immediately after an explaining episode. For example:

Has everyone understood that?
Are you all with me?
Before I go on, is anyone not clear?
Any questions before you start work on the examples?

Most of these questions, which are common enough in both primary and secondary classrooms, tend to give the impression that the teacher expects that all but one or two pupils will have grasped the explanation and that the exceptions will need only a little additional information to reach a state of understanding. In the case of some teachers the impression is an accurate one and they will confidently assure one that 'the third year, top set, know all about the process of osmosis' because they 'explained it in detail the previous week.' Most teachers show greater awareness of the problems associated with getting an explanation understood than this. They may expect their pupils to perceive that the questions are giving them opportunities for seeking clarification of confusions, reiteration of crucial points or simply additional information in order that sense may be made of the message. In other words, the teacher is prepared to elaborate further, change forms of expression, offer more exemplars, etc. in response to cues from pupils regarding the gaps in or blocks to understanding that still exist.

Being prepared to respond in the manner suggested above, important though it is in teaching and learning, will not necessarily prevent a teacher from making assumptions about the success of explaining episodes that do not match the facts. A familiar response to questions asked after an explaining episode is not a battery of demands for further explanation but a steady silence that remains unbroken even when the questions are repeated. When this happens there will be occasions where teachers are tempted to interpret the silence as positive feedback. On rare occasions they will be right but, more often, the assumption is false. A mistake of this kind will be corrected later, if conscientious teachers check pupils' work based on the explanation, against clearly defined criteria for deciding how well the explanation has been understood. However, the difficulty of this task when some thirty pupils are involved, is very considerable and certain practices (getting pupils to mark their own or each other's work) prevent it taking place at all.

It is, of course, possible for teachers to ask for pupil responses in a manner that promises psychological rewards for asking questions in order to gain understanding, and still be met with silence. In this case, teachers are more justified than in the previous example in interpreting the silence as meaning that every pupil has understood the message, but it is doubtful that this state of affairs occurs as often as do the silences.

What then prevents pupils from responding? Setting aside those teachers who ridicule pupils when they fail to pick up immediately the explanation being proffered, we still cannot say with any certainty that teachers who are approachable and willing to discuss difficulties will be successful in getting pupils to admit to some lack of understanding. To do so is to ignore the degree to which pupil responses are inhibited by their perception of how their peers will react to their public admittance of a learning deficiency. While their perceptions can be inaccurate for reasons associated with each individual pupil's self concept, they can sometimes be based upon information communicated by other pupils who have not, themselves, failed to understand. Examples include overt expressions of impatience to get on with the next stage, contempt for what is deemed the stupidity of the pupils having difficulty understanding the explanation and expressions of superiority that reflect a state of mind that is likely to be in direct contrast with that of those pupils still confused. It is also true that the pupils who are confident that their peers perceive them as able in the subject show a greater willingness to admit to a degree of ignorance than those who are known, and know themselves to be struggling.

Several of the last points are worthy of fuller examination and this will be undertaken when problems of understanding are discussed in Chapter 4. At this stage they are mentioned in order to draw attention to the way in which 'learner' factors become crucial to the success of an explaining episode when explaining is evaluated as a strategic act (to use Green's terms) or procedural means (to use Smith's terms). What is necessary before proceeding further is some exploration of the concept of explanation with a view to arriving at an interpretation of its nature that is helpful to a consideration of its function in teaching and learning.

2.0 EXPLANATION AND EXPLAINING IN TEACHING

Explanation is a concept about which there are various theories. A selection offered by Taylor (1970:1) is summarised as follows:

> To tell us the purpose of things; to describe; to go beyond description and give in terms of laws an explanation of the behaviour of matter; to have as its aim understanding; the ability to predict and control events.

Within each of these propositions can be recognised both common and unique elements but, in the main, the concern is either with finding or discovering knowledge, or, with imparting or communicating knowledge. The distinction draws attention both to 'explaining' which is active and a matter of pedagogy and to 'explanations' which are neither action nor process, but products of investigatory activity to be gained, found, given, listened to, ignored, etc.

2.1 Explaining Something as an Achievement and a Task

The distinction that has been suggested above has much in common with that recognised by Ryle (1949) in respect of the verb 'to explain'. Ryle proposes that there are contexts in which it is an 'achievement' verb and other contexts in which it is a task verb. A context likely to call forth the former interpretation is that with which the researcher is familiar. In seeking to provide an explanation of a phenomenon for which no satisfactory explanation is known he is concerned with the discovery of new knowledge and the testing of hypotheses. His problem is one of deciding the appropriate kind of enquiry that will produce the information he needs to provide an explanation. When he succeeds in this it can be said that he has 'explained' something in the achievement sense of the verb.

One who explains in the task sense is not trying to find something out. He is concerned with imparting knowledge rather than seeking it. His problem is not one of deciding a method of enquiry, but of communication, of getting someone to understand a message. Martin (1970: 16) using Ryle's achievement/task interpretations reminds us that, ultimately, both are connected with knowledge and that both have as their goal, understanding. She goes on to say, however, that one who explains something (in the achievement sense) is a producer of explanations which constitute the raw material used in explaining something (in the task sense) to someone. Martin (ibid: 17) also points out that,

> .... the problems associated with how to get someone to understand something, which take one into the areas of psychology and pedagogy are not problems with which one who is <u>seeking</u> explanations of things must necessarily deal.

Clearly, studies in child development, learning theory, etc. which can inform the giver of explanations are not of use to the producer of explanations, unless they happen to be his area of research. Nor do we expect the giver of explanations to add to the body of public knowledge. His preoccupation is with enabling a person to understand something. The practical activity he engages in is not to do with controlled research but with finding effective ways of presenting explanations without loss of accuracy and with motivating people to come to grips with the notions they contain.

While teachers can be said to handle explanations in the achievement sense of 'explain', that part of teaching activity that would be categorised as explaining is clearly of the task kind, i.e. they are concerned with explaining something to someone. Although the essential differences between explanations that are for someone and those that are not may seem to be of small importance, if clarity is to be attained, and in a tutor-tutee relationship this is essential, the differences are of prime importance.

2.2 Explaining as Teaching and as Distinct from Teaching

In thinking of explaining something to someone as a tutor-tutee activity it is necessary to bear in mind that tutoring (or teaching), though it may involve explaining, is different from it. Reason and rationality are given a central role in explaining: that the same can be claimed of teaching is a view that has considerable support, including that of Scheffler (1960:57) who maintains:

> To teach in the standard sense, is at some points at least to submit oneself to the understanding and independent judgement of the pupil, to his demand for reasons, to his sense of what constitutes an adequate explanation. To teach someone that such and such is the case is not merely to try to get him to believe it: deception, for example, is not a method or mode of teaching. Teaching involves further that if we try to get the student to believe that such and such is the case, we try also to get him to believe it for reasons that are within the limits of his

> capacity to grasp and are <u>our</u> reasons. Teaching, in this way, requires us to reveal our reasons to the student and, by so doing, to submit them to his evaluation and criticism.

This view is typical of what is commonly referred to as rationality theory. The theory postulates that rationality and reason enter into teaching in at least two distinct ways; the one relating to the <u>manner</u> in which teaching proceeds; the other to the learning at which teaching aims. As in the case of explaining, not every way of getting someone to behave according to some norm would qualify as teaching. Hempel (1965:465) suggests 'a general constraining principle on manner governing teaching', namely, whatever method you use the pupil's reasoning must be acknowledged or you will not be teaching. A criticism of this notion is that a method could take account of the pupil's reasoning and not be rational or that it could acknowledge pupil reasoning but be ineffective in achieving goals.

Another interpretation of the theory is that dialogue or conversation must take place in the course of teaching. While this is the case in explaining, it again poses problems for teaching. It is possible to teach without language and to speak not as dialogue or conversation, for example, lecturing. Indeed, asking and answering questions is not necessarily dialogue. Martin (1970:96-9) also rejects the proposal that dialogue or conversation <u>must</u> take place at some points in the lesson on the grounds that if teaching containing no dialogue or conversation has been effective in promoting learning it seems irrational to label it wrong. She suggests that a dispositional interpretating of the rational constraint on manner is more useful (i.e. the pupil's) reason must be acknowledged if the appropriate situation were to arise) because it allows more things to qualify as teaching than the categorical. However, this is not necessary in the case of explaining.

The rational constraint on <u>learning</u> suggested by rationality theory which is seen as independent of the rational constraint on manner does not constitute a recommendation of what students ought to learn, but a criteria against which specific aims and objectives are tested. The theory proposed that whatever you want your pupil to learn you must intend him to achieve a level of learning or mastery such that his reason is acknowledged; or you will not be teaching. Furthermore, teaching must aim not simply at the acquisition of belief but that, plus proper backing for them. This would seem a wholly reasonable constraint were it not the case that proper backing is not to be the authority of the teacher or the textbook. In other words, pupils should not be asked to believe things merely because teachers and textbooks say so.

In the usual sense of 'teach' this constraint is unhelpful and does not take account of the possibilities that a teacher could set his sights this high and not be teaching, or, in the activity sense of teaching, one whose role is that of a teacher could be prevented from engaging in teaching.

While there is likely to be considerable support for attempts by proponents of rational theory to distinguish teaching from indoctrination and brain washing, many involved with education and teaching would draw the line at taking up a position that would rule out methods involving lectures, assignments concerned with reciting, television teaching and machine approaches. In the case of the rational constraints upon learning, much of the activity engaged in by teachers would not qualify as teaching and, thus, to be at all acceptable this part of the theory would have to be interpreted as applying to teaching as a whole. Indeed, as Martin (ibid:101) points out the narrow interpretation suggested builds into the definition of 'teach' -

> a decision which ought to be backed up by arguments showing that the sort of learning in question really is desirable.

She suggests that the assumption implicit in this analysis of teaching is that shared by people who advocate learning with understanding as opposed to what they claim is rote learning. While there may be a case to be argued during curriculum planning, etc. she does not accept that it qualifies as a conceptual point about teaching. Indeed, she contends that:

> An analysis of teaching should be open enough to include as teaching those cases in which for good reasons something less than learning with understanding is aimed at.
>
> (ibid:102)

In the light of the range of criticisms that she offers, Martin (ibid:104) contends that her loosening up of the definition of teaching offered by writers presenting the rational theory of teaching is justified and that if, indeed, teaching involves acknowledging pupil rationality, the sense in which it must be acknowledged 'is a good deal weaker than their writings at times lead one to believe.'

All the points that have been raised in the brief examination of the rational theory of teaching are applicable to explaining something to someone. When the theory is applied to explaining, the rational constraint upon manner governs explaining strictly. The explainer is expected to proceed on the assumption that the explainee is rational regardless of the explainee's actual state or the explainer's view of that state. In requiring the explainer to shift the question in an explaining episode over to the explainee it, in effect, requires that he acknowledges the explainee's reason. A further constraint is that a tutor in an explaining episode must try to answer an underlying question and at least one other question which, in his view, is helpful in ministering to the basis of the state the tutee is in.

The question and answer approach although it raises problems in teaching, and to work, must include in answering, pointing and demonstrating, etc. affords no such problems when applied to explaining. Nor is it necessary to apply the dispositional interpretation that Martin considers necessary in teaching (i.e. subsidiary question and answer only required in teaching episode if appropriate occasion occurs) to explaining. Explaining something to someone does involve both a particular <u>division</u> and a <u>kind</u> of discourse. In this respect it diverges markedly from teaching.

In the case of rational constraint on learning it is generally true that someone who is explaining something to another is trying to get that person to understand something and therefore more than the acquisition of beliefs is involved. The continuous series model (which will be discussed in the next chapter) requires backing of a belief to be of a particular nature, namely, from the relevant subject matter. Thus, although we may conceive of explaining as question shifting (between tutor and tutee) the aim for the <u>underlying</u> question is understanding. However, the aim for subsidiary questions may be more modest and give greater opportunities for acknowledging the reason of the tutee. The prime reason for revealing how it is possible for explaining to be a central activity of teaching and yet distinct from it, has to do with perceiving explaining as a phenomenon that is governed by specific conditions, a number of which apply to teaching in a weaker sense and a number of which do not apply to teaching at all. Thus, although explaining is being considered in the context of teaching and, indeed, learning, it will be treated as an independent concept during the discussion that follows which attempts to illuminate the crucial general features of explaining something to someone.

CHAPTER 3

1.0 KINDS OF EXPLANATION

In the previous chapter, in considering explanation and explaining within the activity of teaching, it was suggested that teachers can be described as 'handlers' of explanations but that their major concern is with explaining something to someone. In order to understand the former activity better it is necessary to examine the kinds of explanations which may be their concern.

1.1 A System of Classification Applied to Explanations

Taylor (1970:2-3) distinguishes three major kinds of explanation, namely: what-explanations, reason-giving or why-explanations, and scientific.

He sees what-explanations as making clear what something or some sequence of events is. They can either relate events and objects to scientific theories, or be connected with decisions about actions.

Reason-giving explanations explain why something had to happen and may attempt to influence the assessments or evaluations others make of our beliefs and actions.

Scientific explanation involves hyothesising a law of nature. Such an explanation will only be correct if the hypothesis is true and since hypothesis or law may, on further investigation, turn out to be false, this type is always open to correction. These three are in common use by writers in the field, with some admitting how-explanations as another category. There are also those who consider that correct answers to why-questions are the only explanations, although when this position is taken an attempt is made to define what is meant by a why-question.

How-questions have no difficulty in calling forth a response. The problem is that the responses to these questions that qualify as explaining rather than telling or describing are more readily categorised as what- or why-explanations. An example of this is, 'How do I set up my apparatus?' It could be argued that in responding to this question the teacher is doing no more than telling or showing the pupil a pattern of joins that will fit the apparatus together. On the other hand, it can be argued that telling and showing are functioning as explaining in the example. If this is the case it cannot be denied that the purpose of the explanation is to tell the pupil what he must do. Furthermore, should the teacher explain the reason for joining a to b and not to c he will be utilising a why-explanation.

It is not difficult to identify one of the central confusions here. Most how-questions are asking, by what means something comes or came about, and thus could be seen as a particular kind of what-question. As a philosophical point the matter is unlikely to be of concern to teachers but as how-questions occur very frequently during lessons it could be of pedagogical interest. To know more about the way in which teachers interpret such questions would shed light upon their conceptions of the appropriate response. Is it generally accepted that a description is called for rather than a what-explanation? How general is the feeling that implicit why-questions should be identified and answered with why-explanations? These are matters that will be considered again later in the study.

What-explanations may simply say what something is, or be related to scientific explanation, often as a preliminary to it. Taylor (1970:35-6) suggests the following types:

(1) There are what-explanations which are attempts to satisfy a theoretical or scientific interest. These explanations are redescriptions in terms which link the thing or event to scientific laws from which the event or the behaviour of the thing could be deduced, and future events or behaviour predicted. Such explanations may or may not have consequences for the actions of hearers.

(2) There are what-explanations which are not attempts to satisfy a theoretical interest but do supply information which satisfies our curiosity and

> which may affect practical decisions
> in ordinary life.

He warns that it is easy to make the mistake of thinking that a what-question has a scientific interest when it has not. For example, an explanation that predicts on the basis of past experience, or one that is based on generalisations may be regarded as acceptable but they are not scientific.

An analysis of the questions asked by teachers during lessons, typically, would identify what-questions as the main stock in trade of many subjects and very popular with the rest. Both Barnes (1969) and Richards (1978) showed that they dominated questioning sessions although not all were concerned with what-explanations. Further examination of this phenomenon will be undertaken later in the study.

Why-questions always call for explanations involving the giving of reasons but there are a number of different kinds of why-questions each calling for a specific response. Green (1971:147) suggests:

> There is the "why" that asks for a causal "because" and the "why" that asks for a motive. There is the "why" that searches for a purposive "because" and the "why" that calls for an historical narrative. There is the "why" that is asking for a priori proof and the "why" that is looking for a moral reason.

He thinks that, though there exists no generally accepted way of classifying these different kinds of questions and their respective explanations, some attempt to offer an orderly classification should be of use to teachers and to a philosophy of pedagogy.

Green sees why-explanations in general, as providing a reason for something, so that we can see why it happens or is done. He (ibid: 148) stresses the point that, in this sense, a good explanation is a good reason even when it is not a true reason. He justifies this further by contending that the connection between a thing to be explained and explanation 'is not that the explanation is true but that it explains.' This view is similar to that of Taylor (1970: 51) who having placed scientific questions in a separate category from other why-explanations, sees the latter as giving reasons to explain both why we did, are doing, or will do something, or to advise others how to act, or decide our own course of action. He points out that:

> Whether when a man gives something as his reason, he is properly said to have this reason is a matter of what beliefs and views he holds. This is a question of fact about himself. No matter how bizarre the beliefs or views he expresses in giving his reasons if he has them (or thinks he does) he would be correctly described as having these reasons.
>
> (Ibid: 55)

It follows from the above position that though a man may not be able to accept the evaluative views behind an explanation offered by another he can still concede that the other <u>has</u> a reason though he need not accept it as being the reason he would put forward. It is not difficult to see why Taylor does not include scientific explanations in the same category as the why-questions described above and why one[(1)] view of the relationship between scientific explanations in terms of reasons, is that they are incompatible The reasons for this view will be examined in the discussion of scientific explanations but, before moving to this category, it is useful to consider the analysis of why-explanations attempted by Green (1970: 148) in which

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(1)	Collingwood R.G. and Winch P.	(1961) (1958)	The Idea of History The Idea of Social Science	O.U.P. R. & K.P.

scientific explanations are accounted for under specific heads that indicate the kind of procedures that have been carried out in arriving at them.

1.2 A Typology of Why-Question Explanations

1.2.1 Deductive Explanations form the first group identified by Green. These are explanations in which that which is to be explained is logically deduced from statements that explain the phenomenon in question, a necessary requirement being that the explanandum (what is to be explained) is shown to be a logical consequence of the explanans (the explanation). The deductive argument is a form of proof or demonstration. The purpose of the proof goes further than to show that it is a necessary claim. Green (ibid: 149) says:

> In this case the request to give a reason why will elicit a demonstration that the explanandum is true, and true a priori.

He identifies distinctions within the category of deductive explanations that have to do with necessary claims and contingent claims. In the case of the former the mode of explanation coincides with the method of proof, i.e. to have explained the proposition is to have established the truth. This is not so for contingent claims, the truth of which can be established without necessarily explaining them. Nor is it necessary to establish that the deductive mode of explanation in question is a necessary claim. In short, for both types, the explanandum is a necessary consequence of the explanans, but only in necessary claims is the explanandum itself a necessary statement. According to Green this position corresponds to distinctions that exist between the empirical and formal sciences. He cites Nagel(1) as follows:

> Few, if any, experimental scientists today believe that their explananda can be shown to be inherently necessary. Indeed, it is just because the propositions (whether singular or general) investigated

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(1) Nagel E. (1961) The Structure of Science p. 21 Harcourt, Brace & World, New York.

> by the empirical sciences can be denied without logical absurdity that observational evidence is required to support them. Accordingly, the justification of claims as to the necessity of propositions, as well as the explanation of why propositions are necessary, are the business of formal disciplines like logic and mathematics and not of empirical inquiry.

This statement of Nagel serves as a reminder that there are other conditions to be satisfied where the deductive pattern of explanation is used in scientific studies. These will be elaborated when scientific explanations are under consideration.

1.2.2 Probabilistic Explanations is the next category that Green (1971: 152) recognises in his analysis of why-explanations. These are explanations in which the truth of the explanans does not guarantee the truth of the explanandum, but offers an account that is probable and, characteristically, some implicit reference to the degree of probability in the explanans. This type can occur in the sciences and are thought by some, for example Hempel (1966), to be scientific when certain conditions are met. Probabilistic explanations differ from deductive explanations, in which cause is related to the truth of the explanans being a sufficient condition for the truth of the explanandum, because no such correspondence exists in their case. Their ability to explain obtains through the establishment of some kind of statistical invariance between the explanandum and the explanans.

Frequently, in every-day life, probabilistic explanations are used in the same way that causal explanations are used even though they do not qualify as such. This is not very surprising when it is borne in mind that causal explanations set forth regularities which is exactly what probabilistic explanations attempt to do.

1.2.3 Green (1971: 154) suggests that, in addition to deductive and probabilistic why-explanations, a type exists that occurs 'whenever ideas of development or evolution play a large explanatory role.' For these he suggests the name genetic-explanations. This is not because they occur only in the biological sciences, but because they are concerned with genesis or the coming into being of something, for example, the sort of inquiry with which geology and history are commonly concerned. The kind of 'because' they require is one that describes how a state of affairs developed or by what process it came about. Green (ibid: 155) mentions two points that are usually made about genetic explanations:

> ... in giving a genetic explanation, not all events in the past will be selected as pertinent to the explanandum. Secondly, what is selected will usually be chosen on the basis of some assumptions about the causal links these events have in the development to be explained. Thus, although genetic explanations are not causal in any strict sense, nevertheless they will make use of causal assumptions and sometimes explicitly so.

He suggests that it may be helpful to think of genetic explanations as responding to a 'why' that looks back in time, but it would be misleading to think of this feature as a defining characteristic. The reference back is not concerned with an event in the past but with a process of development, because what is sought is to explain some present or past state of affairs in reference to its genesis.

Gallie (1970: 158) describes the characteristics of genetic explanations somewhat similarly in his discussion of explanations in history and the genetic sciences. The points are summarised below, each referring to a characteristic genetic explanation:

(1) Seeks to establish or at least helps to indicate some kind of continuity between one or a number of temporally prior conditions and a subsequent result.

(2) Does not pretend to predictive power: the prior event is not taken in conjunction with certain universal laws, to constitute a sufficient condition of the occurrence of the subsequent event.

(3) Emphasizes that what came earlier explains, in the genetic sense, what came before and not vice versa. i.e. The prior event is not taken, in conjunction with certain universal laws, to constitute both a sufficient and a necessary condition of the occurrence of the subsequent event.

Green (1971: 156) argues that genetic explanations may be used for explaining future expectations and, thus, an answer to the question 'Why do modern societies tend to require a great deal of education?' might call for a 'kind of explanation framed in genesis but not in terms of history.' It seems a reasonable response to say that the example he gives is somewhat doubtful in respect of the way it could be interpreted and that others he cites, for example, 'What might be the necessary and sufficient conditions under which a society would require a great deal of education of all its citizens?', although genetic in character would qualify as a what-explanation in Taylor's categories (see p.28) and not as an example of a why-explanation.

1.2.4 The final category of why-explanations that Green (1971: 156) identifies are, typically, forward looking. He calls the category <u>teleological</u> and <u>functional explanations</u>. By teleological he means purposive or goal directed and, thus, answers to this kind of why-question will refer to the future. The contexts he has in mind are those in which there is reference to certain consciously held goals or purposes for which such actions are taken. Green (ibid: 157) points out that in the biological sciences the notion of intention or purpose has to be replaced by function, (hence the title of the category) as, for example, in asking 'What is the purpose of the lungs?' Clearly, it is not an explanation of interest that is demanded but of function within an organic system. Green suggests that a feature of functional explanations is that they presuppose the presence of a system while remaining outside the system. Thus, they describe consequences and effects rather than intentions and goals. This last category completes his analysis of different kinds of why-questions.

1.3 Scientific Explanations

As would be expected Green's discussion of deductive why-explanations (see p. 37) contains statements that are much the same as those found in Taylor's description of scientific explanations. Taylor (1970: 4) takes as his model Hempel's view of explanation, known as the 'covering law model of explanation'. He considers it to be 'especially clear and elegant', giving a correct account of what explanation is and ought to be in the field of science. Taylor argues that the chief questions to which scientific explanations address themselves are:

> Why did this happen? Why have things changed, or developed in this way rather than that? Why, when things happen, does that happen?

He says that these questions tend to be thought of as causes, i.e. events that bring about certain others which are called their effects and he warns that thinking of scientific explanations in this manner produces problems as the event picked out as a cause of an event will almost certainly be one of a set of others, all of which are necessary for the event to take place. He maintains that though scientists do try to discover how events are connected and how given a particular set of facts the occurrence of an event is necessary, they do so by looking for universal propositions and general laws rather than for causes which both precede and necessitate their effects. Thus, an explanation of why an event occurs shows how the event is related to others by general laws.

Using the covering law model of explanation Taylor (ibid: 8) contends that a scientific explanation of an event (which he calls event 'a' consists of three elements:

(1) a universal generalisation, or law statement: whenever an event of type 'b' happens, an event of type 'a' happens;

(2) a statement of initial conditions: 'b' happened;

(3) a statement of the consequent conditions; 'a' happened.

He points out that the relationship between (1), (2) and (3) can be stated another way, namely, 'If the generalisation in (1) is true then, given the facts stated in (2), the event mentioned in (3) must occur.'

This model works equally well for explaining laws, the laws and definitions. Two features are worthy of note. 'The statements in the explanation logically entail[(1)] the statement that the event being explained occurred', and the explanation must contain a universal generalisation. The reason for these respective stipulations is that, in the former case, in any valid argument, 'the premises taken together entail the conclusion', and in the case of the latter, explanations without universal generalisations will not entail what they are supposed to explain.[(2)]

Hempel, himself, in conjunction with Oppenheim (1970: 8-10) makes clear that the general agreement that exists about what constitutes the major objectives of science is not carried into opinions concerning the function and essential characteristics of scientific explanation. - Their own pattern of scientific explanation divides it into two constituents, namely the explanandum[(3)] and the explanans,[(4)] the latter

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(1) Entail - a term used by logicians that refers to the relation between propositions when the step from one to the other is a valid deductive inference.

(2) There are very exceptional circumstances in which this would not be the case.

(3) By the explanandum, they understand the sentence describing the phenomenon to be explained - not the phenomenon itself.

(4) By the explanans, the class of those sentences which are adduced to account for the phenomenon.

being divided again into those containing sentences that cite particular antecedent conditions and those sentences representing general laws. For an explanation to be sound, its constitutents have to satisfy logical and empirical conditions of adequacy, as shown in the summary below:

I. Logical conditions of adequacy:

R^1 The explanandum must be logically deducible from the information in the explanans.

R^2 The explanans must contain general laws which are actually required for derivation of the explanandum.

R^3 The explanans must have empirical content, i.e. must be capable, at least in principle, of test by experiment or observation.

II. Empirical condition of adequacy.

R^4 The sentences constituting the explanans must be true.

Hempel and Oppenheim (ibid: 11) reject the notion that it would be more appropriate to substitute 'highly confirmed by all the relevant evidence available' for 'true' on the grounds that this leads to difficulties when an explanation made earlier on the basis of available evidence is shown to be wrong in the light of new evidence. They favour the conclusion that the soundness of the explanation had been probable but the fuller evidence now available suggests that the original explanans was not true. Certain of the requirements demanded are to be found in Green's why-explanation category. However, Hempel and Oppenheim offer a more demanding set of requirements because they are not concerned with why-explanations in general but those that qualify as scientific explanations. They, too, include what they term motivational and teleogical approaches as a separate category, which corresponds in some respects to Green's teleological and functional category of why-explanations, described on p.40. The kind of phenomena they include in this are the various types of behaviour of animals and humans that, for example, are explained in psychology:

> .... by subscription under laws or even general theories of learning or conditioning; and while frequently the regularities involved cannot be stated with the same generality and precision as in physics and chemistry, it is clear at least, that the general character of those explanations conforms to our earlier characterization.
>
> (ibid: 13)

Not all scientific explanations are based on laws of strictly universal form. Hempel (1966: 58-9) recognises a type that he calls probabilistic explanations, again a category included by Green in his analysis of why-explanations. Hempel contends that probabilistic explanations share certain basic features with corresponding deductive-nomological explanations. Both explain the event in question by referring to other events with which the explanandum event is connected by laws. The first major difference is that in the deductive type the laws are of universal form and, in the other type, of probabilistic form - hence the name for this type of explanation. The second, that going on information contained in the explanans of a deductive explanation, the explanandum was to be expected with deductive certainty. On the other hand, an inductive explanation, of the kind necessary in probabilistic explanations

> shows only that, on the information contained in the explanans, the explanandum was to be expected with high probability, and perhaps with "practical certainty"; it is in this manner that the latter argument meets the requirement of explanatory relevance.
>
> (ibid: 59)

Being scientific is to do with making statements that are based in some way on evidence but as can be seen from the brief examination of scientific explanations, the precise nature of the relationship between statements and evidence is a controversial topic in the philosophy of science.

1.4 A Conceptual Classification Applied to Explanations

A dimension that could be used as an analytical base for identifying different kinds of explanation cuts across the categories that have been arrived at through the systems of classification discussed thus far. It has to do with the nature and level of the concepts embodied in explanations of one kind and another and is well exemplified by the distinction that Vygotsky (1962) makes between spontaneous and non-spontaneous (or scientific) concepts. The former, he thinks, can be acquired by an individual before he is conscious enough of them to be able to define them in words. On the other hand, scientific concepts which are usually non-spontaneous start their development with a verbal formulation and their use in non-spontaneous operations. In other words, they start their lives in a child's mind at a level which a spontaneous concept reaches much later.

Within the context of explaining something to someone, questions concerning the kind of concepts to be found within specific explanations are very pertinent and could lead to the identification of distinct categories. One such category would be for explanations that are to do with phenomena that can be understood in terms of spontaneous concepts and, another, that would accommodate explanations that involved scientific concepts that can be acquired only through specific teaching. However, categorisation would not be as clear cut as this for some explanations demand both spontaneous concepts and scientific ones. Furthermore, a stage between the two extremes can be recognised in which a spontaneous concept reaches a level in an individual at which it is possible for a related scientific concept to be absorbed. It is possible to think of these concepts as intermediate, which indicates that they have started out as spontaneous concepts but are developing into scientific concepts as a result of further experience and learning. Vygotsky (ibid: 109) describes the process as follows:

> In working its slow way upward, an everyday concept clears a path for the scientific concept and its downward development. It creates a series of structures necessary for the evolution of a concept more primitive; elementary aspects which give it body and vitality. Scientific concepts, in turn, supply structures for the upward development of the child's concepts towards consciousness and deliberate use.

It is likely that at different stages in an individual's life one or other conceptual category will dominate the explanations he seeks to have and those which others consider necessary for him to understand. This is certainly true in school where, at the primary stage, explanations based upon spontaneous concepts abound and at higher secondary level most explanations utilise scientific concepts. But perhaps the concepts with which most explanations are concerned in school learning will be those in the intermediate category. This view is supported by Carroll (1964: 81) who goes on to say that they are usually acquired through the study of verbal formulations and the practice of recognition of instances and non-instances. In this they have more in common with scientific concepts than spontaneous concepts and the same is likely to be true of the explanations that embody them.

It is not the case that different subjects demonstrate any common consistency in their use of the different conceptual categories of explanation and thus in the intellectual demands they make upon pupils through their explanations. Certain subjects early on at the secondary stage deal in explanations that contain scientific concepts, both those which start life as such and others which have grown out of spontaneous ones. For example, the first year of a chemistry course set for C.S.E. or G.C.E. ordinary level, involves the employment of scientific explanations on a large scale. Geography, on the other hand, can utilise spontaneous concepts in the explanations it is concerned with at this level.

A possible effect of these conceptual distinctions is to place some constraints upon the number of options open to a teacher as a means of putting across an explanation. More particularly, it may influence choice when it comes to deciding between practical procedures in which first-hand experience of the phenomena is possible and procedures that rely upon verbal formulations. Indeed, certain explanations, by their very nature, lend themselves to one rather than other kinds of procedures. An attempt to classify the concepts they utilise can provide some guidelines for deciding how best to organise the explanation, other things being equal.

It would be illuminating to discover the extent to which teachers are aware of the specific characteristics of satisfactory scientific explanations or, indeed, of the variety of types of explanation that they encounter, each type with its own peculiarities and requirements. As they will be called upon to handle explanations it could be pedagogically useful to know which types are dominant in specific subject areas and at different stages of pupil development. Questions concerned with the positive advantages of knowing more about the characteristics of explanations will be discussed in relation to explaining and understanding in education which is undertaken in Chapter 4. At this stage suffice it to say that unless the various notions of explanation are kept distinct it is very easy to move from one to another without realising it and it is difficult to understand general claims about the function of explanation in education.

2.0 THE NATURE OF EXPLAINING SOMETHING TO SOMEONE

It is now the turn of the notion, explaining something to someone to be examined with the object of identifying the conditions necessary to the success of this activity. As in the case of explanation, there are a range of models to choose from, each seeing 'explaining' as a distinct kind of activity.

2.1 Explaining Something to Someone as Gap Filling

Dray's (1957) continuous series model directs attention to the fact that for someone to understand something it is not enough for him to be given an item of information, the information must be connected or linked up with the topic in question so clearly that he can go from the information to the topic without coming up against large gaps, thus it is possible to see explaining as gap-filling.

Dray (1957: 73-5) contends that an explanation breaks down an event into sub-sequences which lead up to that event; a continuous series of happenings in which the series may be but need not be temporal and the happenings may be, but need not be observable. He insists that his model provides objective standards for judging whether or not something is an explanation but offers no clear conditions for judging the adequacy of a series. He (ibid: 69) states that the sum of sub-sequences must 'raise no further demand for explanation in that particular context' a pragmatic condition of adequacy since what is acceptable for one person need not be for another. Pragmatic standards can be objective, in cases where there is wide agreement for example, but this is not to say that they can replace logical and empirical standards.

In arguing the case for his model, Dray offers it as an alternative to Hempel's covering law model which was discussed earlier (see pp. 41-44). It is important to note that he accepts the Hempelian model as a theory of explanation in science but suggests that, in certain other areas and particularly where the thing being explained is a human action, it is inappropriate. Speaking of explanations in history he maintains that many sound historical explanations do not require laws.

Dray (ibid: 70) argues that a general law does not necessarily offer an explanation for the fact that something happens, though it may explain the cause of the happening. It is indeed true that the covering law model does not purport to offer an account of the explanation of non-causal facts that must contain the explanation of causal facts, as grounds for adequacy. Furthermore, attempting to do so will result in a shift in the explanandum events and, thus, to a shift in the question. Dray appears to think that the continuous series model does not encounter the phenomenon of question shifting because it refers to a series of facts contributing to the story of what happened. However, if the 'story' contains elements in which it is first necessary to answer 'why' with an explanation that establishes cause and then to answer a 'why' that explains the way in which the effect came about, it can be argued that a shift in question has occurred. Martin (1970: 46) supports the view that a question shift is embedded in the model but suggests that if it is viewed

> from the standpoint of a theory or analysis of explaining something to someone instead of from the standpoint of a theory of an explanation(1) of something, Dray's shift in question takes on special significance.

By this she means that the aim of explaining something to someone is understanding and that although she rejects the idea that the question shifting implicit in the continuous series model is a <u>necessary</u> condition for understanding she thinks Dray is on the track of something important involving some kind of shift in question for explaining something to someone.

Whatever the limitations of Dray's model in giving an account of explanation it makes some useful contributions to an analysis of explaining something to someone. For instance, it takes account of the explainer and the explainee, concerning itself with questions like 'what must a person do to get someone to understand something?' It draws attention to the crucial role of understanding in explaining, emphasising the importance of seeing connections, as necessary for understanding. It

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(1) Martin uses explanation to indicate that she is referring to Ryles notion of explanation as a successful outcome of research, etc. and <u>not</u> to explanation in the task sense.

brings to light the considerable differences that exist among people in respect of their ability to connect an event and an item of information: a situation that, in turn, influences the length of the series needed before the explanation in question is attained.

Martin (ibid: 59) suggests that the most important contribution of the model is its underlying conception of explanation as filling in:

> It is assumed that for explaining to take place there is some gap and that explaining involves filling that gap. It seems to me that this view of explaining something to someone is essentially correct.

2.2 The Philosophical Conditions Governing Explaining

If Dray's account of explaining something to someone as gap-filling lacks systematic criteria for deciding just what the gap to be filled is in between, the same criticism cannot be levelled at Bromberger (1965) whose analysis takes account of this phenomenon as well as certain other aspects of the problem. Indeed, his detailed discussion of the characteristic features of explaining episodes, finally arrives at a set of conditions that must be met by all explaining episodes, in order to qualify as such.

He describes an explaining episode as one in which a tutor answers a question, that may or may not have been actually put, for his tutee. He works on the assumption that there is some question that the tutor addresses himself to, even though it is not always clear what that question is. In certain respects these episodes are similar to the episodes identified within the procedural means of teaching by Smith that were discussed earlier (see pp. 14-15). Although Smith does not require the presence of an underlying question, he does suggest that from a psychological standpoint the episodes represent gaps to be filled with information.

A concept that has not been introduced before, but which is important in Bromberger's (1965: 82) analysis is that of 'predicament'. He identifies two kinds: 'p' - predicaments and 'b' - predicaments. A person is in a 'p' - predicament with regard to any question that he thinks has a right answer, but for which he can think of no answer to which he, himself, cannot see objections. A person is in a 'b' - predicament with regard to any question that has a right answer, but the answer is beyond what he can conceive of. Bromberger points out that it is possible for a person to be in either one of the predicaments or both at the same time. The importance of the predicaments to his view of explanation is that they indicate the state of mind of the tutee. His concern with this factor and certain others that will be discussed later, is demonstrated in his fourth hypothesis which is given below.

> The essential characteristics of explaining episodes are the following:
>
> (a) the question is sound, i.e. admits of a right answer;
>
> (b) the tutor is rational and knows the right answer to the question at the time of the episode;
>
> (c) during the episode the tutor knows, or believes, or at least assumes that at the beginning of the episode, the tutee was in a 'p' - predicament with regard to the question, or that, at the beginning of the episode the tutee was in a 'b' - predicament with regard to the question, or that at the beginning of the episode, the tutee was in either a 'p' - predicament or a 'b' - predicament with regard to the question;
>
> (d) in the course of the episode the tutor presents the facts that, in his opinion, the tutee must learn to know the right answer to the question;
>
> (e) in the course of the episode the tutor also provides the tutee with such instruction as he (the tutor) thinks necessary to remove the basis of whichever of the states mentioned in (c) he deems the tutee to be in:
>
> (f) at the end of the episode all the facts mentioned in (d) and (e) have been presented to the tutee by the tutor.
>
> (ibid: 94-95)

Martin (1970: 63-65) criticises certain aspects of each of the proposals offered in the above hypotheses. In the first instance, she takes up the truth requirement ((a) and (b)) on the grounds that if it is applied too strictly it rules out too many potential explaining episodes and if it is applied too loosely

> it allows the tutor's views about the truth of what he says to prevail over the view of someone who describes the tutor as having explained to his tutee.

Martin (ibid: 67) maintains that the latter example could not be allowed to qualify as explaining something to someone unless the tutor's views of the soundness of the question are justified. Certain explanations would founder on a too strict application of the truth requirement. For example, a tutor's judgement of soundness of question and correctness of answer would be justified when the explaining episode took place but in the light of later knowledge shown to be wrong. Furthermore, there could be occasions when the tutor decides <u>not</u> to present all the facts to the tutee, because he considers them to be beyond the tutee's understanding at his current stage of development. This situation calls for a loosening up of the truth requirement to allow the tutor to present to the tutee an account that diverges somewhat from the tutor's view of the truth. Martin (ibid: 70) is prepared to press the point that there are occasions when explaining something to someone involves some simplification, possible omissions where material is too difficult and 'even something very much like fabrication and myth' on the grounds that it is necessary to take account of pedagogy if we are to be able to say truly that someone has explained something to someone. She suggests that what is being sought are logical conditions, and distinguishes between conditions that have to do with the 'logic' of a term or concept and those that are formal, specifying relations holding between statements. Martin (ibid: 73) insists that:

> There is no reason, in principle, why some of the

> "logical" conclusions of explaining something to someone may not be "pedagogical" in the sense that they incorporate into the analysis of explaining something to someone what might normally be called pedagogical conditions.

The truth requirement contained in (a), (b) and (d) of Bromberger's conditions is not the only requirement that Martin objects to. She questions both the tutee's predicament, condition (c) and the need to provide such instruction as is thought necessary by the tutor (e).

In the case of the tutee's predicament she thinks the 'p' - predicament and 'b' - predicament do not cover the range of possible predicaments that a tutee could find himself in.

Martin (ibid: 74-78) suggests the following additional predicaments in which the tutee:

> can think of an answer which is not correct but to which he can think of no decisive objections - ('m' - predicament); (1)
>
> can think of two answers, one correct, the other not correct but can think of no decisive objections to either - ('a' - predicament); (2)
>
> can conceive of the right answer to the question without objections and conceive of no other to which he does not have decisive objections - ('r' - predicament); (3)
>
> thinks that the question is unsound although, in fact, it is sound, and can conceive of no answer to it - ('f' - predicament). (4)

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(1) 'm' - predicament - intended to remind one that the person in the predicament is mistaken.

(2) 'a' - predicament - the person in the predicament cannot choose between alternatives.

(3) 'r' - predicament - the person in the predicament has the <u>right</u> answers to the question.

(4) 'f' - predicament - the person in the predicament is under a false presupposition.

In the case of the last predicament the tutor would, during the explaining episode, have to convince the tutee that the question was a sound one.

In view of the range of predicaments identified, and the list is not considered to be exhaustive, Martin (ibid:80) is persuaded that it is more useful to replace Bromberger's (c) requirement with one that is opened up to include 'some rational predicament with regard to the question.'

Condition (e) is criticised both for its requirement that instruction be given that is necessary to remove the basis of the state the tutor deems the tutee to be in and, indeed, that instruction should necessarily have to be provided. While appreciating Bromberger's wish to distinguish explaining something to someone from just telling something to someone Martin points out that situations arise in which a tutor can explain without there being any need to offer instruction, for example, in cases where to remove the basis of the state a tutee was in, it would take a personality change; or where a value judgement is involved that makes it necessary to change a tutee's attitudes in order to remove the basis of his predicament.

Bromberger's analysis conceives of explaining episodes as answering a single, underlying question. Giving instruction along the lines Bromberger indicates in condition (e) could well impose a shift in question somewhat similar to that discussed earlier when Dray's continuous series model was under consideration.

Martin (ibid: 82) proposes that the instruction required by this condition

> be viewed along the lines in which Bromberger views an explaining episode as a whole, namely, in terms of question answering. The question or questions answered in what Bromberger has called instruction would be subsidiary to the underlying question.

Use of this proposal would entail a shift in question, i.e. from the underlying question which it is the primary task of the tutor to answer, to answering such subsidiary questions as are seen by the tutor to be necessary to the tutee's predicament. How the tutor tackles the subsidiary question or questions is a matter for pedagogy and not a matter that need be included as an essential characteristic of explaining episodes. This last statement could be challenged on the grounds that effective explaining is as much influenced by pedagogical considerations as by the philosophical ones being presented here. There appears to be no clear reason why the latter are considered to be essential and the former not. Indeed, because the objective of explaining episodes is understanding, it could be that certain pedagogical considerations are essential characteristics. These points will be raised again during the discussion of understanding something that takes place in Chapter 4.

Martin (ibid: 84-85) takes account of many of the objections to Bromberger's conditions that have been raised by offering her own modified form of Hypothesis Four, which includes the modifications she proposes in her discussions relating to individual characteristics. By and large, the effect is to loosen up the requirements and conditions somewhat while retaining all the points identified by the analysis. She calls her modified account Hypothesis Five, a version of which is given below:

> The essential characteristics of explaining episodes are the following:
>
> (a) the underlying question is sound, i.e. admits of a right answer, or the tutor believes, or at least assumes, that the underlying question is sound, i.e. admits of a right answer;
>
> (b) the tutor is rational and knows the right answer to the underlying question at the time of the episode, or thinks, or at least assumes he knows the right answer to the underlying question at the time of the episode;
>
> (c) during the episode the tutor knows, or believes,

or at least assumes that at the beginning of the episode the tutee was in some rational predicament with regard to the underlying question;

(d) in the course of the episode the tutor presents the facts or some of the facts or what he believes or at least assumes to be the facts or some of the facts, that, in his opinion, the tutee must learn to know the right answer or the answer the tutor believes or assumes is right; or he presents material that he knows, or believes, or at least assumes, is not the facts but that, in his opinion, is sufficiently related to the facts and is pedagogically helpful to the tutee in learning an answer to the underlying question which the tutor knows or believes or at least assumes, is not the right answer, but which is sufficiently related to the right answer, or the answer he believes or at least assumes is right, so that it is pedagogically justified.

(e) In the course of the episode the tutor also provides or attempts to provide the tutee with answers to such subsidiary questions as he (the tutor) thinks are necessary to remove the basis of whichever of the states mentioned in (c) he deems the tutee to be in; or are effective in removing the basis of whichever of the states mentioned in (c) he deems the tutee to be in; or are helpful in removing through the basis of whichever of the states mentioned in (c) he deems the tutee to be in.

(f) At the end of the episode all the facts, or what the tutor believes or at least assumes to be facts, mentioned in (d) or the material that, in his opinion, is related to the facts in the way outlined in (d) have been presented to

> the tutee by the tutor and the answers or what the tutor takes to be answers mentioned in (e) have been provided.

Martin (ibid: 86) warns that it is possible that neither Bromberger's hypothesis nor her own modified form contain a necessary set of conditions for explaining something to someone. She suggests that both are an improvement on Dray's continuous series model because they impose some kind of truth requirement, recognise the importance of taking account of the explainer's view of the explainee's state in an explaining episode and require some instruction to be given.

2.3 Explaining as Reason Giving

In order to understand the claim that a tutee's rationality must be acknowledged in explaining something to someone, it is useful to undertake the discussion of explaining as reason-giving.

There is no general agreement about the claim that the tutee's rationality must be acknowledged and, thus, that explaining something to someone involves giving and having reasons.

Green (1971: 159F) differentiates between explaining and giving reasons particularly where the subject is human behaviour. He suggests that explanations have to do with the causes why someone did something, and reasons, with the justification for doing something and makes a point of citing history, as a subject in which this kind of distinction is useful. A confusing aspect of this view is that it is quite usual to believe that explaining something to someone may involve logical and empirical reasons as part of the explanation. Green attempts to meet this by pointing out that in common usage explaining and reason-giving are used as though they are one and the same.

It is difficult to quarrel with this point or with his view that the giving of reasons does not, in itself, qualify as explaining; whether the reasons be those he refers to as ones offered because they are publicly acceptable, or the real reasons. Furthermore, neither Dray's continuous series model nor Bromberger's fourth hypothesis emphasise reason-giving in their conditions governing explaining episodes. On the other hand, there emerged in previous discussion the knowledge that explaining something to someone shares certain features with the concept of teaching, one such being, that they are both subject to rational constraints on manner and learning. Thus, there is a view that one who is explaining something to someone must acknowledge the reason of the explainee or the activity will not be deemed explaining. In other words, the process involves reason <u>giving</u> and reason <u>having</u> in order that the end product of an explaining episode be, understanding.

Martin (1970: 104) supporting the above view argues that the major question left in doubt by both Dray <u>and</u> Bromberger is whether or not they acknowledge the tutee's rationality. As has been mentioned earlier, she subscribes to rationality theory in relation to teaching while warning that the sense in which the pupil's rationality must be acknowledged is weaker than the proponents of rational theory contend. In the case of explaining something to somebody she maintains that there is a strong requirement for the explainer to acknowledge the explainee's rationality. Like teaching, the activity is governed by both a rational constraint on manner and on learning.

In looking first at the rational constraint on manner, Martin (ibid: 104) points out that in the hypothesis she offers as a modification of Bromberger's fourth hypothesis (see pp. 55-57) condition (c) places a rational constraint on manner by requiring the explainer 'to <u>treat</u> the explainee as being in a rational predicament' with regard to the underlying question. It is important to bear in mind that this requirement does not imply that the explainee <u>is</u> rational, nor that the explainer <u>knows</u> or <u>believes</u> the explainee to be rational. It requires only that the explainer proceeds on the assumption that the explainee is rational. She refers, also, to condition (e) in her hypothesis as another rational constraint on manner requiring, as it does, that the explainer shift the question during an explaining episode. She suggests that, in effect, 'it requires that he acknowledge the explainee's reason.' Bearing in mind that the condition to which she refers requires the tutor in an explaining episode to try to answer the underlying question of the episode and at least one other subsidiary question that, in his view, is necessary, effective, or helpful in removing the basis of the state the tutee is in, the point she makes is a valid one.

One last point worthy of note is that in relation to explanation Martin (ibid: 107) rejects the possibility of a dispositional interpretation of the constraint on manner, of the kind she advocates for teaching, on the grounds that the constraints govern explaining more strictly than they do teaching. She argues that 'if teaching is closely connected with acknowledging the other's reason, how much more so is explaining.'

The rational constraint on learning governs the whole activity of explaining something to someone because in this case learning is related to understanding the underlying question of an explaining episode. A desire to get the tutee to know the right answer to the underlying question in an explaining episode is implicit in Bromberger's analysis, but he does not go as far as requiring that the tutee be able to make the connection between the right answer and the underlying question. This last condition would be necessary where a learning objective for the episode is understanding.

Martin (ibid: 108) is careful to point out that although she sees explaining as an activity involving question shifting she sees it aiming at understanding 'only in relation to the underlying question of an explaining episode.' In other words, the explainer does not have to aim at understanding in relation to the subsidiary questions included in an episode. In accepting the rational constraint on learning in relation to explanation, she makes clear that, as with the rational constraint on manner, it governs explaining strictly and once again must not be construed dispositionally.

Agreement with a contention that explaining acknowledges the pupil's rationality in a stronger way than does teaching leads to some dissatisfaction with Dray's continuous series model and Bromberger's Hypothesis Four for failing adequately to take account of the central role of reason giving and reason having in explaining something to someone. This is not to devalue the contributions made by their models to our understanding of the activity in question but to point out that it has been necessary to turn to a theory of teaching to illuminate one essential aspect. Still to be examined is the notion of explaining as a particular use of language. This again demands insights from a theory of teaching as well as looking to semantic and communication theory for helpful contributions.

2.4 Contributions from Linguistic Theories of Teaching

The linguistic theory of teaching has a number of different versions and that of B. Othanel Smith (1961: 87), whose concept of teaching was examined earlier, (see pp. 14-16) emerges as a moderate in respect of the role he assigns to language in teaching. Starting from the position that, by teaching, he refers to 'ways of making something known to others' he offers these definitions:

> Teaching: arrangement and manipulation of a situation in which there are gaps or obstructions which an individual will seek to overcome and from which he will learn in the course of doing so.
>
> (Brubacher 1939: 108)

> Teaching: intimate contact between a more mature personality and a less mature one which is designed to further the education of the latter.
>
> (Morrison 1934: 41)

> Teaching: impartation of knowledge to an individual by another in school.
>
> (Adapted from common usage)

Smith criticises each of these for incorporating a particular view of how teaching is to be carried on. The first he thinks argues that the individual learns by engaging in problem solving and, thus, to teach is to engage and direct the pupil in problem solving activities. The second suggests that education is the development of the individual through an adaptive process, i.e. through learning. The intimate contact required appears to be more suited to tutoring than teaching and is again associated with a specific theory of education. The last definition sees teaching as the impartation of knowledge and, thus, views the function of education as the cultivation of the mind. Within this definition teaching would adopt the features of lecturing.

In rejecting the biases that attempt to suggest how the actions of teaching are to be conducted Smith (ibid: 88) suggests the acceptance of the genetic sense of teaching, namely, that it is a 'system of actions intended to induce learning.' This definition carries with it acceptance of the fact that

> these actions may be performed differently from culture to culture or from one individual to another within the same culture, depending upon the state of knowledge about teaching and the teacher's pedagogical knowledge and skill.

A point brought out in the first chapter of this thesis is that Smith (ibid: 90-91) sees teaching as one thing and learning as another, thus learning does not necessarily issue from teaching. He thinks this is significant for pedagogical research because it makes the analysis of teaching a less complicated task. Teaching has its own forms, constituents and regularities. Indeed, under specific conditions, for example the context of the classroom, the teacher tends to behave in characteristic ways. The activities involved could be called 'a system of actions directed to pupils.'

To see how language functions within the concept of teaching offered by Smith (ibid: 91) it is useful to reproduce his pedagogical model:(1)

A Pedagogical Model

I Independent Variables (Teacher)	III Intervening Variables (Pupils)	II Dependent Variables (Pupils)
(1) Linguistic behaviour (2) Performative behaviour (3) Expressive behaviour	These variables consist of postulated explanatory entities and processes such as memories, beliefs, needs, inferences and associative mechanisms	(1) Linguistic behaviour (2) Performative behaviour (3) Expressive behaviour

From the model it can be seen that teaching acts appear in the first category as independent variables, pupil acts, as dependent variables in the second, while the third category contains a variety of events and processes which are the intervening variables. The teacher cannot see the intervening variables in the pupil, such as learning, he infers them from the behaviour of the pupil which appears in the second category. Smith (ibid: 92-93) says that the model fails to depict the ebb and flow of teaching or to give a complete picture of the cycle of giving and taking instruction. If extended it would show pupil behaviours generating the teachers intervening variables which would then lead to teacher action, thus starting the cycle again. He symbolises the cycle as follows:

$$P_t - D_t - R_t \quad - P_p - D_p - R_p \,\| \; - P_t - D_t - R_t$$

$$- P_p - D_p - R_p \,\| \; - P_t - D_t - R_t \quad - P_p - D_p - R_p \,\|$$

------------ achievement,

Where, P_t is the teacher's perception of the pupil's

(1) The model draws upon the psychological paradigm developed by Tolman.
See - Tolman E.C. (1952) 'A Psychological Model' in Toward a General Theory of Social Actions Parsons T. and Shils E.A. (eds.) pp.279-302. Cambridge: Harvard University Press.

behaviour; D_t is the teacher's diagnosis of the pupil's state of interest, readiness, knowledge and the like, made by inference from the behaviour of the pupil; and R_t is the action taken by the teacher in light of his diagnosis; and where P_p is the pupil's perception of the teacher's behaviour; D_p is the pupil's diagnosis of the teacher's state of interest, what he is saying, and so on, as inferred from the teacher's behaviour; and R_p is the reaction of the pupil to the actions of the teacher.

Each unit marked off by the double vertical lines is an instance of the teaching cycle.

From this can be seen that the cycle is made up of two sub-units; $P_t - D_t - R_t$ is the act of teaching, and $P_p - D_p - R_p$ the act of taking instruction.

Although Smith (ibid: 94) includes as independent variables linguistic, performative and expressive behaviour, he is of the view that teaching acts consist largely in verbal behaviour 'in what is done with and to people through the medium of words.' However, he contends that, more important than knowing language to be the primary medium of instruction, is knowing what is done with language in teaching, in other words, the variety of actions that are carried out linguistically.

All the logical operations identified by Smith (ibid:95 -96) and included earlier in the discussion of the activities of teaching (see p. 16) are considered by him to be performed through a particular use of language in the classroom. From the examples he gives, the two categories that have some bearing upon explaining something to someone are classifying and, as would be expected, explaining. He suggests that teachers clarify automatically when they define, describe or explain and that the logic of the activity is more complex than the verbal act of saying what something is. The logic is made apparent when a teacher tells why he clarifies as he does for, in doing so, he will be required to set out the criteria. Of explaining, he says, it sets forth '<u>an antecedent condition of which the particular event to be accounted for is taken as the effect</u>.' (1) It can also offer rules and facts in support of decisions, judgements or actions taken.

It is clear from the comparisons that Smith makes between logical actions of the sort described above, and what he calls directive actions, that he sees the former as involving expository uses of language. Moreover, the pupil is expected to remember what has been said by the teacher and to be able to repeat the message in his own words as and when the situation demands.

The linguistic role of the pupil is more than that of a passive receiver. As can be seen from the model the dependent variables parallel the independent ones. Thus, in the instruction-taking part of the cycle the pupil performs linguistic actions that are very much the same as those of the teacher. He may perform these actions voluntarily or at the invitation of the teacher but, in doing so, he is not instructing anyone. His role, according to Smith (ibid: 98), is to 'bear witness that he is taking instruction, that he understands what is happening or that he is taking part in (accepting or dissenting from) what is going on.'

It is not an easy matter to decide how this theory of teaching adds to a knowledge of the necessary conditions for explaining something to someone. The cycle of teaching with its pupil and teacher interaction fits the dialogue aspect of an explaining episode quite neatly, but leaves open the question of whether or not it is possible to offer an interpretation of the teacher and pupil behaviour patterns described and still take account of important requirements

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(1) The underlining is that of the present writer.

identified in the other models of explaining that have been discussed. An attempt to offer an interpretation may be helpful here:

From observation of pupil behaviour the teacher (in the role of explainer) perceives that the pupil (in the role of explainee) is in some kind of rational predicament. (P_t). The teacher identifies the underlying question and proceeding on the assumption that the pupil is rational (D_t) offers what he sees to be the relevant facts, taking account of the previous diagnoses. - End of first sub-unit, which could be deemed an act of explaining.

The sub-unit which could be called an act of taking explanation is offered yet more tentatively:

From observation of teacher behaviour, the pupil perceives that the teacher is aware that he, the pupil, is in a rational predicament (P_p). The pupil judges the teacher to be offering an explanation, attempts to diagnose what he is saying, i.e. make contact with the meaning (D_p) and responds in one way or another that is related to his diagnosis (R_p). The cycle that follows may involve a shift in question but this will depend upon the teacher's perception of the pupil's response. The process goes on until the underlying question has been answered which, in an ideal cycle, will coincide with the pupil achieving understanding.

As can be seen, it is possible to take Smith's theory of teaching as a theory of explaining mainly because it is not specific about the nature of the elements that make up the sub-unit acts and thus allows the inclusion of conditions and requirements that have been identified in other models. What his model does not do is lay down precise guide-lines as to what is involved in explaining something to someone. The points he does make are: that explaining is a logical operation to be performed linguistically; that the pattern of explaining episodes is a dialogue between teacher and pupil in which the language use of the teacher is expository, its purpose instruction. The language use of the pupil parallels that of the teacher, its purpose to bear witness that he is taking instruction.

This summary makes clear that the pupil side of the model is as important to the successful conclusion of explaining cycles as the teacher's side. Furthermore, the teacher is required to diagnose the pupil's state of interest, readiness and knowledge before proceeding with his action which, in turn, will be influenced by this diagnosis. Thus, not only is the pupil given a more active role in the explaining cycle, his motivation and state of knowledge are to be assessed in order that the explanation may be modified to accommodate these factors. The position of the pupil as explainee is given greater prominence with these conditions than in the case when the explainer is required to proceed on the <u>assumption</u> that his pupil is rational. They also serve to remind the teacher as explainer of factors to be taken into account in what is now the pedagogical as well as logical problem of presenting whatever answers are necessary to remove the basis of whatever states the pupil is in with regard to the underlying question and any necessary subsidiary questions.

The theory that has just been discussed is cautious compared with the somewhat extreme views to be found in the linguistic theory offered by Price (1958). This shares some features with rationality theory but differs from it over what it takes to be the most crucial feature of teaching. In Price's theory, the use of language by the teacher is as central and important to it as the teacher's acknowledgement of the pupil's rationality is to rationality theory.

Price (ibid: 326) contends that teaching involves four uses of sentences which are: an assertive use, a clarificatory use, an explanatory use and a supervisory use. It is important to note that he is not suggesting that teaching <u>only</u> involves these four uses of language. Indeed, he suggests that in different situations many things are done which are not the four uses in question but which supplement them in the teacher's attempt to promote understanding. Nor is he saying that every case of teaching involves the use of all four sentences but that, in any specific case of teaching, one or other use will dominate. However, from the example he utilises to illustrate the assertive use, it would appear that very few cases of teaching would fail to use sentences in at least an assertive way. He also distinguishes an active and an acquiescent use of sentences, the former being attributed to the speaker in a communication and the latter to the listener.

Relating these points to teaching, Price (ibid: 327) maintains that teaching sentences are always used in an active or acquiescent way. As the speaker, the teacher employs a use of language that is assertive, classificatory, explanatory, supervisory and active. On the other hand, the hearer, who learns, i.e. the pupil, is expected to employ a correspondingly acquiescent use. Thus, the role ascribed to the pupil is totally passive to a degree that allows Price (ibid: 327) to say that teaching succeeds 'when the students use of sentences corresponds in a acquiescent way to that which the teacher puts them.'

2.5 Explaining as a Use of Language

It will come as no surprise to find that Price's theory of teaching has been shown to be totally inadequate[1] and that it fails for being altogether too narrow in its aims, namely, the promotion of understanding-that and understanding-how, and in the manner of proceeding that it demands of teacher and pupil. Martin (1970: 114) while rejecting it on the grounds that it is an extreme linguistic theory of teaching, suggests that it may have something to offer the theory of explaining something to someone. She points out that the overall objection to the theory, i.e. that its aims

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(1) Notably Israel Scheffler (1958) 'Comment' in Harvard Educational Review 28: 1958 pp. 337-339.

and manner of proceeding are too narrow, may not be upheld in the case of explaining.

There is no doubt that the aims of explaining something to someone are considerably narrower than those of teaching and include understanding-that and understanding-how. However, it has emerged from earlier considerations of kinds of explanation (see pp. 33-34) that there are explanations whose respective goals are understanding-what and understanding-why. This raises the question of whether or not Price's aims accommodate these. There is a sound reason for suggesting they are accommodated, which utilises a point raised earlier (see pp. 33-34) for which it is argued that answers to how-questions that require an explanation rather than mere telling can only be given with reference to what or why, although the linguistic form of the original question obscures this.

If it is accepted that the aim of Price's theory is the promotion of understanding this is highly acceptable in a theory of explaining something to someone because explaining is not concerned with the 'whole child' or directly with establishing norms and beliefs, as is the case with teaching. Indeed, bearing in mind Green's notion that explaining and reason giving are different activities (see p.57) it is possible to view explaining as a much more intellectual activity than teaching. This is an important point, for Price's theory is often justifiably criticised on the grounds that its view of teaching as an activity is too highly intellectual.

Martin (ibid: 115) raises various other objections to Price's theory as a theory of teaching and discusses them in relation to explaining. One of these is the statement that one who has received education believes he has been taught. Taken in conjunction with learning this is a somewhat odd notion. Presumably, the anticipated result from being taught is that the pupil has learnt and one would expect a pupil to <u>know</u> this rather than to <u>believe</u> he has been taught. However, in explaining how, to someone, the position is rather different as believing what has been said is highly relevant in this case. Thus, another valid objection loses its force.

An objective that may be a bigger stumbling block in Price's theory still has to be resolved, namely, that in a successful teaching episode the pupil's use of sentences shall correspond in an acquiescent way to the teacher's. Whether or not this objection can be overcome will depend to a great extent on the interpretation of 'correspond in an acquiescent way.' If it is interpreted to mean an echoing of the teacher's views, it is as unacceptable in a theory of explaining something to someone as it was in a theory of teaching. However, if what is meant has more to do with accepting and believing what the teacher says this <u>is</u> an important aspect of explaining because, here, the teacher is trying to promote a specific understanding of the underlying question and in relation to the underlying question only this carries the seal of success. Substitution of the pupil's views, for example, will not count as success for a number of reasons. In the first instance, an explaining episode that <u>meets the conditions of a theory of explanation</u> requires a sound underlying question that admits of a right answer, it further requires that the tutor be rational and, lastly, that the tutor (within the limits of current knowledge) knows the right answer to the question. If these conditions are met substitution of the pupil's views must carry the implication that he refuses to accept the explanation or that he has failed to understand the answer - a state that can be remedied perhaps through a shift in question. In neither case can the response be considered a successful outcome as understanding has not been achieved.

Moving in from objectives and applying Price's theory of the manner in which teaching proceeds, to explaining, requires the examination of certain linguistic features. In maintaining that in teaching sentences are used by the teacher in at least an active and assertive way Price's (1958: 327) requirements are clearly at variance with a great deal of teaching behaviour. The question to be answered is whether or not the same is true in relation to explaining something to someone. In other words, can the teacher explain something to the pupil without using sentences in the manner described? The answer depends upon what is involved in the use of active assertive sentences. One requirement is that the teacher takes on the role of explainer and does not get the pupil to work out the explanation for himself. This is no problem for, if the pupil was working out the explanation for himself, the teacher would not be engaging in explaining and an explaining episode would not be taking place. Thus, it is the case that in explaining something to someone sentences <u>are</u> used in an active way.

A more difficult objection to meet concerns the <u>need</u> to involve an assertive use of sentences in an explaining episode, particularly if this is construed as a strict requirement. An explanatory use of sentences has been identified by Price as one of the four uses of sentences involved in teaching. He also maintains that individual uses can operate at one and the same time in a sentence although one use will dominate. Bearing this in mind, it would be reasonable to assume that within the context of explaining something to someone the explanatory use <u>must</u> dominate and the assertive use, at best, take a relatively unimportant role. However, this does not meet his requirement that sentences be used in at least an assertive way and suggests that it is necessary to know more about the nature and function of an assertive use.

Martin (1970: 119) maintains that if Price has in mind the <u>user's purpose</u> in making a statement, he is 'justified in differentiating an assertive use from his other uses.' This being the case, an explanatory use would dominate in an explaining situation, for the user's purpose would be to explain. In this sense of assertive use Price's requirement does not hold true for explaining something to someone.

On the other hand, as Martin (ibid: 119-20) points out, explaining something to another does involve using sentences that state or assert something about something. If Price means by an assertive use of language that when certain sentences are used they state or assert things about the world, then this use should not be contrasted with the other uses. She argues that this feature 'is independent of the speaker's general objective in using the sentences.' This means that a speaker could achieve his objective, for example, clarifying, because he uses sentences that assert things. Thus, it can be said that when someone is using sentences in an explanatory way, the sentences must assert something about the issue in question. Martin contends that in this case the requirement holds true for explaining something to someone.

In referring to the assertive use Price speaks of employing sentences to assert facts. It is clear that he assumes the statements made will be true or at least considered to be true at the time of the explanation. Martin (ibid: 121) would have the notion of a fact construed broadly so as to include value judgements, theories and moral judgements. She also includes statements that the explainer takes to be false but uses for good pedagogical reasons. This last condition, which Martin includes in her modified form of Bromberger's Hypothesis Four, (see pp. 55-57) is one that calls for strict control. For while it would be difficult to disagree with the view that there may be sound pedagogical reasons for a tutor to give his tutee facts that are not the true facts but are sufficiently related to the true facts to be helpful to the tutee in learning the answer to the underlying question, an objection could be raised on the grounds that the tutor has not given an explanation of something to someone. He may have prepared the ground for an explanation of the underlying question at some later date or stimulated ideas and actions in relation to the tutee such that the tutee works out the correct answer for himself but in neither of these instances is it possible to say that the tutor has explained the underlying question to the tutee.

The peculiar contribution of Price's theory of explaining something to someone cannot be left as being merely an emphasis upon the need for the tutor to state or assert the facts of the matter being explained. This emphasis is a major part of what he has to say but he goes further than this by ruling out the notion of a simple citation of relevant facts upon which no linguistic work has been done to organise them coherently or relate them to the underlying question, as being adequate. In other words, the task of organising, relating and finally presenting the explanation must be undertaken by the explainer.

There will be occasions in teaching and learning when the function of explainer is taken on by a pupil. The majority of occasions will involve two pupils and, more rarely, a pupil explaining something to a teacher. It is important not to confuse the latter situation with one in which the teacher asks a pupil to explain to him something that he, the teacher, already knows. In this case, although he may use the word 'explain' the teacher is really asking the pupil to demonstrate to him what he, the pupil, knows or doesn't know, as the case may be. More commonly, where the activity of explaining something to someone is going on in a classroom it is the teacher who takes on the role of explainer.

Price assigns to the explainee a passive linguistic role that corresponds to that of the explainer. It would be a mistake to interpret this as meaning that the explainee remains inert or that he is expected to parrot whatever the explainer says. Passive here refers to mood and thus carries the implication that the explainee is expected to respond as one who has received the action. The condition that requires that his reason be acknowledged affords him opportunities to accept or reject what is offered or to respond in a way that may trigger a shift in question, making necessary the answering of subsidiary questions before understanding is achieved. In the ideal episode the explainee will be striving to come to terms with the explanation being offered and, thus, his linguistic behaviour will demonstrate a preoccupation with acts that 'correspond to those of the explainer' because their major objective is understanding of the 'something', i.e. the underlying question that is being explained to him by 'someone', i.e. the explainer.

Although, initially, the conditions that Price proposes appear to be extreme and terms like 'active and assertive' in relation to language use almost persuades one to reject them out of hand, closer examination has shown that they have some contribution to make to explaining. If 'active' and 'assertive' are used to mean that the explainer must be prepared to take on the role of the one who organises and presents the explanation as best he can and, in doing so, to make clear statements of fact as and when appropriate, Price is demanding no more than is usually necessary if an accurate explanation is to succeed in promoting understanding. However, this does not prevent the demand from being deemed totally ludicrous in respect of many other activities that qualify as teaching and, indeed, in the case of certain other methods and ways of getting pupils to arrive at explanations which are not the specific kind of explaining with which this thesis is concerned.

2.6 The Essential Characteristics of Explaining Something to Someone

If Price's model draws attention to the existence of a linguistic condition on explaining something to someone and, in doing so, differentiates explaining from teaching by requiring a certain use of language, it is necessary to include other requirements that have been proposed and discussed. The attempt to define the philosophical nature of explaining with sufficient sensitivity to enable it to be distinguished from related activities like telling and informing considers six conditions, which are:

(1) A linguistic condition that requires the explainer to use language actively and assertively.[1]

(2) A rationality condition that requires the explainer to be rational with the implication that he will conduct his manner of explaining rationally.

(3) A rationality condition that requires the explainer to acknowledge the explainee's reason.

(4) A truth condition that requires the explainer to present the true facts or what he perceives the true facts to be and not to misrepresent them for any reason.

(5) An understanding condition that exerts pedagogical constraints upon the way in which an explainer proceeds.

(6) A question-shifting condition that requires an explainer to answer the underlying question and at least one subsidiary question.

Martin (1970: 128-29) contends that the above conditions have logical status and that each one must be met before it can be said that someone has explained something to another. She embodies all these conditions in yet another model which she refers to as Hypothesis Six, which is given below:

> The essential characteristics of explaining episodes are the following:
>
> (a) the underlying question is sound, i.e. admits of a right(2) answer or the tutor believes, or at least assumes, that the underlying question is sound, i.e. admits of a right answer;

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(1) Actively and assertively is used in the sense that is discussed on pp. 69-71 and 73.

(2) It is appreciated that the notion of 'right' affords philosophical problems, which are not the concern of the present writer. The term is used in this thesis to mean one or a limited number of responses that, within the bounds of available knowledge, are generally held to be acceptable as the answer to a specific question.

(b) the tutor is rational and understands W[1] at the time of the episode, or thinks, or at least assumes, he understands W at the time of the episode;

(c) during the episode the tutor knows, or believes, or at least assumes, that at the beginning of the episode the tutee was in some rational predicament with regard to the underlying question;

(d) in the course of the episode the tutor states the right answer, or what he believes, or at least assumes, to be the right answer to the underlying question, or that part of the right answer, or what he takes to be the right answer, that in his opinion the tutee must learn in order to understand W or, for good pedagogical reasons, he states what he knows, or believes, or at least assumes, is not the right answer to the underlying question but is, in his opinion, sufficiently related to the right answer so that it will not prevent the tutee from understanding W at some later date;

(e) in the course of the episode the tutor also provides or attempts to provide the tutee with answers to such subsidiary questions as he (the tutor) thinks necessary or effective or at least helpful for removing the basis of the predicament he deems the tutee to be in;

(f) in the course of the episode the tutor encourages or allows the tutee to exercise, or at least does nothing to prevent the tutee from exercising, his reason and judgement with respect to the underlying and subsidiary questions and the answers to them given the tutee by the tutor;

(g) at the end of the episode the tutor has organised for the tutee and stated to him the answers mentioned in (c) and (e).

This modified hypothesis of Martin's appears to answer most of the criticisms that have been made of the other models and, from a purely philosophical standpoint, is the most satisfactory in relation to the kind of explaining episodes to be found in the context of teaching and learning. However, an account that is concerned only with philosophical aspects

(1) 'W' here occupies a position taken up by an indirect question whose corresponding direct question underlines the episode.

cannot do full justice to all the factors present in the problem. It tends to place its emphasis upon the definitive and logical characteristics of the act and the explanations rather than upon the dynamic aspects of episodes. Influential factors rooted in contextual, cultural and behavioural considerations are either ignored or given only cursory attention.

The contention that a complete account of the characteristics of an explaining episode cannot be said to have been given while gaps of the sort described exist is one that can be defended, utilising support from social, psychological, linguistic and pedagogical theories. Indeed, within classroom contexts, matters such as the perception of a tutee's predicament, question shifting and organisation of presentation are complex problems which will be informed by events that have occurred before the episode and by those that arise from within the situation in which the episode occurs. Cultural and conceptual distinctions between explainer and explainee being examples of the former; social interaction and role relationships examples of the latter.

Another omission in Martin's modified hypothesis is any consideration of how an explaining episode arises within and is inserted into the broader context of the lesson. If this would seem to be a simple matter, a glance at transcripts of lessons containing explaining episodes soon dispels this belief.

Starting from the position that a pupil's predicament in relation to some underlying question prompts the teacher to engage in an act of explaining, the context in which this information is received by the teacher is itself varied and may have implications for the conduct of the ensuing explaining episodes.

It is possible that a teacher may perceive his pupils' predicament while marking their work and, as a result, plan and take an entire lesson as an explaining episode. Most frequently, explanations are evoked within the dynamic situation of the lesson itself by a pupil's question to the teacher, uncertain and incorrect pupil response to questions asked by the teacher, and questions asked by pupils of pupils when working in groups.

A teacher may decide that the subject matter of his lesson is new and difficult and may choose to open the lesson with an act of explaining. He may find it necessary to continue to ask subsidiary questions that have a bearing on the underlying question at intervals throughout the entire lesson in his attempt to promote understanding. This raises the problem of deciding where the explaining episode begins and ends. If it begins and ends with each separate sequence of dialogue it is likely that many sequences will not achieve understanding of the underlying question. Indeed, in the case just described, it is only achieved within the final sequence of the string of sequences that have taken place within the lesson and which are directed at the underlying question.

A teacher may choose to explain something to someone by telling a story. This raises the question of whether the episode can be regarded as dialogue. If the story contains an explanation and at some stage the teacher asks the pupil a subsidiary question that has a bearing on the underlying question and receives a response that satisfies the condition concerned with acknowledging the pupil's reason, it would appear that it does satisfy Martin's conditions. But this situation is another that makes it difficult to decide what constitutes the explaining episode, i.e. is the whole story to be taken as the teacher's explanation of the underlying question? For good pedagogical reasons, such as maintaining interest, the teacher may have included much material that does not contribute anything to the explanation but is bound in with those statements that do. There is nothing in Martin's hypothesis that informs problems of how an explanation is inserted into the broader context of the lesson.

Conceiving of an explaining episode as a sequence or sequences of dialogue concerned with answering an underlying question and at least one subsidiary question that has bearing on the underlying question carries the implication that the length and complexity of episodes demonstrates considerable variation. Indeed, an explaining episode will share certain characteristics with Halliday's (1978) 'text-in-situation' which he regards as a unit of semantic structure which has no connotations of size. As such, it seems unlikely that specific conditions or procedures can be found for defining the duration of an explaining episode. A more fruitful approach appears to be one that examines each episode within the situation in which it arises and takes account of dynamic and contextual factors in coming to decisions about it.

In concluding the discussion of Martin's Hypothesis, of the six conditions it reveals, the one pertaining to understanding requires further clarification. The understanding that explaining something to someone aims at goes beyond merely having an answer to the underlying question. It has affinities with knowing and believing and its nature is that of a cognitive verb. However, although understanding is what every explaining episode aims at, it does not necessarily follow that if all other conditions are satisfied it will be achieved. For in the same way that a teacher may teach and a pupil fail to learn, so an explainer may give an explanation and the explainee fail to understand. Problems of this sort will be examined in the next chapter, together with the closely associated and equally complex notion of meaning.

Before leaving this discussion of the characteristics of explaining episodes it is worth looking at certain situations which require careful interpretation. One such situation involves the asking of a why-question that is rational but cannot be deemed to have a 'right' answer.

A useful notion when considering questions of this kind concerns the distinction drawn by Green (1971: 159-162) between explaining and giving reasons. He points out that answers to this 'why' have to do with justifying views, opinions, attitudes and behaviours. In these cases, a pupil may legitimately decide for himself whether to accept or reject the teacher's position. He may substitute his own views and even try to persuade the teacher that he (the pupil) has a better case than that offered by the teacher. Using Green's distinction, these activities are all to do with 'reason giving' and <u>not</u> with explaining something to someone <u>in the sense that it is used in the thesis</u>. Open-ended questions would tend to fall into this reason-giving category as it is impossible to conceive of explaining without incorporating the notion of an explanation. As has been made clear in the discussion of kinds of explanations, implicit in the concept of an explanation is that, characteristically, it carries the correct answer to an underlying question.

Another situation requiring special interpretation is one in which a why-question which has a right answer is posed by the pupil but in responding the teacher does not initiate an explaining episode. Instead, he meets the pupil's question and subsequent questions with questions of his own. The objective of this, meeting a question with another question, is the setting up in the mind of the pupil a conceptual and cognitive set that is potentially useful for working out the answer to the underlying question. In this case, as with the last example, the teacher is not explaining. He is, for <u>good</u> pedagogical reasons, drawing from the pupil information that is already known and indicating ways in which it may be used to advantage. Although the activity is concerned with arriving at an explanation, the teacher does not take on the job of explainer, instead he attempts to manoeuvre the pupil into a position where he can find the explanation himself. Thus, this situation does not qualify as an example of explaining something to someone in the sense that has been defined by the present writer for the proposed investigation.

Nor would a situation qualify where the pupil had obtained the explanation by carrying out relevant experiments or by sifting through experimental data supplied by another. For this reason, the so-called Discovery Method makes, or should make when utilised effectively, less use of the activity of explaining something to someone than do traditional methods. This tendency is not only to be found in the teaching situation. Texts written for use with courses like Nuffield Science tend to guide pupils by asking questions rather than by offering explanations, while those geared to a more traditional syllabus contain a great many explanations. However, obtaining understanding of an explanation through reading it in a book does not qualify as an example of explaining something to someone any more than do the previous two examples. The reason why this is so, involves the conception of an explaining episode as a dialogue between explainer and explainee, in which it is possible for the explainee to ask and receive answers to subsidiary questions that have a bearing upon the underlying question. While the writer of a book may attempt to emulate this feature by providing hypothetical questions that may be in the mind of the reader, he cannot set up the sort of exploratory interaction that is possible in the face-to-face situations characteristic of explaining episodes.

One last situation that causes problems in deciding whether or not it qualifies as an explaining episode, is one in which a why-question has been asked by the pupil which has a right answer that is known to the teacher. The teacher offers some of the facts that are necessary to explain the underlying question and having done so suggests to the pupil that he can now work out the rest of the explanation for himself. Whether or not the pupil succeeds in working out the explanation from the new position he is in as a result of being given some of the facts is not a matter which helps very much with deciding if this situation is one in which the teacher has explained something to someone. It is doubtful that it would qualify. However, as it contains some activity which appears to go beyond reason-giving and as this particular kind of episode occurs quite frequently in teaching in relation to both Discovery Method and Traditional Methods it will be examined as a special case of explaining, thus taking account of it but differentiating it from what normally passes as explaining something to someone within the context of this thesis.

CHAPTER 4

1.0 UNDERSTANDING SOMETHING

1.1 Understanding as Seeing Connections

1.2 Promoting and Achieving Understanding

2.0 MEANING AND ITS COMMUNICATION IN THE ACT OF EXPLAINING

2.1 Learning the Meaning of Words

2.2 Communicating Meanings and Understanding Communications

2.3 Sociosemantic Factors in Communication

2.4 Context and Situation in Communication

2.5 The Influence upon Communication of What is Explained

3.0 EFFECTIVENESS IN EXPLAINING SOMETHING TO SOMEONE

3.1 Verbal Actions in Relation to Communicated Meanings

3.2 Studies of Teacher Effectiveness in Explaining

1.0 UNDERSTANDING SOMETHING

The discussion of the previous chapter identified a variety of conditions that are characteristic of an explaining episode. Of only one of the conditions is it possible to say that it must be an objective but that the explaining episode is no less an explaining episode if it falls short of achieving this objective. The objective in question is that of understanding which, in this respect, is very much like learning. It can be achieved without the activity of explaining taking place and not attained after every effort has been made by the explainer to promote it. A variety of acts and strategies going on in the classroom may have understanding as an objective but have nothing to do with explaining something to someone. Indeed, when discussing understanding it should be borne in mind that it is very much an open question whether explaining is the most effective way to promote understanding even though by definition explaining has understanding as its goal.

Initial discussion will be concerned with the essential characteristics of understanding, as a first step towards identifying some of the problems involved in its attainment. It is also thought necessary to consider it both from the position of promoter, which in classroom contexts is most commonly the teacher, and the position of the one trying to achieve understanding, that is, the pupil. As the focus for examining the act of explanation is that of explaining something to someone, a degree of consistency is achieved if the focus of this examination is 'understanding something'.

The understanding that explaining something to someone aims at has nothing to do with being understood. It has some affinity with knowing and believing and when a person is said to understand in the sense in question, the verb 'understand' is cognitive in character. Bearing this distinction in mind a negative thesis of Ryle (1949: 170-71) offers further illumination. He rules out feelings and flashes of insight on the grounds that they are neither necessary for, nor a guarantee of, understanding, and contends:

> Even if you claimed that you had experienced a flash or click of comprehension and had actually so, you would still withdraw your other claim to have understood the argument if you found that you could not paraphrase it, illustrate, expand or recast it; and you would allow someone else to have understood it who could meet all examination questions about it, but reported no click of comprehension.

In short, Ryle is claiming that the true test of understanding is some kind of appropriate performance in which the knowing that is achieved through understanding is demonstrated.

This leaves open to interpretation the question of what counts as an adequate demonstration or performance. The knowledge required for understanding certain things involves knowing how. In these cases some degree of competence in performance is clearly necessary but it is doubtful whether the requirement demands competence in executing the task. It is possible to say that a person understands the game of cricket though he is not a competent player or does not choose to play or had never had the opportunity to play. It is true that there are aspects of the game that can only be appreciated and thus understood at first hand, i.e. as a player. However, the fact that the understanding of the game that the person in question has acquired does not incorporate the experiences of a player will not prevent him understanding the game from the perspective of spectator. Furthermore, his understanding can be tested by asking him to explain the laws and strategic concepts of the game; to comment on the state of play and even to make judgements concerning the merits of specific bowlers or batsmen. Recognising that different aspects of understanding can be had of one and the same thing may well be an important step towards a clearer understanding of something and another may involve accepting that one sort of understanding of something may be deeper and better informed than another.

Martin (1970: 150-51) offers her own explanation of why it is possible to accept that a variety of different sorts of understanding exist in relation to the same thing or class of things. She maintains that the verb to understand shares with the verb to explain the propensity for sometimes being followed by an indirect question and sometimes not:

> Thus we say that the assistant mechanic understands why the engine seized up but also that he understands the engine seizure; that the critic understands how the work of art hangs together, but also that he understands the work of art.

She claims that where someone is said to understand something and no indirect question is implied it does no harm to the 'initial attribution of understanding' to supply one or more such questions. This would then allow the verb understand to take a variety of indirect questions, i.e. 'that given any object of understanding, more than one indirect question may be applicable to it.' She admits when offering this proposal that in certain contexts an indirect question may have a special status. By this she means that, in a given context, it may be possible to understand something only in terms of a particular indirect question.

Martin (ibid: 150) draws attention to the view held by some that it is possible to distinguish the theoretical disciplines from one another 'in terms of the questions they ask and purport to answer about phenomena.' She is not prepared to dismiss this view out of hand on the grounds that much asking and answering of characteristic questions does go on in the disciplines making it necessary for the learner to understand things in terms of certain other indirect questions. However, it is also true that there are other questions which are shared by more than one discipline and indeed aspects of one discipline that can be understood only in terms of another. For example, the digestive system in Biology cannot be fully understood without reference to the chemical actions involved. Thus, the questions to be asked and answered in relation to these phenomena will, in this case, be those found within the discipline of chemistry. It would seem, therefore, that no discipline has sole rights over the phenomena it studies and that they share questions, vocabulary and other things.

A notable feature of understanding is that it lacks the characteristic of being complete. That is to say, in absolute sense it is open-ended. It is possible to have in mind some accepted standard when judging one's own or another's understanding of a particular phenomenon, but there are always new ways of viewing things and new knowledge can effect changes in what have been previously accepted as good explanations.

1.1 Understanding as Seeing Connections

Understanding is often viewed as involving connections or relationships. The continuous series model of Dray (discussed in Chapter 2) with its emphasis upon gap filling, is based upon this assumption. Thus, to understand why something happened or is the case, it is at least necessary to see the connection between cause and effect. In other words, it is not enough to know the cause and the effect the requirement is that the relationship between the two must be perceived and understood. Bearing this claim in mind it is reasonable to suggest that seeing connections plays a crucial role in understanding. Martin (1970: 153-54) takes this position and points out that the sort of connections to be seen will differ depending on the sort of understanding involved. She suggests that there are two sorts of connection that depend upon the manner in which the thing to be understood is treated, as follows:

> On the one hand X may be treated as a whole, a unity, and may be connected or related to something else, something apart from it; let us call connections of this sort external. On the other hand, X may be taken in isolation - that is to say, without relating it to other things - treated as a composite, and parts or aspects of it may be connected or related; let us call connections or relations of this sort internal.

Martin offers works of art as examples of the latter type of connection. A work often has its parts singled out for attention and relationships sought. It is possible for two people to have internal understanding of the same thing and their understanding to be very different. For as Martin (ibid: 155) points out we 'never understand a thing per se; rather, we understand it under some description.' The issue is made more complex by the fact that different sorts of relationship can be seen as a result of selecting certain parts for attention. However, the connection or relationship must be there to be seen, where 'seen' is used to mean, become aware of, and not to imagine, fancy or visualise.

Examples of external connections are numerous and include causal relationships, i.e. a relationship between two distinct entities is pointed to. Martin (ibid: 158) maintains that saying that someone has external understanding of something

> is, in effect, to say that he understands something under some description as bearing some relation to something else which is, itself, under some description.

A common form of external understanding involves classifying something in an illuminating way. In other words, understanding by classifying involves a redescription of something, a change in its original classification, that relates it to a different class of things. Martin admits that it is not possible to set limits on the way in which something can legitimately be redescribed nor can one do more than hope that re-description will lead to understanding, for so much depends upon the experience, knowledge, competence and purposes of the person involved in doing the understanding. However, this does not argue against the practice which is effective if only because the process of looking around and beyond something in an attempt to understand that something, is, in itself, to some degree illuminating. It is also possible to look within something in an attempt to understand it, thus analysing is an alternative to classifying. This tends to be particularly effective in relation to internal understanding, but not exclusively so.

Within the notion of seeing connections as a case of understanding lies the implication that the 'seeing' is something that a person must do for himself. Help can be offered by others through the giving of relevant information, the development of a conceptual repertoire and breaking down the explanation into simpler units but, in the end, the work has to be undertaken by the receiver of the explanation and this involves him in an intellectual confrontation with the relevant facts. Use is made of this phenomenon by proponents of Discovery Methods when making claims in respect of their effectiveness in promoting understanding. They point out that the pupil <u>has</u> to confront the available evidence in trying to work out an explanation for himself. It is true that the pupil is not in this position when something is being explained to him by another but it is still essential that he be involved <u>actively</u> with the information being offered to him. Indeed, by whatever means the information comes to the pupil, be it an explaining episode or through his own experimentation, some sort of active engagement is necessary if understanding is to be achieved. Thus, setting aside rote learning, which has to do with telling rather than explaining, it is a mistake to assume that active assertive use of language by the Teacher precludes active confrontation of the material by the pupil. It is also necessary, as has been mentioned above, to differentiate questions concerning the method of obtaining information from those associated with what the pupil does with the information when he has it.

1.2 Promoting and Achieving Understanding

In attempting to promote understanding the teacher is thrown back upon his ability to use language in a way that is intelligible to the pupil. For, though all the conditions governing an explaining episode are taken account of problems associated with communication may interfere and be particularly resistant to attempts to overcome them. There is nothing new about this problem for as far back as the Seventeenth Century, Locke (1690) in his translation theory of understanding claimed that understanding is dependent upon finding the right words in order to communicate our ideas to another without 'the inconvenience of obscurity or uncertainty in the signification of words.' A particular version of the theory is offered by Steiner (1975: 28) who, in attempting to describe the processes that have to go on before an individual can receive communication and respond to it, arrives at an interpretation that claims 'a message from a source language passes into a receptor language via a transformational process.' In other words, an individual understands what is said to him in his own language in much the same way as he understands one that speaks to him in a language that he has some knowledge of but which is not his mother tongue. Steiner sees the translation occurring from private language into public language and vice versa, where public language is 'speakers' language.

That Steiner's theory is altogether too exaggerated is a view supported by Parkinson (1977) and Stewart (1977). Parkinson (1977: 11-12) is highly critical of Steiner's (1975: 198) view that that with which a word is associated is the meaning of the word and although associations will vary greatly from one person to another, such that no dictionary could include them, nevertheless, it is in this manner that individuals 'put meaning into meaning'. He points out that on Steiner's theory understanding of another will be well nigh unattainable for it would be quite impossible to know all the private associations that a word has for another person. Stewart (1977: 29-30) also takes up this point and says that if syntax and vocabulary with private nuances and associations are deemed to be a person's idiolect, then:

> translating into my idiolect with my associations could do nothing for my understanding of your idiolect with your associations, since it is just because they are different that Steiner says we must translate in the first place. If, alternatively, he means that we keep the associations and change the expressions into our own personal idioms, to match, then it is simply false that we do anything of the kind. For one thing, even if we tried, we would already have to understand the other person's words first, or at least have learnt the translation rules which, again, carries some kind of prior understanding with it.

It should be stressed that both Parkinson and Stewart do not dispute that there are aspects of privacy of association and of intention in a person's use of language. However, as he, Stewart, (ibid: 41) points out there are problems about speakers meaning, i.e. connotations and implications, commentator problems concerned with why someone should have said what he did and 'problems of utterance meaning, problems of simply saying what the original said'. Thus, in answer to a question concerned with how one understands the meaning of x and y, one can only reply in the same way that one understands anything, i.e. through familiarity with the language and thought of the appropriate milieu. Furthermore, there are no theoretical obstacles to doing this, those that do exist are of a practical or a special nature in contexts where there is little opportunity to engage in dialogue. In a sense, problems of understanding and problems of translation are the same problem but, unlike Steiner's view, problems of translation are seen as problems of understanding and not the other way around.

It is advisable for a teacher to take account of the practical and special obstacles to understanding, that Stewart mentions, when seeking to promote understanding as the end products of an explaining episode for both are likely to be in evidence in a context of this nature. Something as fundamental as finding the right words will force him to take account of a variety of factors. Gurney (1973: 92-93) suggests that a 'sender' in this situation will make an assessment of the age, intelligence and state of knowledge of the receiver with a view to selecting the right conceptual level of the message. He will note the motivation, interests and state of readiness to ensure attention and, finally, select a suitable register(1) with a view to accomplishing maximum information flow and the easing of the listener's task in understanding what is being said, both of which optimise the chances of the sender accomplishing his purpose. Gurney (ibid: 94) adds the warning that having taken account of all these factors there is likely to be 'all the difference in the world between our intention to communicate and what we actually achieve.'

Doughty and Thornton (1973: 60) call that which takes place during the process of understanding an aspect of the activity of languaging. They contend that a self consistent symbol system is used to derive meaningfulness from the 'meaning potential'(2) encoded in the utterances of others. They include among their postulates about language as a form of behaviour unique to human beings, one that offers the view that a particular language is learnt by human beings through continuous interaction with others who already have an operational command of that language, and another that has much to do with activities involved in understanding. They claim that acquiring a capacity to 'language' is the same as acquiring a capacity to make meanings. Therefore, it is possible to say:

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(1) Register, a term associated with M.A.K. Halliday that is defined as any variety of language distinguished according to characteristics of use.

(2) Meaning - potential, a notion associated with M.A.K. Halliday. (1975: 8)

> that an individual uses language to discriminate between one experience and the next; he calls upon the categories of his language for classifying and recording what he experiences; and he makes use of the resources of the symbolic system in his possession to understand what it is that he has experienced.
>
> (ibid: 61)

The points raised here have implications for explaining episodes, having, as they do, understanding as their desired goal. The implications suggest that for a teacher to obtain the desired goal he must pay attention to certain linguistic features that are influential in the task of getting over what he wants to say. In doing so, he may well be faced with questions concerning the degree to which his own use of language is clear and direct and the way in which he will try to utilise the existing command of language in the pupil. In other words, as the teacher prepares to explain something to someone he is confronted with the problem of meaning and its communication.

2.0 MEANING AND ITS COMMUNICATION IN EXPLAINING SOMETHING TO SOMEONE

It is possible to ask two kinds of questions about meaning. The first kind can be thought of as what-questions, for example, what is meaning? The second kind are how-questions, for example, How do I know what words to use to convey meaning? Within the context of understanding an explanation given by one person to another, communication of meaning is an essential feature and thus the second kind of question is more useful. Causal theories of meaning appear to get over the problem by having something to say to both.

2.1 Learning the Meaning of Words

Causal theorists affirm that every word that is learnt comes to produce a mental image of or about the corresponding thing in the 'real' world. A process akin to conditioning is seen as going on as words acquire meaning for an individual. Two distinct aspects, namely, the physical content and the psychological content are present in the situation in which learning the meaning of a word is going on. A person comes to understand another by a process in which one person's thought is associated causally with certain words which when uttered cause the other person to have the same or similar thoughts. This view has some weaknesses as a theory of meaning. Perhaps the most obvious is its pseudo-scientific character. It gives the impression of following from scientific discoveries largely because it is known that words stimulate the nervous system and produce effects and that communicating behaviour can only occur because these processes are taking place. What does follow is that science can explain how certain sounds serve as vehicles of communication. Indeed, questions about what it is for a word to have a meaning and what the meaning is of a particular word are not proper questions for scientists. Taylor (1970:120-23) attacks the errors in causal theory convincingly. He rejects the notion that communication consists in uttering words which cause effects on the thoughts of another as implying something like a reflex action or an automatic response that, in his view, is the last thing we would say is true of understanding. He asserts that a distinction must be drawn between causal relations and meaning relations and also points out that in communication words convey thoughts not because 'they are causally related to the things thought about but because they are related by convention.'

Taylor (ibid:123-26) not only believes that the causal theory misinterprets the concepts of understanding and communication, he thinks it fails altogether in its attempt to define the meanings of particular words in terms of their effects on hearers. He maintains that learning the meaning of words is learning to use them in regular and correct ways. Thus, there are rules implicit in their use which give a word its meaning. He (ibid:127) maintains that these rules are prior logically, and that:

> A word's having a meaning can be likened to its having consequences in use which are determined by such rules.

In trying to answer the question concerning the meaning of a word, Taylor (ibid:130-31) offers four suggestions:

(1) particular objects, events or situations (this chair, this red thing);

(2) classes of objects, events or situations (chairs, red things);

(3) universals, properties or essences (redness, chairness);

(4) mental states, ideas, images or thoughts.

He points out that at different times we accept one or other of these suggestions. The first three correspond to the pattern and order that the world displays, the fourth reflects what we have in mind. Of course, what one has in mind and conveys through speech may not correspond to the real world but to personal perceptions of the world. It is, therefore, possible to think of meanings as:

1. independent and real characteristics of the world;
2. things in the mind;
3. what we use words to talk about.

Taylor (ibid: 149) rejects all three of these as a possible theory of meaning(1) and offers the view that:

> Understanding and knowing the meaning of words is using them correctly and responding appropriately when others use them. The concepts of understanding and knowing the meaning of a word refer to patterns of behaviour, in particular, skills exhibited over fairly long periods.

This account does appear to pay more attention to cultural and contextual features than is the case in causal theory although it does not elaborate upon their influence. It is also pertinent in relation to explaining as an activity of teaching. The point raised in it could be incorporated into

(1) For the purpose of this study it is not necessary to discuss the philosophical reasons offered by Taylor in rejecting the proposed theories of meaning.

criteria to be used by the teacher in making a realistic assessment of the state of knowledge and linguistic competence of the pupil. He could also bear these in mind when selecting the words of his explanations, making sure that within the demands imposed by the subject matter he utilises words most likely to be those with which the receiver of the explanation is familiar.

There are problems associated with deciding how long must a word be used before it can be assumed that its meaning is understood by the user, even from a position in which one is able to concentrate attention on the language used by a particular individual over a period of time. For the teacher meeting hundreds of pupils for a relatively short time during each week it could be an impossible task to make such judgements with any degree of accuracy. He probably gets round the problem by making judgements that are related to his perception of what, typically, can be expected of a pupil at a given age and stage of conceptual development. Taylor's theory of meaning draws attention to the need for awareness on the part of teachers that the assessments they make of the linguistic competences of their pupils are at best crude and in cases involving individual pupils, very wide of the mark. The difficulties associated with making assessments of linguistic competences may be exacerbated by other factors. One example is the ability of some pupils to <u>speak</u> words after a very slight acquaintance with them. Studies of classroom dialogue such as those of Barnes (1969 and 1976) and Richards (1978) support this observation and, further, claim that pupils can habitually use words appropriately in specific contexts while having little or no understanding of their meaning.

There are also problems associated with both private and restricted meanings. An example of the former is the idiosyncratic experiences associated with a particular word that influence an individual's conception of its meaning and of the latter, those meanings which arise within the context of social, ethnic, interest and occupational speech networks,[1] contained within a speech community, and which are shared by their numbers.

2.2 Communicating Meanings and Understanding Communications

Within the context of explaining something to someone the complexity of the problems described above tends to increase. It is highly likely that the notions within the explanation consist of 'compounds' of concepts or that conceptually they are of an order of difficulty that will be found demanding by the pupil. The need to operate within the limits of the receiver's linguistic competence in order that the intended meaning is conveyed as accurately as possible, cannot be over-stressed, particularly where there is new material that the receiver has to match with existing mental structures or sets in order to make sense of the explanation. Yet another difficulty is encountered when attempting to define new words, particularly those deemed to be technical, with reference to other words. Again, the teacher's selection of words to convey the meaning of the new word is dependent for its success upon the accuracy of his assessment of the pupil's vocabulary. Evidence from studies of Barnes (1969 & 1976) and Richards (1978) finds that teachers are on the whole aware of the problems posed by technical vocabulary,[2] but in their attempts to re-define such terms through the use of non-specialist vocabulary, they demonstrate less awareness of the limits of the vocabularies of their pupils than could be hoped for. If, in fact, a non-technical word is totally unfamiliar to the receiver, i.e. he has not encountered it, used it correctly or responded to it or another's use of it, on some earlier occasion, the re-definition is no help at all.

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(1) The term speech-network is that used by Fishman (1970) in his discussion of the nature of the language varieties to be found in a speech community of even moderate complexity.

(2) A technical term is seen as a word or phrase which, when used in the context of a specific subject, carries a single scientific meaning.

Another view that offers insights into the function of language in communicating meaning in cognitive discourse is that of Harrison (1972: 153-155). He sees language as a system of linguistic devices[1] where linguistic devices are characterised as 'systems (of rules), each of which determines or is determined by a certain sort of social discourse.' In discussing the function of these devices within the activity of giving information he maintains that informative discourse is highly complex involving the interplay of a number of linguistic devices. These points are relevant to a consideration of explaining something to someone where the giving of information is a necessary condition. The view of understanding is similarly useful. Harrison (ibid: 161-162) rejects the idea that understanding can be interpreted in terms of a certain picture preferring to believe that a learner possessing linguistic competence can be said to know the 'rule-licensed procedures appropriate to a given utterance' and the 'experienced-licensed implications that an utterance possesses.' He qualifies the latter aspect further by adding - 'in the event that it is taken as trustworthy, in virtue of the fact that it generates certain rule-licensed procedures.'

Harrison (ibid: 162) suggests, that if his view is correct, it must follow for a given information utterance (which he symbolises as 'U') that when someone understands 'U'

> the fact that he knows how to generate the rule-licensed procedures appropriate to 'U' is always prior to, and is the ground of, his knowledge of the experience-licensed implications of 'U'. Thus, to say of somebody that he understands 'U' may mean simply that he possesses the strictly linguistic capacity to carry out the rule-licensed procedures appropriate to 'U'. Or it may, or may also, mean that he has seen, or is capable of seeing a greater or smaller number of experience,

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(1) He uses the phrase 'linguistic devices' to replace 'language game' on the grounds that 'Language games' are not, as has often been pointed out much like games. In general any phrase which ties our conception of linguistic rules to a particular metaphor is to be avoided.

(Ibid:8)

licensed implications of 'U'.

The distinction that is made here between rule-licensed procedures and experience-licensed implications are implicit in Taylor's model (see pp. 82-83) as 'the ability to use words correctly and respond appropriately when others use them', on the one hand, and the reference to 'patterns of behaviour, in particular skills exhibited over fairly long periods', on the other. The distinction also appears to account for it being possible to say of someone that he understands what is being said without understanding the significance of what is said.

Harrison (ibid: 166) warns that the distinction in question cannot be used to clarify distinctions between telling and revealing, pointing out that it is possible to exhibit the cognitive content of an utterance by producing other utterances that state it. In the case of distinctions between what is told to another and what the utterance reveals (considered as an inductive sign) to that other it is only intelligible,

> by virtue of the fact that we can state what it is that we have been told and, thus, can distinguish what we have been told from what we have assumed, inferred, invented, imagined, and so forth.

Thus, to say that someone understands the meaning of an informative utterance is to say, at the very least, that he can perform the rule-licensed procedures appropriate to the utterance and can say what the speaker responsible for the utterance told him in uttering the utterance.

Katz (1972 : 3-4), discussing semantics, points out that linguistic theory is concerned primarily with an ideal speaker and listener unaffected by grammatically irrelevant distractions, such as, shifts of attention and characteristic errors in applying his knowledge of the language in actual performance. In accepting the view that the basic function of natural languages is to serve as vehicles of communication for their speakers he maintains that it is not function that distinguishes one language from another but differences in the range of information that can be commanded. He cites (ibid: 69) the principle of expressibility associated with Frege (1963) which postulates that anything which is thinkable is communicable through some sentence of a natural language and the principle of universality of Tarski (1956) that natural languages can express whatever can be meaningfully spoken about. This latter view is shared by Searle (1969) who also argues that whatever a speaker might want to mean can be said.

Rommetveit (1969: 166) argues that Searle's principle of expressibility should be 'conceived of as a basic pragmatic postulate of verbal communication.' He rejects the contention that everything that can be meant can be said on the grounds that it ignores the function of dynamic residuals(1) in acts of verbal communication. He maintains that an encounter between a restricted and elaborated code(2) may, in part, be described as a mismatch of presuppositions. Lack of inter-subjectivity is caused by a failure to adopt the role of the other, i.e.

> to the "restricted" speaker's failure to engage in the kind of decentered categorization and attribution characteristic of the listener's approach and to the "elaborated" listener's incapacity to share the engagement and more restricted perspective of the speaker.

Mismatches of the sort Rommetveit describes make it difficult for the interpretive and 'filling in' procedures that promote the meaningfulness of an utterance to operate. Cicourel

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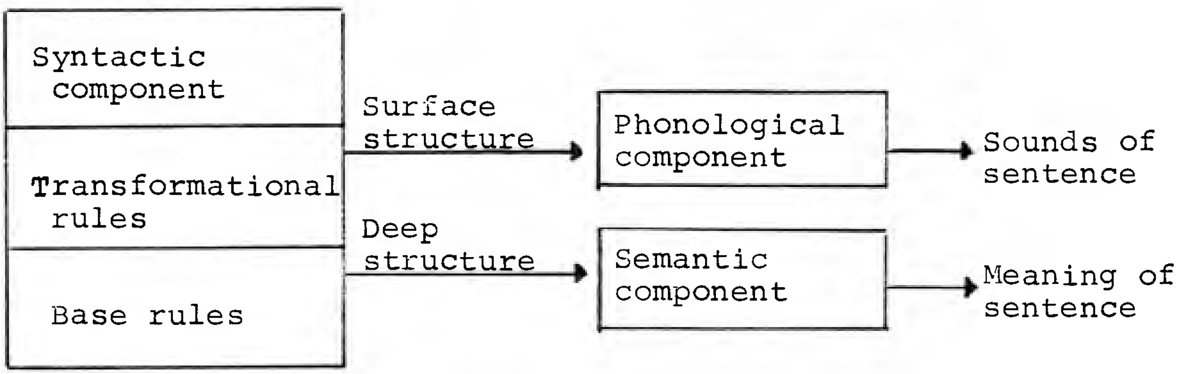
(1) Residuals - Tacitly taken for granted commonalities with respect to interpretations (ibid: 164).

(2) Rommetveit is referring to Bernstein's notion of restricted and elaborated codes.

(1973) has more to say about these procedures which will be discussed during the examination of sociosemantic factors in communication that takes place in section (2.3) of this chapter.

At this stage, the points raised by Rommetveit serve as a clear reminder that in the accounts that have been offered many statements refer to ideal states and appear to be concerned with that aspect of language that Chomsky (1965) identifies as linguistic competence. He finds it necessary to distinguish linguistic competence which he perceives as a system of rules that formally represent the ideal linguistic structures that underlie the utterances of natural speech from linguistic performance perceived as the principles speakers use in producing and understanding rational speech. The diagram below shows Chomsky's attempt to relate utterances to their underlying meanings.



A theory of the ideal speaker's linguistic competence to relate accoustic signals to meaning is broader than a theory of language and in real life situations, where conditions and individuals vary so much more, factors from a variety of distinct fields and disciplines are introduced. Chomsky's model serves as a reminder that in producing an utterance with the intention of communicating meaning there must be congruence between the phonological, grammatical and semantic dimensions of language. If to this requirement are added those factors associated with interaction processes, perceptual sensitivity and conceptualisation, it would seem to be something of an accomplishment to be able to hold an intelligible conversation.

Clearly, the key to holding intelligible conversation lies within the notion of communication, but it would be wrong to think of language and communication as one and the same. Language is one powerful medium for communication but not the only one. It is also widely accepted that language is used for thinking about things in the absence of any wish on the part of the thinker to communicate his thoughts to another. It could be argued that subsequently these thoughts may form all or part of a communication but it seems highly unlikely that this happens to all thoughts. Some are likely to be stored in the thinker's mind or totally discarded.

Communication is not necessarily concerned with supplying new information. Many conversations only confirm what is already known or partially known. Even so, there may be a gap between what an individual intends to communicate and what he actually achieves. The fact that this problem arises in ordinary conversations carries the implication that in everyday situations it is necessary to add to the dimensions of linguistic competence and linguistic performance that of communicative competence. There is considerable support for this view. For example, Greene (1977: 88) argues that whether competence is thought of as a neutral linguistic description or as rules actually used by a speaker there is still the question of whether, in principle, it is possible to give an account of the linguistic meanings of utterances without taking into account the way they are used to communicate in particular <u>situations</u>.

This position is similar to that expressed by Halliday (1973) although Halliday argues against Chomsky's notion of linguistic competence on the grounds that it is more concerned with 'knowing' than with 'doing' things with language. Greene does not support Halliday in this for she interprets Chomsky as claiming that native speakers <u>behave</u> as if they follow linguistic rules and not that they know the rules. Perhaps more important to explaining something to someone is the implication that the ability to communicate depends on the speaker behaving as if he is following the rules for using language appropriately. Greene (1977: 89) suggests that a competent speaker needs to be equipped both with

> a systematic knowledge of the mapping rules between linguistic forms and potential meanings (the domain of Chomsky's theory) (1) and equally with a systematic knowledge of how to map potential linguistic meanings in the actual meanings appropriate to their use in specific contexts (as Halliday is trying to do.)

Competence and performance theories appear to account for different stages in the communicative function of language. There appears to be little doubt that one alone cannot do so and in no situation involving language use is this more true than that of explaining something to someone.

One further distinction that may have relevance for explaining arises from the role of intentions in the theory of language use. Platts (1979: 86) suggests that 'a sentence has meaning because people give it meaning by uttering it with certain intentions' and goes on to claim that it is not necessary to consider a range of intentional theories as that of Grice (1969: 147:77) is the most plausible. This makes a crucial distinction between sentence-meaning and utterer's-meaning, where the utterer's-meaning is defined in terms of utterer's-intention. The final stage of the theory attempts to define sentence-meaning in terms of utterer's-meaning.

Platts (1979:92) on the basis of a requirement that there is no intention on the part of the speaker to conceal his meaning, argues that it is possible to maintain that:

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(1) The brackets are those of the present writer.

1. An utterance is a piece of linguistic behaviour only if it is intentional.

2. Sentence meaning can be defined in terms of utterer's intentions.

3. The meaning of any sentence in a language can be determined by reference to the intentions with which it is uttered.

This view raises some problems in certain contexts but in explaining something to someone it appears to be both relevant and acceptable. It clarifies the position when, as commonly occurs in explaining, the meaning of an utterance is taken by the explainee to mean something other than that intended by the explainer. The theory has implications for explainer and explainee that have to do with the need to build in adequate checks, possibly through a shift in question, so that discrepancies between the utterer's-intentions (i.e. the sentence-meanings) of the explainer and the interpretations of these by the explainee will not go unnoticed.

The problem of misinterpretation is discussed by Saugstad (1977: 208-9) in his theory of communication and use of language. He reminds the reader that individuals participating in communication must be capable of perceiving, thinking, imagining and remembering. He (ibid: 221) argues that understanding involves specifying because for an individual to understand what another is communicating he must understand the communication as concerning the representation of some specific category. It follows, therefore, that two individuals engaged in communication must be capable of selecting the same category represented, otherwise it would not be possible to correct interpretations that were not in agreement with what was communicated by the first person, nor for the first person to ascertain whether or not the receiver of the communication had understood him correctly.

Saugstad (ibid: 230-31) maintains that more than one interpretation can be given by an individual who is to understand that something is being communicated to him, therefore the reaction on the part of the organism must be seen as a selective reaction. Thus, it would appear that the four activities involved in communicating (perceiving, thinking, imagining, remembering) must be subject to some direction of attention. He argues (ibid: 247) that understanding should not be seen as always present in an individual even though the individual consistently demonstrates that he is capable of understanding communications. In cases where an individual does not understand what is being communicated Saugstad (ibid: 250) suggests that the reason may be to do with:

(1) category represented

(2) whether sign used to make reference to the category represented is actually being used for this particular reference.

A point worthy of note is that if the sign in (2) is lacking it cannot be assumed that (1) has not been faulty.

2.3 Sociosemantic Factors in Communication

The points that Saugstad makes concerning first the need for speaker and receiver of a communication to select the same category represented and, secondly, that understanding that something is being communicated involves a selective reaction, draws attention to those aspects of communication that are not revealed through a philosophical examination of the activity that is concerned only with ideal states. Rather, it is a social-functional approach to language that is likely to be the more fruitful, particularly in relation to the activity of explaining something to someone. Halliday (1978: 56) has just this approach to language. He argues that language can be considered from two main perspectives. The intra-organism perspective is concerned with what goes on inside a person and the inter-organism perspective with what goes on between persons in communication. He concentrates his attention upon the latter but sees them as complementary. Thus, mental operations concerned with an individual's retrieval of past learning, for transfer to relevant contexts as they arise, make possible the communicative facility that Halliday (ibid:61) has in mind when he contends that

> a text[1] is meaningful not so much because the hearer does not know what the speaker is going to say, as in a mathematical model of communication, but because he does know. He has abundant evidence, both from his knowledge of the general (including statistical) properties of the linguistic system and from his sensibility to the particular cultural, situational and verbal context; and this enables him to make informed guesses about the meanings that are coming his way.

In everyday speech participants take for granted their sharing of a common interpretation and their 'filling in' of what is necessary to promote meaningfulness (the et cetera assumption) will have a high degree of success. However, an explaining episode is potentially a situation where the hearer lacks abundant evidence about the meanings coming his way. It will be more difficult therefore for 'informed guesses' to be made but this need not prevent the hearer who is 'sensible' to the situational and verbal content, from doing so. Indeed, an explaining episode is rarely a novel and isolated incident. It usually occurs within a specific situation and is linked to all that is going on in that situation, and to earlier experiences in which the same, or related concepts, that are present in that situation, have arisen. But it is likely that there will be more strain upon perception and memory than is the case in ordinary conversation.

Where the situation is one involving teacher and pupils, factors associated with status have to be taken into account. Teachers are in an authoritative position by reason of their specialist knowledge and ascribed power, they control the functions, the interaction and thus the language in episodes.

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(1) Text - The concept of a text, with particular reference to the text-in-situation is regarded by Halliday as the basic unit of semantic structure. It has no connotations of size and may refer to speech act, exchange, narrative, episode, etc.

(ibid: 60)

The characteristic demands upon communicative competence are in their hands and it is highly likely that the communications in subject explanations will present pupils with more problems to overcome than do ordinary conversational communications.

To make a more sensitive comparison it is necessary to employ an approach such as Halliday's (ibid: 60-61) in which he uses situational factors as determinants of the text which identifies categories of field, tenor and mode. He defines the first two as follows:

> Field refers to the ongoing activity and the particular purposes that the use of language is serving within the context of that activity; tenor refers to the interrelations among the participants (status and role relationships).......

Mode is not confined simply to the medium of communication, i.e. spoken or written to be spoken, it also reflects the kind of speech by monologuing or conversation.

If the categories are used to analyse the determinants of a number of explaining episodes certain of the situational features tend to conform to a common pattern. This is to be expected, as explaining something to someone is a specific language activity governed by sets of conditions which constrain it relatively strongly. The actual form of an explanation can vary from one episode to another and certain features, as for instance, procedural strategies, or style of discourse, reveal clear distinctions.

A number of these distinctions reflect the explainer's procedural options, the selection of which may have been influenced by the nature of the explanation or informed by what the explainer perceives to be the state of the explainee. Thus, an explaining episode could incorporate the telling of a story, use of an analogy, a breakdown of the underlying question into simpler parts, or a logical sequence, for example, from familiar material to new material.

Halliday (ibid: 68) also offers a model of language that brings together linguistic, social and cultural systems. In doing so, he centres attention upon those components of a sociolinguistic theory that enable him to view text as a semantic unit that is realised through grammatical units such as sentences. He argues

> a child learning his mother tongue is constructing a meaning potential: that is, he is constructing a semantic system, together with its realizations.

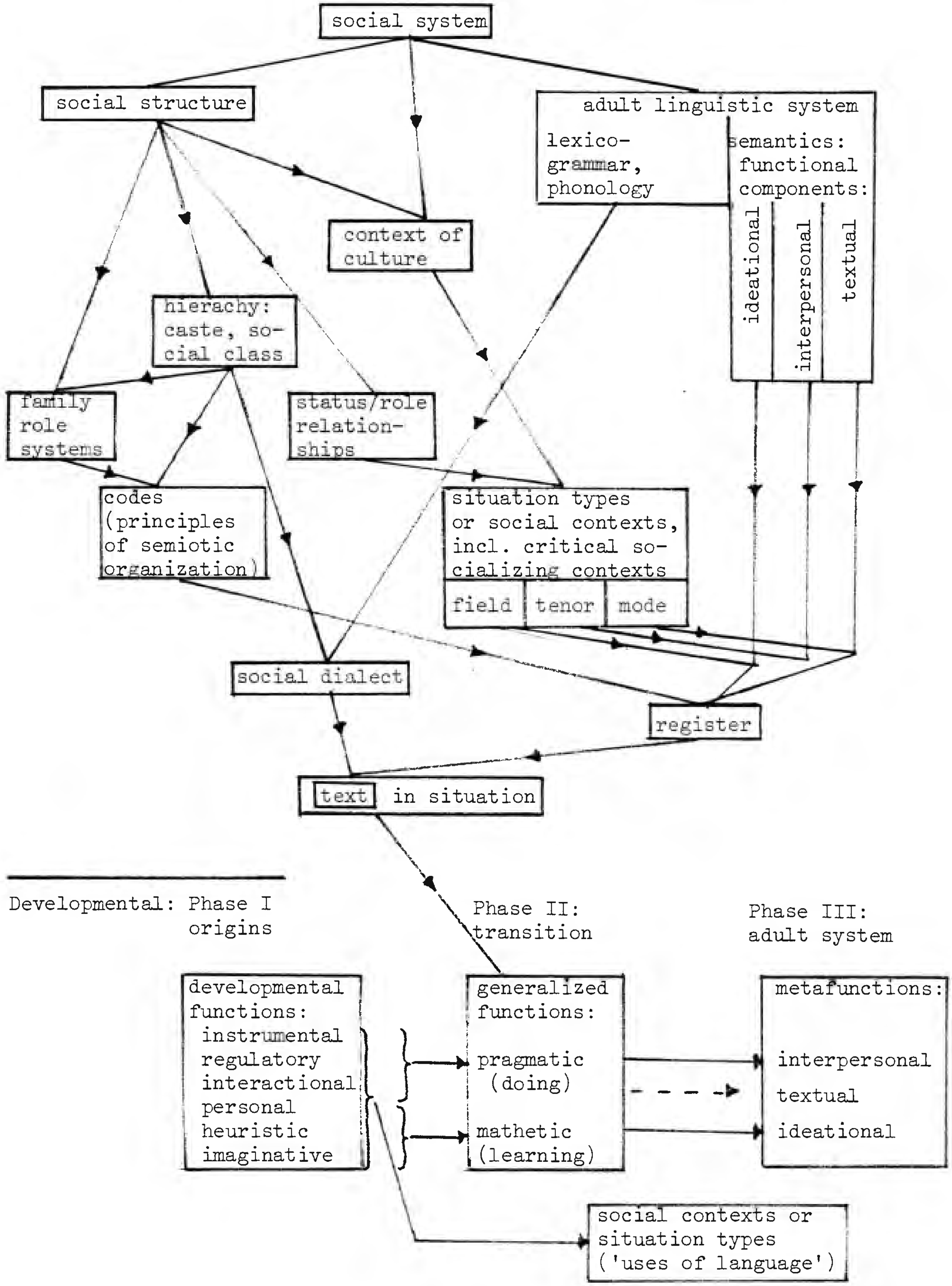
The number and variety of sociological factors that appear in Halliday's model are intimidating, the more so because of their potentiality for influencing an individual's semantic interpretation of communication. The schematic representation is given on page 108.

This view of language as social semiotic makes an important contribution to a discussion of the factors involved in communicating meanings not least because it represents the child's mode of access and, in doing so, raises questions about conceptions of correspondence between what is offered as a stimulus and the responses that pupils are able to make.

One such question concerns the 'differences that exist between teachers' theories of learning and systems of knowledge and the constructs that are possible for pupils within the constraints of their experience of the world and their mental development. Moreover, teachers, having the authority to control and initiate action, are in a position to present their constructs to pupils who, in turn, in the role of learners, are under pressure to accept and conform to them.

The issues raised have important implications for explaining because its central activity is the communication of meanings by one who understands something to another or others who do not.

(ibid: 69)


social system
social structure
adult linguistic system
lexico-grammar, phonology
semantics: functional components:
ideational
interpersonal
textual
context of culture
hierachy: caste, social class
family role systems
status/role relationships
codes (principles of semiotic organization)
situation types or social contexts, incl. critical socializing contexts
field
tenor
mode
social dialect
register
text in situation
Developmental: Phase I origins
Phase II: transition
Phase III: adult system
developmental functions:
instrumental
regulatory
interactional
personal
heuristic
imaginative
generalized functions:
pragmatic (doing)
mathetic (learning)
metafunctions:
interpersonal
textual
ideational
social contexts or situation types ('uses of language')

The need to find a frame of reference that can be shared by teacher and pupils alike, especially at the outset of an explaining episode where mutual understanding is at its lowest level, is a first priority.

It is also the case that meanings are largely communicated through words and, thus, language functions provide the key to all that is going on. Moreover, as the developmental aspect of Halliday's model reminds us, language itself cannot be taken for granted. The phases he identifies in learning a native language draw attention to the distinctive nature of the respective systems, i.e. child and adult. The implications for the communication of meaning generated by this distinction are far reaching. Within the context of explaining something to someone an important implication is that certain procedural options will fail to work because a young explainee is being treated as though he has an adult system. Being at one or other of the earlier phases of language development he is more dependent than the adult upon situational constraints. Moreover, if understanding the explanation is dependent upon the re-interpretation of context at the deeply abstract level typical of the adult system, he will be unable to meet this requirement.

The importance of the developmental perspective in communication interaction between adult and child is stressed also by Cicourel (1973: 49) who maintains that

> adults are continually supplying children with lexical items or categories whose meaning can

> be decided only partially by reference to adult oral and written dictionaries, and where instructions by adults to children about meaning are not equivalent to an adult's use of written dictionaries.

He suggests that alongside the acquisition of grammar and surface rule competence the child learns interpretive procedures which play an important role in verbal interaction and which are best understood through a discussion of their characteristics from the standpoint of adult competence. Cicourel (ibid: 52-56) offers a number of these, which are summarised below, warning that the list is not necessarily a complete one.

a. The reciprocity of perspectives.(1) The taking for granted by speaker and learner that they share a common interpretation of the features of the immediate scene. The speaker assumes that the hearer expects him to emit recognisable and intelligible utterances, that the account he (the speaker) offers is intelligible and that the hearer will receive it as such. The hearer assumes that the speaker has made the assumptions outlined above and expects to comply with what is expected of him (the hearer), namely, to appear to understand.

b. The et cetera assumption.(2) The 'filling in' by speaker and hearer of what is necessary to promote the meaningfulness of an utterance. This allows things to pass in verbal interaction despite their ambiguity or lack of clarity.

c. Normal forms. The efforts made by speaker and hearer, when the reciprocity of perspectives is in doubt, to normalise the discrepancies with a view to achieving congruence.

d. Retrospective sense of occurrence. The assumptions made by speaker and hearer that what is said by each to the other will at some subsequent time clarify what at the time is an ambiguous utterance, despite the fact that a later utterance that would have this effect may not occur.

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(1) Cicourel attributes this property to Schutz (1953; 1955).

(2) Cicourel associates this property with the work of Garfinkel (1964).

e. Talk itself as reflexive. The expectation of participants in verbal interaction that talk will occur because it is fundamental to the scene and because it is seen as a necessary way of communicating recognisable and intelligible elements of the scene. Talk is continuously folded back upon itself so that the presence of 'proper' talk and further talk provide a sense of well being and 'a basis for members to describe the arrangement successfully to each other.'

f. Descriptive vocabularies as indexical expressions. Members take for granted their reliance upon the existence and use of these vocabularies for 'handling bodies of information and activities where the vocabularies themselves are consistent features of the experience being described.' The significance of these are that they provide 'instructions' for retrieving the 'full relevance of an utterance' by suggesting what must be filled in to obtain the meaning.

If, as Cicourel contends, these interpretive procedures perform the important function of facilitating communication in ordinary everyday verbal interaction, and the evidence points to this being the case, this raises the question of their function in the specific context of explaining something to someone with a view to promoting understanding of that something.

Explaining, in whatever situation it occurs, is thought of as a dialogue involving explainer and explainee. There is therefore nothing to be gained from setting up an explainer - explainee relationship that fails to accommodate the effect of the explainee who, because he lacks understanding of some particular phenomenon, is in the weaker position.

Where the explaining episode occurs in the context of the classroom teaching and learning, the problems are likely to be more complex and possibly more numerous. The pupil is exposed to considerable demands of one kind and another during routine learning and, unfortunately, few studies of the acquisition and use of language throw much light upon how information is exchanged and how pupils process information in classroom settings. These matters are particularly relevant to explaining for, in the interest of accurate communication, the teacher must avoid taking for granted the pupil's understanding of verbal inputs. In relation to this last point Cicourel (1974: 325-326) makes a pertinent statement in claiming that,

> We are not clear about how continuous feedback mechanisms operate so that contextual information about sound patterns, their intonation and intensity, knowledge of grammatical rules, visual appearances and stored information interact with competing sources that may interfere with the child's performance in the classroom ......

He goes on to say that grammatical context is crucial for the perception of speech. Thus, teachers who are not aware of their pupils' abilities and capacity to recognise, receive and process information, are unable to make accurate estimates about the nature and degree of the interference that can occur because of 'inputs' from unattended channels of information, or supply information, that works <u>with</u> the grain of the pupils understanding by utilising structures formed by <u>his</u> conceptual and social learning.

Problems of pattern recognition and attention Cicourel links with: the quality and availability of the sensory information about current events, what the short term memory can extract from this transient sensory image and, finally, the storing of information in the long term memory. Bearing these in mind he argues that the presentation of new material to children should be organised to coincide with the existing information that it is presumed the child possesses. A view that has been expressed often by developmental and other psychologists in relation to concept learning.

The consequences of this theory apply to all children, but not uniformly so. For example, a major problem in the translation of verbal material has to do with the receiver's ability to recognise and comprehend the incoming information. Thus, pupils who are less accustomed to hearing and using formal language will have difficulty in understanding explanations that are couched in a formal style of discourse.

Cicourel (ibid: 328) contends that they would have difficulty processing the information because rehearsal of unfamiliar material and linkage to the long-term memory becomes something of a major problem. He justifies this point with the statement:

> I am assuming that if memory is organized according to storage of dialect-relevant information and storage of syntactic structures sensitive to their contextual usage, then relying on the perception of several sources of information would complicate the processing of instructions whose organization and lexical items presumed standardized rules and meanings.
>
> (ibid: 328-29)

It is true that much of what Cicourel contends in relation to interpretive competence refers to use of language in everyday communication and does not deal specifically with explaining something to someone. However, it has been argued that explaining occurs within the wider context of everyday communication and, thus, his views do throw light upon that activity.

Cicourel faces up to the problems of communication raised when <u>real</u> speakers with differing life experiences engage in dialogue for specific purposes, in a way that most philosophical accounts fail to do. It is tempting to explore in greater depth, through studies from the field of cognitive psychology, the conceptual matters and intellectual processes that he mentions but this is neither possible nor seen as necessary within the limits of the thesis. His succinct integration of sociolinguistic factors with cognitive ones is of particular value to the work in hand. His view of the manner in which social experience influences the organisation of the intellectual operations[(1)] involved in an information processing model of thinking and learning is one that 'explainers', the more so if they are teachers, need to understand and take account of in their explanations of something to someone.

2.4 Context and Situation in Communication

It has been argued that language users are fallible information processors for reasons that can be understood with reference to psychological and sociological theory and that attempts to describe language in communication, which fail to take account of this, are inadequate. Rommetveit (1979: 163) makes the point succinctly when he affirms:

> The notion of linguistic competence we encounter in early generative-transformational theories of language may be conceived of as a heavenly version of a basic common code, a version devoid of dialectical variations, stripped of ambiguities, and dyed in pure Cartezian reason. Sociolinguistics, on the other hand, is by definition a study of human discourse under conditions of social, cultural and linguistic variation.

A similar criticism can be levelled at accounts that fail to respond to Wittgenstein's[(2)] claim that an utterance has meaning only in the stream of life. In this case, the remedy would appear to involve paying attention to context and situation. The preceding discussion of sociosemantic factors in communication makes frequent reference to these notions which are of major importance where the approach to

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(1) Operations is a term used by Guil ford (1963) which refers to the following: cognition, memory, divergent productions, convergent productions and evaluation.

(2) In Malcolm, N. (1967) Ludwig Wittgenstein, A Memoir, O.U.P. Oxford

language is a functional one. As the present thesis is concerned with language in use in a specific situation, namely, an explaining episode, it would appear to be advantageous to examine how and to what degree contextual and situational factors influence the communication of meaning.

A useful starting place for a discussion of context and situation in the issue of dynamic residuals in human communication, or to use Wittgenstein's terminology (1962: 247), the bottom level of interpretation. Rommetveit (1979: 164) interprets this as meaning that whatever is meant and understood by participants in a communication, a prerequisite is that something else is taken for granted. This is a position argued by ethnomethodologists such as Garfinkel (1972: 28) who maintain that,

> no matter how specific the terms of common understanding may be - a contract may be considered the prototype - they attain the status of an agreement for persons only in so far as the stipulated conditions carry along an unspoken et cetera clause.

An et cetera clause is one of the basic features of social interaction that Cicourel (1973: 53) lists and which has been discussed in the section 2.3 (see p. 110). He discusses at some length the problem of participant interpretation in differing situationally bounded sequences and claims that a great deal of performance 'depends upon the unfolding situation that cannot be automatically pre-programmed by built-in competence.' (Ibid: 71)

Cicourel (ibid: 165) contends that a problem for children is the expectation of adults that they will utilise relatively context free communication although in reality during maturation a child may equate a range of images of previous experience with a specific context which to an adult would appear unrelated. He suggests that in order to achieve adult interactional competence the child must acquire a facility with certain properties, which are summarised below:

1. Reflexive thinking about informational particulars selectively available from multiple sources in an emergent context provide participants with a basis for creating continuous instructions for programming their activities in socially acceptable ways.

2. Despite cultural differences and different spatial arrangements in the setting, participants must behave as if they share the same social setting and are receiving and processing the same information. Various appearances and utterances (signs) must be treated as 'obvious' despite the possibility that the participants are aware that differences exist and are being communicated in subtle ways.

3. In addition to assuming tacitly that they are oriented to the 'same' environment of objects and thoughts despite cultural differences and the use of a particular dialect or standardized (oral or sign) language, the participants must also be familiar with normative constraints about who can speak first, or next, what topics are considered socially relevant and acceptable, how to terminate an exchange, when someone's talk (or signs) is being insulting, distrustful or 'odd'.

4. Participants expect each other to possess 'normal form' repertoires of possible appearances, behaviours and utterances (signs) which can be expressed or 'understood' when emergent in contextually organized settings. Participants also assume that each will normalize discrepancies to sustain the social interaction.

5. The previous points imply that the participants must be able to go beyond the information given to recognize appearances, behaviours, utterances or gestures as meaningful activities, while filling in appropriate information where relevant by linking present informational resources to prior sources and future possibilities.

6. The ability to go beyond the information given and thus retrospectively and prospectively link immediate information to past and possible future objects, events or thoughts is central for the articulation of idealized normative (signs) rules (like conversational rules or linguistic

rules as applied to model sentences) with contingent social settings.

7. Participants must be capable of articulating immediate settings with idealized rules and general informational particulars of a substantive nature under the assumption that this is a routine feature of the interactional setting, yet simultaneously may or may not recognize that much of what transpires may not be accountable in standardized or colloquial expressions.

(ibid: 168-169)

Cicourel (ibid: 171) considers the elements of interpretive procedures to be minimally relevant for every-day interactional competence. He claims that in the classroom modification of the child's interactional competence is continually taking place largely because he has to contend with a system of representation that is different from the way he learns to process recognised information. To understand how language works in communications such as those occurring in an explaining episode, it is necessary to know how the participant's knowledge of the world and his perception of what is going on in the immediate situation influence what he says and understands.

Rommetveit (1979: 164-165) takes up the position that semantic potentialities in discourse can be conceived of as a 'draft of a contract concerning categorization' that is bound to a 'scheme of attributes' of a more comprehensive nature and that, together, they constitute 'a minimal constant residual of sustained shared world knowledge.' However, he stresses the point that semantic potentialities in discourse are not static components of such knowledge, mediated linguistically, but potentially shared strategies which are used to catalogue and achieve 'cognitive-emotive perspectives' of what is being discussed. Moreover, in the 'Here and Now' of a dialogue only very tiny pieces of shared world knowledge will enter the episode. Institutions, rituals and situations provide interactional frames and thus determine 'which more restricted subsets of semantic potentialities are intended within different kinds of contexts'. These points support the view that no communication is entirely context free and suggest that dependency varies, some communications being more dependent than others.

Bearing in mind the evidence from studies by Olson (1970) and Deutsch (1976) which show that explicitly introduced referential domains can affect linguistic coding and decoding it is clear that contextual factors play a major part in determining what goes on in a dialogically established 'Here and Now'. However, Olson (1972:143-144) warns that language can reorganise only to a limited degree the information from other sources that are on hand and maintains

> The manner in which words and sentences derive their meaning from perception and the ways in which perceived context determines both the production and comprehension of utterances are aspects of the primary use of language for communication and instruction.

He (ibid:147-148) cites the work of Glucksberg and Krauss (1967) in making the point that conflicts between what is perceptually salient and what is informative to a listener result in the former being dominant. He too maintains that children's use of language is not tied to immediately perceived cues but quickly reflects alternatives in the context as a whole within the limits of their processing ability. Descriptions are cumulative and words used in them come to reflect as the perceived context a wider context that is both the present and the historical context. In this way sentences eventually reflect the accumulated context which allows a minimum number of sentences to be mapped upon the largest number of perceived contexts.

Thus, contexts are multi-layered and, indeed, concentric in character and in any situation the perceived context with which a particular communication is associated is, in fact, a class of contexts, some of which are salient and others irrelevant.

Olson (ibid: 148) claims that sentences change less than do situations, any elaboration being dependent upon the intention of the speaker, the knowledge of the symbolic system that he shares with the listener, the assumptions he makes about the listener's background knowledge and the differentiations that have import within the culture. Bearing in mind the suggested relation between perception and language he offers five preliminary hypotheses about how sentences are comprehended in a variety of contexts:

1. A sentence is comprehended (or miscomprehended) relative to a context. This context is specified either by a perceptual situation or by preceding sentences. These contextual events may be considered as the presuppositions of an utterance in that they determine the form of utterance that will be permissible.

2. Sentences compatible with their contexts, that is, sentences which do not violate their presuppositions, are more readily processed than those that are not.

3. Sentences which are not compatible with their contexts must be brought into such a correspondence either by recoding the context or recoding the sentence.

4. In the case of an incompatibility of an utterance and its context, the perceptual or contextual events are more readily recoded than are the sentences.

5. Ease of comprehension depends upon the number of alternatives among which the subject must choose.

Olson (ibid: 149-154) used these hypotheses as the basis for a series of studies,[1] evidence from which suggests that: ease of comprehension of a sentence depends on the perceptual coding of any preceding event; that comprehension proceeds on the basis of the surface structure; and that the complexity of the processing involved reflects the

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(1) Olson and Filby (1972)

number of alternatives among which a subject must choose.

In order to appreciate the nature and range of variables that are present in the perceived context it is helpful to employ a model that purposes to reveal contextual categories within everyday sequences of linguistic interaction. For this purpose the sentence may not be as useful a unit as Halliday's (1978: 135F) semantic unit 'text'. Reference to this notion has been made in section 2.3 but it may be helpful to mention again that texts are 'instances of linguistic interaction in which people actually engage.' Thus, an explaining episode is a text whether it be composed of one or several sentences.

Halliday (ibid:142F) suggests that a particular situation type can be interpreted as a semiotic structure that can be represented as a complex of the dimensions of field, mode and tenor.(1) He claims that these dimensions are more than components of the speech setting, they are conceptual frames within which meanings are exchanged. Text varieties embedded in situation he calls registers, describing register as the configuration of semantic resources that the member of a culture typically associates with a situation type. It is possible to describe a situation and its associated register but the degree of specificity varies. The more stereotyped the situation, the more restricted will be the range of options from which selections in field, mode and tenor can be made.

Registers reflect individual experience and, thus, the capacity to mean while also reflecting the on-going activity within the situation itself. Thus, register can be said to be the selection of meanings that constitute

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(1) Field, mode and tenor are defined in section 2.3 see p.106.

the variety to which a text belongs and also a particular selection of words and structures.

Control of a range of registers facilitates understanding in discourse and, indeed, the ability to communicate meanings. Being able to shift from one register to another as necessary indicates conscious, or unconscious but intuitive awareness of linguistic forms. This kind of skill can be promoted by the demands of formal education although the variety of different life experiences that an individual enjoys is also highly influential.

The relevance of these notions for the situations with which this thesis is concerned cannot be over-stressed. So many philosophical considerations of the act of explaining concern themselves solely with topic and subject matter, or view the participants as 'ideal' thus under-estimating the part played by purposive role; the relationship of the language-user to the medium of transmission; the relationships among participants in language events and, particularly important where teaching and learning are involved, the functional addresser/addressee relationship and functional tenor of discourse, both a constant source of situational and linguistic variation.

It may be fruitful to speculate how often problems of meaning and understanding arise in explaining episodes not so much because the explanations lack logical form, or the explainer fails to present the relevant facts in an 'orderly' manner but for reasons to do with reciprocity. In other words, the pupil is under-represented both in setting up of a mutual context in which explaining can take place and in the part he is enabled to play within the context. It is all too easy to make it impossible for the explainee to contribute what he knows by establishing functional relationships and tenors of discourse of a kind that inadvertently incapacitates him with regard to activities like question shifting the success of which depends upon genuine interaction between addresser and addressee.

It is important, of course, not to underestimate the difficulties that are of a psychological nature. The inability of a participant in an explaining episode to grasp the essential aspects of a notion because the conceptual level is too high and he lacks prerequisite concepts, or because the subject is outside his experience. However, it is likely that in many cases the explainer's awareness of these problems will be dependent upon his understanding how social and cultural contexts influence the explainee's facility for interpreting his (the explainer's) communications. Moreover, this knowledge can then inform any attempts the explainer makes to remedy the matter.

2.5 The Influence upon Communication of What is Explained

The examination of factors influencing the communication of meanings up to this stage has been concerned with natural speech in everyday contexts. Implications for explaining episodes have been drawn and it has been argued that certain conditions govern the activity of explaining something to someone and, similarly, that of understanding something. It seems an opportune moment to focus attention upon the 'something' that is to be explained by the explainer and understood by the explainee. The objective is to establish what influence, if any, is exerted upon the activity of communication by factors that have to do with the nature of the something to be explained, i.e. the explanation.

The subject of an explanation may arise from any context of what we perceive as the known world. It may arise from a very common everyday occurrence and be capable of being explained in familiar everyday language. Nevertheless, however simple and familiar the language is called upon to be while remaining adequate and appropriate, factors associated with perception, organisation, interpretation, level of interest and human interaction remain to influence accurate communication of intended meaning.

The problems increase when the context from which the explanation is generated is not one that occurs spontaneously in daily life. Such contexts are often concerned with specific disciplines and situations which, in contrast with those that commonly occur from day to day, are highly specialised with respect to their notions, relationships and language forms. The concepts contained within these explanations are likely to be abstract rather than concrete; or, to use Vygotsky's (1962) terms, scientific rather than spontaneous. Compound and complex concepts demanding a higher order of intellectual activity will occur more frequently than is the case in everyday contexts and many of these will be totally unfamiliar because they do not normally arise spontaneously in people's lives. A great deal of formal learning in school involves explanations of this kind although clearly there is a gradual development in their conceptual level.

The typology of explanations discussed in Chapter 3 has prepared the ground for arguing that while a particular explanation type may arise in any lesson context, typically certain types are dominant in specific disciplines and areas. Thus, probabilistic explanations occur frequently in psychology, the teleological and functional category of explanations in biology.(1)

If it is accepted that, initially, the nature of a discipline to some degree determines the kind of explanations that will be offered, it seems equally likely that the something to be explained exerts an influence upon the act of explaining.

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(1) The explanations are usually thought of as functional rather than teleological, because asking the purpose of an organ implies its function and not its goal.

The phenomenon water can be the subject of an explanation in several subject disciplines to be found in schools because the things to be known and understood about water are very numerous and varied. In an art lesson, the significance within a painting of reflections on water is likely to give rise to a very different kind of explaining episode than is the case in deciding if water is a compound or a mixture within the context of a science lesson. In the former, an open-ended reason-giving explaining episode that utilises actual paintings as reference points is a likely option and in the latter a deductive statement that draws upon practical evidence or a deductive argument that is a form of proof.

It does appear that the fundamental character of the explanation has a constraining effect upon the options open to the explainer for conducting the act of explaining. For example, genetic explanations cite the way in which a state of affairs come about, which is why they abound in History teaching. In these explanations the explainer directs the explainee's attention to events in the past. To afford the explainee first-hand experience of the events in question is <u>not</u> an option that is available to the explainer. At best, he can attempt to reconstruct the situation for the explainee.

On the other hand, a teacher offering a deductive scientific explanation can choose to refer to an act that has taken place or is taking place before the eyes of the explainee. However, he is constrained by empirical and logical conditions of adequacy and, thus, in most instances, is unable to resort to open-ended reason-giving.

It seems probable that more often than is commonly perceived, the nature of what is to be explained is largely responsible for the noticeable degree of consistency that is to be found in the way teachers go about their acts of explanation within their subjects. This is particularly true of subjects in which the exact nature and procedures are sharply defined and the concepts highly specialised as in the teaching of science.

It is also the case that the language with which scientific concepts are discussed tends to be different from that which passes as natural speech and for this reason alone become a barrier to understanding. For example, Katz (1972: 364) maintains that with the growth of theory within scientific fields, ordinary everyday language that once served as a descriptive vocabulary has been replaced by

> a system of technical constructs specially designed to make description more precise and explanation more encompassing. Often the phenomena to be described and explained by the theory are not homogeneous but break up into several kinds, each kind having its own structure. In such cases concepts from the everyday language are found to contain an admixture of features from phenomena of different kinds. Sometimes such mixed concepts can survive with a bit of polishing, to serve as descriptive apparatus for the areas of interconnection. But more often it is necessary to replace ordinary concepts by technical ones, each referring exclusively and unequivocally to aspects of one kind of phenomenon in order to sort out such admixtures.

The effects of this move is felt in the teaching and learning of school subjects and not only those subjects that are clearly scientific in character but in others, particularly where they have changed from a descriptive approach to one employing quantifying or scientific methods.(1)

It was claimed earlier (see p. 21) that teachers are not usually concerned with arriving at scientific explanations, but with handling them, in the sense that they try to communicate them to others. It is reasonable to assume that

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(1) A typical example is Geography.

from the mid-primary stage onwards the communication of scientific explanations will be a common occurrence. Some aspects of the scientific explanations considered in schools, for example, their closed nature make them appear easier to handle than more open-ended kinds that have to do with justification, evaluation or probability. However, the conceptual level and complexity of many scientific explanations tends to challenge the intellectual and cognitive faculties of the individual and understanding is dependent to a large extent upon the ability to perceive relationships including causal relationships.

Taking account of the points raised by Katz and evidence from studies of language in teaching of science,(1) it is clear that a phenomenon to be reckoned with in the communication of meaning in scientific explanations is that of the appearance of technical constructs to replace every-day language. In order to assess the nature and size of the problem that faces an explainer who is himself a specialist in a science subject but who is attempting to explain something to someone who is not a specialist, it is helpful to examine briefly the nature of scientific language with the object of understanding its characteristic features and identifying how it is different from ordinary everyday language.

In the first place, because science is a specialised activity, it requires accurate communication between those involved in it. This leads as Katz has claimed to the production of technical terms and locations. Bloomfield (1947: 42) writing on the linguistic aspects of science, enlarges upon this:

> The exact response and the careful and often complex calculations of science, enforce an unusually meticulous style of speech. The

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(1) Notably those of Taylor (1968), Barnes (1969 & 1976) and Richards (1978).

> syntactic scope of forms and the domain of substitutes have to be clearly indicated. This with the elimination of personal factors, produces a general scientific style of utterance. The sentence may extend to great length and may awake an immediate response only in hearers or readers who are favourably predisposed by training; on the other hand, the message once grasped is unmistakable.

He draws a sharp linguistic distinction between formal and informal scientific discourse. The informal uses ordinary language to which is added technical terms and phrases and certain syntactic and stylistic restrictions which help to produce uniform response in a qualified listener. Formal scientific discourse uses

> a rigidly limited vocabulary and syntax and moves from sentence to sentence only within the range of conventional rules. In general it can be carried only in writing.
>
> (ibid: 43)

Bloomfield discusses the general character of scientific language. A brief summary is given of some of the points he would mention:

(1) The utterances made by scientists are part of scientific procedure.

(2) Linguistically, as well as in handling, science is a public activity. The participants learn to ignore private factors of meaning, so that the grammatical, stylistic and lexical features of their informal discourse become indifferent.

(3) Scientific discourse is translatable.

(4) A postulational form, an explicit statement of what is taken for granted, is used to avoid the effect of changes in meaning.

(5) The hypothesis and any suppositions related to the work in hand are stated.

(6) All new terms are rigidly defined.

(7) Sentences often consist either of a statement-phrase, or of several such in co-ordination. In large sentences statements figure as sub-ordinate parts.

(8) Science speech follows ordinary language in designating sets of similar phenomena, but a more systematic determination (such as provided by existence statements) is required.

(9) The language is specialised in the direction of forms which successfully communicate handling responses and lend themselves to elaborate re-shaping.

The character of scientific language is manifested linguistically through certain lexical, syntactic and semantic features. These have been investigated by linguisticians largely through the analysis of written scientific texts.

Barber (1962: 21f) describes a piece of small scale research and compares his findings with those of similar studies by Rumszewiz and Siddiqui respectively. He and Siddiqui used texts from different fields of science. Rumszewiz used samples from four text books of agriculture and four passages of recent prose drama. The results obtained by the three researchers showed a high degree of agreement and some examples of these are tabled below.

Feature Investigated		Scientific text	Prose Drama
Length of sentence - in no. of words	(a) average	27.6	7
	(b) most numerous	16-20	1-9
Sentences containing	(a) statements	97%	$66\frac{2}{3}$%
	(b) questions or requests	3%	$33\frac{1}{3}$%
Presence of non-finite verbs as a percentage of all verb forms		39%	17%
Presence of finite verbs with modal auxiliaries	(a) passive	28%	3%
	(b) non-passive	72%	97%

The figures do show impressive distinctions but it should be borne in mind that modern prose drama is a somewhat unusual text to use for this comparison and it is possible that it was selected largely because its characteristic features polarise at the opposite end from those of scientific texts. Whatever the reasons for the choice it is unwise to assume that the shorter sentences of the prose drama passage are easier to comprehend than the longer ones in the scientific texts. Problems of interpretation and meaning are just as likely to arise in the former as the latter. Indeed, in terms of meaning a short sentence is no guarantee of clarity.

Perhaps the features that most increase the degree of difficulty are associated with lack of personal characteristics of style, increased formality or high concentration of unfamiliar words and constructions.

Barber does distinguish a number of other features of scientific texts. Subordinate clauses (in the traditional sense of strings containing finite verbs) are very sparingly used. The majority of sentences contain 1 main clause and 0-2 subordinate clauses.

Non-finite verbs are of three kinds:-

ing endings	47%
past participles	34%
infinitives	19%

An analysis of the lexical items was carried out by Barber to find out the number of texts in which a word appeared and the frequency of occurrences. Using such indicators as Zipf's Law and Thorndike's Teachers' Word Book, a measure of word intensity was obtained which revealed that the appearance of certain words in all the texts is due to the particular type of text selected. A wide range of scientific and mathematical terms were represented, some technical, but many non-technical that have not qualified for general service lists. One last point made by Barber is that a student of technical reading requires a large passive vocabulary of synonyms.

If, as seems likely, scientific explanations call forth some limited use of scientific language, a pupil will need to learn to use the scientific language of the subjects he studies. This may well present difficulties not unlike those which face adult students of a science, for whom English is the second language. Thakur (1966: 5f), discussing programmes for teaching scientific English in India, describes the difficulties facing Indian students. The points stressed by him and considered by the present writer to be relevant to the situation of the young learner of scientific English are listed below:

(1) Generating complex sentences by embedding one base structure into another.

(2) Defining concepts in appropriate English; this generally requires a recursive structure.

(3) Discriminating the way a word is used in a scientific text and its entirely different use in day-to-day language.

Further evidence that school children encounter and, indeed, must come to terms with the difficulties of scientific English is provided by Taylor (1968: 136-137). This rigorous study of deep structure in an elementary chemistry textbook prompted the conclusion that:

> Pupils will find chemistry difficult in the early stages because the combinations of categories are unfamiliar and their assignation of linguistic units to the correct conceptual categories is uncertain. That is why a good deal of illustration from everyday life is necessary. But there are limits to how far this can be done, so that when the learner is

> trying to codify for himself the relation between various phenomena he is increasingly thrust back upon the purely symbolic operations of the language. The sorts of relationships with which any discipline deals are different in various ways from those of everyday life. That is why we can say with full seriousness that to learn chemistry is to learn the language of chemistry...............

Through the textual analysis made by Taylor are exposed the demands which the language of chemistry makes upon the pupil. He must find the language with which to organise his experience into valid scientific concepts. Much of the language of science concerns hypothetical and ideal states, it being possible to demonstrate the relation between them only verbally. The pupil must recognise a definition, a criterial attribute when it occurs and in Taylor's view:

> This demands purely linguistic skills: since criterial attributes often appear in identical surface syntactic constructions to the noisy ones, he has to be able to recognise the linguistic cues which, through transformation, enable him to differentiate.
>
> (ibid: 10)

A final example, this time concerned with a lexical feature of scientific English, is an investigation into the relationship of the technical vocabulary of Human Biology to the development of the appropriate scientific concepts. In this study Evans (1972: 12) defines a technical term as 'a word or phrase which when used within the context of the subject carries a single scientific meaning.' He concludes that in studying school biology the pupil is presented with an enormous number of such terms, around 2000 being typical of G.C.E. ordinary level.

There are clearly language problems facing the teacher and learner in subjects that are dealing largely with scientific constructs and probably never more so than when the teacher becomes an explainer. Here the teacher is forced to consider how to put over scientific phenomena in language that can be understood by the explainee.

This poses the question of whether it is generally the case that teachers do take account of this problem in explaining and other activities of teaching. Stubbs (1976: 10) speaking of language use in schools accepts that the subject specific language of an academic student has an intellectual function, but points out that a problem that stems from this is that of the academic specialist who has a natural propensity for thinking about his subject in its specialist terminology and when explaining something to a non-specialist seems unable to utilise ordinary language even in those cases where this can be done readily. He suggests that the reason for this is,

> it is easier to use one technical term to explain another, using terms like counters to be shuffled around, rather than thinking about what they actually mean and relate to in real experience.
>
> (ibid: 14)

He identifies a related problem that has to do with teachers failing to recognise a valid idea offered by a pupil because the language used by the pupil is 'homely'. He illustrates this point with an example offered by Keddie (1971), in which a pupil looking at a diagram of a foetus in the uterus asks the teacher how it goes to the toilet. The teacher reprimands the pupil for being silly because he fails to recognise that the question is a perfectly valid biological concern and that, in asking it, the pupil demonstrates awareness, interest and thought.

Stubbs (ibid: 76) refers to the work of Bellack et al (1966)[1] on language in the classroom, in claiming that

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(1) This work will be discussed later in the chapter.

teacher-pupil dialogue has an underlying structure and pattern which with remarkably little deviation is followed by teachers and pupils. Within the pattern the teacher is most active in the sense that he structures the cycles and is primarily the solicitor of the interaction that takes place. The pupil's role is that of a responder. Stubbs appears somewhat critical of this pattern and this is hardly surprising when it is borne in mind that he is talking of the activities of teaching and not just of explaining. Within the context of teaching this regular pattern of communication does appear to be somewhat one-sided, whereas, within the context of explaining something to someone, it can be more readily accepted without raising value-loaded questions about the respective merits of particular pedagogical strategies and styles. Furthermore, as has been argued earlier, although the pupil is in a responding role in an explaining episode he cannot be inactive. For, to achieve understanding, an active engagement with the meaning of the explanation is necessary and, in the end, this is something that the pupil must do for himself.

3.0 EFFECTIVENESS IN EXPLAINING SOMETHING TO SOMEONE

It has been possible to identify a range of philosophical and pedagogical conditions that govern or influence the activity of explaining something to someone but it is also possible that within the pedagogical dimension of explaining lie factors that are to do with personal qualities, strategies, organisation and style, which may play a large part in the effectiveness of the communication of meanings.

3.1 Verbal Actions in Relation to Communicated Meanings

A useful starting point in considering the factors listed above is to have some idea of the range of different kinds of meanings that teachers attempt to communicate to pupils. The study of Bellack (1965: 97-98) cited earlier by Stubbs looked at the communication of meanings in secondary level teaching and attempted to define operationally the various dimensions of meaning identified.

Having examined transcripts of classroom discourse he was able to identify basic verbal actions, which he refers to as pedagogical moves, and classify them in terms of their pedagogical functions in relation to the discourse of the classroom. The four pedagogical moves he revealed are described as follows:

> Structuring: Structuring moves serve the pedagogical functions of focusing attention on subject matter or classroom procedures and launching interaction between students and teachers. They set the context for subsequent behaviour or performance. For example, teachers frequently begin a class period with a structuring move in which they focus attention on the topic or problem to be discussed during that session.
>
> Soliciting: Moves in this category are designed to elicit a verbal response, encourage persons addressed to attend to something, or elicit a physical response. All questions are solicitations, as are commands, imperatives and requests.
>
> Responding: These moves bear a reciprocal relationship to soliciting moves and occur only in relation to them. Their pedagogical function is to fulfil the expectation of soliciting moves. Thus, students' answers to teachers' questions are classified as responding moves.
>
> Reacting:These moves are occasioned by a structuring, soliciting, responding, or another reacting move, but are not directly elicited by them. Pedagogically, these moves serve to shape or mold classroom discussion by accepting, rejecting, modifying or expanding what has been said previously. Reacting moves differ from responding moves, in that while a responding move is always directly elicited by a solicitation, preceding moves serve only as the occasion for reactions. Rating by a teacher of a student's response, for example, is designated a reacting move.

> As we proceeded with the analysis of the data in terms of pedagogical moves it became evident that these moves occur in classroom discourse in certain cyclical patterns or combinations, which we designated 'teaching cycles'. A teaching cycle begins either with a structuring or with a soliciting move, both of which are <u>initiating</u> maneuvers; that is, they serve the function of getting a cycle under way. In contrast, responding and reacting moves are <u>reflexive</u> in nature; they are either solicited or occasioned by a preceding move.
>
> (ibid: 97)

Teaching cycles were revealed which begin with an initiating manoeuvre that is always a soliciting or structuring move. Responding and reacting moves have to be solicited by a preceding move and are reflexive in nature. One typical cycle according to Bellack (ibid: 98) begins with

> a soliciting move by the teacher in the form of a question, continues with a responding move by the student addressed and ends with a rating reaction by the teacher.

Using the concepts of pedagogical moves and teaching cycles he is able to describe classroom discourse in terms of specific kinds of meaning that reflect a dimension concerned with 'the pedagogical significance of what teachers and students communicate' and another concerned with the 'meaning represented by the content of the messages communicated.' His analysis of what teachers and pupils communicate revealed the following functionally distinct types of meaning:

(a) <u>substantive</u> with associated - refers to the subject matter of the class.

(b) <u>substantive</u> logical - refers to the cognitive process involved in dealing with the subject matter.

(c) <u>instructional</u> with associated - involves routine classroom procedures that are part of the instructional process.

(d) <u>instructional</u> logical - refers to distinctively didactic verbal processes such as explaining procedures and giving directions.

The data obtained by Bellack (ibid: 103: 5) from the observation and analysis of classroom language revealed a very consistent and stable pattern of pedagogical discourse, a summary of which follows:

1. Teachers dominate the verbal activities of the classrooms studied. The teacher-pupil ratio of activity in terms of lines spoken is approximately 3 to 1; in terms of moves, the ratio is about 3 to 2.

2. The pedagogical roles of the classroom are clearly delineated for teachers and pupils. Teachers are responsible for structuring the lesson, soliciting responses from pupils and reacting to pupils' responses. The pupil's primary task is to respond to the teacher's solicitations. Occasionally, pupils react to preceding statements but these reactions are rarely evaluative. Pupils do not react evaluatively to teachers' statements, and they evaluate other pupils' responses only when the teacher asks them to do so.

Pupils infrequently solicit responses from the teacher about substantive meanings. Pupils seldom spontaneously structure the discourse; their structuring moves are almost always presented in fulfilment of specific assignments made by the teacher, and usually involve debates or reports.

3. Structuring accounts for about six per cent of the moves spoken, soliciting, responding and reacting each account for approximately 30 per cent of the moves.

4. Analysis of discourse in terms of teaching cycles centres on the dimensions of rate, source and pattern.

Analysis in terms of these three dimensions indicates that the basic verbal interchange in the classroom is the solicitation-response. Teachers shape and frame this verbal unit most frequently with reacting moves, although teachers differ in the extent to which they use both structuring and reacting moves.

5. In approximately two-thirds of the moves and about three quarters of the line speakers referred to or talked about substantive material. Of all the categories of analysis, classes varied most widely in the substantive meanings expressed.

6. By far the largest proportion of the discourse involved empirical meanings. This includes fact stating and explaining, which accounted for between 50 and 60 per cent of the total discourse in most of the classrooms studied. Analytic (defining and interpreting) and evaluative (opining and justifying) meanings were expressed much less frequently, each of them accounting for less than 10 per cent of the discourse in any class. Thus, most of the experimental unit was devoted to stating facts and explaining principles and problems of international trade, while considerably less of the discourse was concerned either with defining terms or with expressing and justifying personal opinions about economic issues.

7. In almost one-half of the moves and approximately one-fourth of the lines of the discourse, speakers conveyed instructional meanings. It was chiefly the teacher who expressed the instructional meanings.

8. Paralleling the instructional category, the analysis of instructional-logical meanings indicated that the most frequent statement in this area involved teachers stating facts, usually about procedures, assignments and other instructional matters. A substantial proportion of statements

in this area also dealt with teachers directing pupils to perform various actions; and almost all of the remaining instructional-logical entries involved some form of rating reaction by the teacher.

9. Teachers can be characterised by a relatively stable emotional style, insofar as the dimensions of potency and activity are concerned and, to a lesser degree, in terms of valence.

The implications for explaining something to someone of item five is very clear and is the more worthy of note when it is borne in mind that the major restriction placed upon teachers by the research procedures was specification of the particular substantive meanings to be covered.

3.2 Studies of Teacher Effectiveness in Explaining

Further evidence from classroom studies is supplied by Gage (1971: 177-181) and his associates, their concern being effectiveness in explaining. Viewing explaining as 'the skill of engendering comprehension - usually orally, verbally and extraneously - of some process, concept or generalization' they were able to arrive at an operational definition of effectiveness in explaining. Not being concerned with explaining as defined by philosophers but with the kind discussed by writers(1) as pedagogical explaining, effectiveness is defined as 'the ability to present ideas in such a way that the pupils would be able to respond to questions testing the comprehension of the idea.'

The sample used in the study consisted of forty-eight experienced teachers in the San Francisco area and their mixed ability classes of between ten and thirty-one pupils. Lesson procedures were standardised, all teachers teaching lessons based upon identical material which they were asked to explain to their classes. The term explain was operation-

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(1) Notably Swift (1961) Thyne (1963) Meux and Smith (1964) Bellack et al (1966) Nuthall and Lawrence (1965)

ally defined as

> the process whereby a teacher's fifteen-minute lecture on the prescribed curriculum material would enable his students to answer ten-multiple choice questions on the content.
>
> (ibid: 179)

After certain adjustments aimed at controlling the experiments the pupils' mean adjusted score on the test was taken as the index of the teacher's effectiveness. In addition to taking the test after the lesson pupils were asked to complete an adapted form of the Stanford Teacher Competence Appraisal Guide which deals with the following dimensions:

(1) clarity of aims
(2) organisation of the lecture
(3) beginning the lecture
(4) clarity of presentation
(5) pacing the lecture
(6) pupil attention
(7) ending the lecture
(8) teacher-pupil rapport
(9) amount of learning

For each dimension, the ratings were made on a seven-point scale ranging from "truly exceptional to weak".

They also completed a self-report sheet of attention. The data collected from the experiment were used by the team to investigate independently three specific problems.

3.2.1. The first study(1) entitled 'Effective in Explaining: Evidence on its Generality and Correlation with Pupil Ratings', (ibid: 182) found that:

(1) The teachers' effectiveness in explaining had some consistency across different topics and different groups of pupils.

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(1) The first study is that of M. Belgard, B. Rosenshine and N.L. Gage.

(2) Student ratings of teachers and student attention over two different topics and two subsets of students are fairly consistent.

(3) Teachers whose classes scored high on the comprehension test received more favourable reports on the appraisal guide and the self-rated attention report.

3.2.2 The second study[2] entitled 'The Modality and Validity of Cues to Lecture Effectiveness'(ibid: 191) found that using a total of sixty-eight judges to rate effective explaining as they perceived it:

(1) Comparison of independent judges ratings with student ratings suggested that students could rate the teacher with reasonable validity.

(2) Student free responses to categories of teacher characteristics (see p. 139).

1. was organised and had planned well;
2. spoke at an appropriate cognitive level;
3. was serious and did not openly display a sense of humour;
4. had and used an outline effectively, and
5. had a good introduction in the sense that he stated objectives clearly and provided adequate background information.

It appears that consistent factors in the ratings are to do with preparation and presentation particularly in relation to cognitive aspects of these activities, for example, structuring and organising lesson materials to make the subject more meaningful. Non-cognitive aspects worthy

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(2) The second study is that of W. Unruh.

of note include vocal quality, seriousness, enthusiasm and vitality. It can be assumed that these contribute to the level of interest promoted.

(3) Judges responses to two check lists are given in the tables below:

F-Ratios and Levels of Significance for 27 Seven-Item Scales for Four Yugoslavia and Four Thailand Teacher-Lessons

Scale No.	Scale Description	Yugoslavia F-Ratio	Thailand F-Ratio
1.	businesslike vs. slipshod	12.87**	25.99**
2.	clear vs. obscure, vague	7.97**	14.13**
3.	dynamic vs. phlegmatic	12.63**	2.87*
4.	emphatic vs. unemphatic	12.28**	1.93
5.	enthusiastic vs. unenthusiastic	17.97**	6.25**
6.	energetic vs. lethargic	30.08**	10.57**
7.	friendly, vs. unfriendly, aloof	27.13**	6.50**
8.	fluent in expression vs. halting in expression	3.49*	8.39**
9.	humorous vs. dull	31.97**	4.94**
10.	interesting vs. boring	13.02**	6.12**
11.	imaginative vs. unimaginative	18.43**	2.53
12.	interested vs. uninterested	12.21**	2.35
13.	poised vs. awkward	1.29	11.33**
14.	positive attitude vs. negative attitude	6.35**	1.59
15.	stimulating vs. dull, unstimulating	10.38**	2.56
16.	Skillful vs. inept, unskillful	15.78**	11.88**
17.	warm vs. cold	13.75**	4.68**
18.	knows and understands subject vs. does not know and understand subject	10.56**	13.42**
19.	lesson is well planned vs. lesson is not well planned	11.11**	14.45**
20.	English expression good vs. English expression not good	.61	14.74**
21.	states objectives of lesson clearly vs. does not state objectives of lesson clearly	2.06	7.45**
22.	makes relationships clear vs. does not make relationships clear	3.70*	4.09*
23.	clearly indicates when moving from one topic to another vs. does not clearly indicate when moving from one topic to another	2.75*	3.64*
24.	makes effective use of voice vs. does not make effective use of voice	9.03**	2.34

Scale No.	Scale Description	Yugoslavia F-Ratio	Thailand F-Ratio
25.	points out clearly what should be learned vs. does not point out clearly what should be learned	4.03**	2.98*
26.	gives adequate amount of detail vs. does not give adequate amount of detail	1.46	2.07
27.	summarizes and reviews frequently vs. does not summarize and review frequently	1.47	2.37

* p .05 ** p .01

(ibid: 199)

Pearson Product-Moment Correlation Coefficients and Estimates of Monotonic Relationships for Four Yugoslavia and Four Thailand Teacher-Lessons

Scale No.	Scale Description	Yugoslavia (N = 38)		Thailand (N = 38)	
		r	Mon.[a]	r	Mon.[a]
1.	business like vs. slipshod	.20	+	.55**	+
2.	clear vs. obscure, vague	.35*	+	.45**	+
3.	dynamic vs. phlegmatic	.32*	+	-.18	-
4.	emphatic vs. unemphatic	.32*	+	-.15	-
5.	enthusiastic vs. unenthusiastic	.35**	+	-.33	-
6.	energetic vs. lethargic	.42**	+	-.35	-
7.	friendly vs. unfriendly, aloof	.07	-	-.28	-
8.	fluent in expression vs. halting in expression	.14	+	.39*	+
9.	humorous vs. dull	.05	-	-.20	-
10.	interesting vs. boring	.29	+	.02	-
11.	imaginative vs. unimaginative	.22	-	.03	-
12.	interested vs. uninterested	.27	+	-.16	-
13.	poised vs. awkward	-.03	-	.43**	+
14.	positive attitude vs. negative attitude	.21	+	.05	-
15.	stimulating vs. dull, unstimulating	.24	+	-.02	-
16.	skillful vs. inept, unskillful	.40**	+	.43**	+
17.	warm vs. cold	.04	-	-.19	-
18.	knows and understands subject vs. does not know and understand it	.28	+	.44**	+
19.	lesson is well planned vs. lesson is not well planned	.26	+	.49**	+
20.	English expression is good vs. English expression is not good	.05	+	.47**	+

Scale No.	Scale Description	Yugoslavia (N = 38) r	Mon.[a]	Thailand (N = 38) r	Mon.[a]
21.	states objectives of lesson clearly vs. does not state objectives clearly	.06	+	.35*	+
22.	makes relationship clear vs. does not make relationship clear	.21	+	.25	+
23.	clearly indicates when moving from one topic to another vs. does not clearly indicate	-.02	-	.23	+
24.	makes effective use of voice vs. does not make effective use of voice	.32*	+	-.02	-
25.	points out clearly what should be learned vs. does not point out clearly what should be learned	.02	+	.21	+
26.	gives adequate amount of detail vs. does not give adequate detail	.09	+	.16	+
27.	summarizes and reviews frequently vs. does not summarize and review frequently	.05	-	.01	-
		Multiple R = .69		Multiple R = .74	

* p .05 ** p .01

[a]Monotonic relationship as described above is indicated here by a plus sign (+). A minus sign (-) indicates that such a relationship was not found with reference to the means of the rater-assigned scores.

(ibid: 200)

The descriptions of good and poor explainers arrived at by means of these scales agree in general with those of the rater's free responses. They indicate that the good teacher is skillful in presenting material, makes the content of the lesson clear, knows the subject matter thoroughly and has successfully planned his lesson. The opposite is seen to be true of poor teachers.

3.2.3 The third study[(1)] entitled 'Objectively Measured Behavioural Predictors of Effectiveness in Explaining' (ibid: 201) aimed at determining objectively measured teacher behaviours that discriminate between the degree of success of explanations. The variables investigated are the stimuli from verbal and non-verbal teacher behaviour that were received by the pupils during the explaining periods.

An analytic grammar specially constructed of variables developed from twenty-seven categories in four areas (linguistic, instructional set, presentational categories, multivariate studies) was used to analyse thirty lectures. Three were divided into three groups each containing five high scoring and five low scoring groups. The Hypothesis Group and the Validation Group had covered material on Yugoslavia while the Cross Validation Group had covered the Thailand material. The variables and the indication of their power to discriminate are given below:

Area		Category
Linguistic Categories	*1	Word length
	*2	Word relevance
	*3	Independent clause length and structure
	*4	Prepositional phrases
	5	Readability estimate
	6	Personal references
	7	Negative sentences
	8	Passive verbs
	9	Awkward and fragmented sentences
Instructional Set	10	Structuring sets
	11	Focusing or arousing sets
Presentational Categories	**12	Rule-and-example pattern
	13	Number of examples
	14	Organisation of topics
	15	Use of enumeration
	**16	Gesture and movement
	*17	Breaks in speech
	*18	Use of map and chalkboard
	*19	Rate of speech
	20	Repetition and redundance

(1) The third study is the work of Barak Rosenshine.

Area		Category
Multivariate Studies	21	Verbal hostility
	22	Non-verbal affect
	23	Reference to pupils' interests
	24	Expansion of pupils' ideas
	25	Ratio of acceptance and praise to criticism
	**26	Explaining links
	27	Conditional words

* Variables in this category discriminated between high and low lectures in the hypothesis group, but <u>not</u> across the three groups.

** Variables in this category discriminated between the high and low lectures across the three groups.

The rule-example-rule pattern of discourse requires some delineation. According to Rosenshine (ibid: 203) 'the term rule refers to the use of a summary statement before or after a series of examples.' The implications of the results suggest that an effective explaining pattern is one that opens the explaining episode with a structuring statement, continues with details and concludes with a reiteration of the structuring statement.

The, perhaps, unexpected significance of gesture and movement may be accounted for by reference to the arousing and focussing of attention function that they have. On the other hand, potential attention rousing verbal variables only discriminated in the Hypothesis Group.

It appears that words such as explaining links can function to link phrases within and between sentences such that a phrase or clause containing a link expands upon another phrase and clause. The words chosen as explaining links are, according to Rosenshine, (ibid: 207) often grammatically dissimilar but perform the same function. He describes them as introducing 'a clause or phrase which states a means, reason or consequence for the main clause.' He considers that the significance of explaining links may account for some of the inconsistent findings in studies of instruction set suggesting that:

> The use of instructional sets may decrease in relative effectiveness as the number of explaining links in the instructional material is increased. If so, explaining links may provide the same sort of linkage and organization within the lecture as the instructional set gives in the introduction to the lecture.

Taken together these three studies afford a great deal of thought provoking data, including much that is puzzling and which arises from exploratory work. There is a methodological weakness concerned with the use of the same teacher in two lessons and, moreover, that these teachers were teaching their own classes. Anything that happened during the experimental period could have been built up before. For example, scores on the attention report may be reflecting established teacher-pupil relationships and not the quality of the explaining going on in the lecture.

There are certain confusions in category description, for example, 'awkward and fragmented sentences.' This could refer to syntactic or semantic features, or both. Thus, it could be that a sentence is syntactically fragmented but contributes to the communication of meaning. On the other hand, if the awkwardness of style (which need not be syntactically incorrect) obscures meaning and confuses the pupil it is a very different matter.

In spite of the weaknesses, the studies make a contribution to a consideration of explaining something to someone not least because they draw attention to the large range of variables that have been obtained by the researchers. In addition to being useful for future research the number and variety of categories involved reveals the inadequacy of a strictly philosophical account of explaining within the context of teaching and learning.

P A R T 2

THE INVESTIGATION

C H A P T E R 5

<u>Abbreviations Used in Presenting the Results</u>

Sci	-	Scientific
Inf	-	Information
How	-	How or by what means
Ded	-	Deductive
Pro	-	Probabilistic
Gen	-	Genetic
Te/f	-	Teleological or functional
Sub-Ass	-	Substantive with associated
Sub-Log	-	Substantive Logical
Inst-Ass	-	Instructional with associated
Inst-Log	-	Instructional with logical
Mat	-	Mathematics
Phy	-	Physics
Che	-	Chemistry
Bio	-	Biology
His	-	History
Geo	-	Geography

1.0 ARRIVING AT AND JUSTIFYING THE HYPOTHESES

1.1 Category 1 The Status of Explaining as an Activity of Teaching and Learning

In the previous chapters a case has been argued for viewing explaining as a common and central activity of teaching that has as its goal understanding both as a long-term aim and as the immediate objective of an explaining episode.

In relation to the last point it has been accepted that explaining need not be necessarily the best way of arriving at understanding although it is likely that in certain contexts this could be claimed and in others it would be clear that some alternative activity would be more effective. It is possible to be in sympathy with the view expressed by Gallie (1964) that 'explaining plays too important a part in teaching' and with the implication this carries that pupils are not given enough opportunities to find things out for themselves. Nevertheless, it is true to say that a teacher is there to answer, or at least be prepared to answer subsidiary questions should the occasion arise.

It is also true that time, previous knowledge and experience, interest, and motivation put their own constraints upon the activities that go on in teaching and learning within a school. A useful example is the teaching of science where the constraints mentioned are encountered in attempting to utilise Discovery Methods as represented in Nuffield Scheme Courses. The problems of experimental scatter and reliability (how many times can a pupil repeat an experiment to check the consistency of his results?) make the production of accurate data something that, in the main, is not feasible within the time allocated to science subjects. If the experiment does 'work', to use a homely expression, there is still all the difference in the world between what can be perceived through the senses and reported upon, for example, a change of colour, or bubbles, and being able to infer what has taken place. Again, a question to be asked is concerned with the number of times a pupil would have to carry out an experiment before he could infer with a degree of certainty any abstract laws and causal relationships involved. A look at the work of research scientists and engineers should serve to convince educationists that the process of arriving at hypotheses, let alone laws, is long drawn out and demands highly repetitive activity. It thus seems somewhat naive to believe that more than a small amount of knowledge within the cognitive areas associated with formal learning can be learned at first hand, without a great deal of verbal information being provided.

In making these criticisms of Discovery Methods it is not the intention to undervalue the contribution to effective teaching and learning that they can undoubtedly make nor to suggest that they are better or worse than any other teaching method. The intention is to reveal those limitations that are a barrier to it being the 'complete' alternative to explaining something to someone, in the sense that the latter is defined in this thesis.

The argument can also serve as some justification for maintaining that there will be occasions when learning is enhanced and promoted by acts of explaining, particularly when explaining takes account of gaps in knowledge and understanding in a manner that is both effective and acceptable.

Unfortunately, there is also the fair criticism to answer, that education would be that much better if pupils and not teachers were the active ones in teaching episodes. Martin (1970: 204), while agreeing that teachers often do talk too much and do work that they could get their pupils to do argues that 'explaining in requiring an active teacher, does not deny an active role to the student.' It seems likely that those strongly opposed to reception learning may be thinking of telling rather than explaining when they make their criticisms, a confusion encountered by Ausubel (1961) when individuals confused his notions of verbal information and reception learning with rote learning.

Whatever is the right balance between first hand experience and received knowledge, and it is not the purpose of this thesis to argue this issue, it cannot be denied that if Discovery Methods can claim to harness man's curiosity drives, asking for explanations and getting them is an equally natural way of making sense of experience. It is an activity that with the increasing ability to use language gets under way from a very early age. It seems altogether foolish to deny this activity a place in formal learning, particularly at the stage when defined or scientific concepts, rules and principles are more in evidence than concrete or spontaneous concepts,[1] thus, increasing the need for verbal formulations. However, it is conceded that setting aside brain washing and indoctrination, teaching is an open activity and there is no one way of teaching that a teacher should be forced to adopt. This does not mean that explaining something to someone may not play a crucial part in teaching or that it ought not to play such a part. It means that, whether to explain something to one's pupil, or not, is a strategic decision to be made by the individual teacher, but explaining would seem to be a bona fide candidate for inclusion among the activities of teaching.

It has been argued within the theoretical background to the thesis that explaining is not the same as telling and describing or other similar activities. One of the best reasons for distinguishing explaining from activities that appear on the surface to be similar is the element of what Peter (1966) has called 'the norm of respect for persons.' Explaining is certainly a highly appropriate way of meeting this norm and comes about through the requirement that one who is explaining something to someone must take account of

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(1) Defined concepts, rules and principles are terms used in a number of psychological models of learning. In this case they are associated with the model offered by Gagné (1977). Spontaneous & scientific concepts, the terms used by Vygotsky (1962) that were discussed in Chapter 3.

the other person's rationality, which in simple terms means acknowledging another person's point of view. In doing this the explainer is called upon to do more than cite the main points in the explanation with which the explainee has to come to grips. He must marshal the points in a manner that reveals their relationships, present them in a way that ensures that they are logically persuasive, take account of their pupils' predicament and shift the question as necessary.

Martin (1970: 216) asks the question 'is it possible to teach someone to explain something to someone?' In arguing that it is possible to do so, she points out the value to this activity of utilising the conditions of explaining something to someone that she identifies. (See pp. 74-75). She warns, however, that she is not suggesting that it is necessary for an explainer to be aware of these conditions but simply that the conditions are there to be used 'in so far as they are found helpful.' She also stresses the point that

> explaining has the advantage over teaching of requiring the explainer to do the linguistic work. It is this work of answering or trying to answer the underlying and subsidiary question of an explaining episode in terms simple and clear enough for another to understand that would seem to provide the link that is said to exist between teaching a subject and coming to understand it. However, the teacher need not do this sort of linguistic work, whereas the explainer must.
>
> Ibid: 218

Pupils are sometimes asked to explain things to their fellows, perhaps for reasons to do with shortage of teacher time rather than to give them practice in explaining or to increase their own knowledge and understanding and that of the other pupil concerned. In assessing the usefulness of these activities it has to be borne in mind that there is explaining and explaining and some may be no use in improving the explainer's own condition or the predicament of the explainee. In short, it cannot be assumed that explaining episodes will do the job that it is hoped, and in some cases expected, they will.

Bearing in mind the points raised in the above discussion the opening category to be investigated contains questions about the extent to which teachers and pupils see explaining as a central activity and whether what they identify as explaining qualifies as such when set against specific philosophical and pedagogical criteria. The specific hypotheses to be tested are:

H1 That the occurrence of an activity in the rankings made by teachers from a list of logical acts of teaching on grounds of centrality and importance will be random.

H2 That the occurrence of an activity in the rankings made by pupils from a list of logical acts of teaching on grounds of centrality and importance will be random.

H3 That the activity teachers identify as explaining meets the philosophical and pedagogical criteria that is accepted as an account of explaining something to someone and which distinguish it from telling and other similar activities.

1.2 Category 2 Types of Explanation and Meaning

According to Green (1971: 147) explanation is 'what is called for by the question "why"' and, thus, on the surface it seems that this question should be among the most common in teaching and learning. Taylor (1970: 32) claims that it is explanatory to say what something is and thus answers to 'what' questions call for explanations. It has been argued (see pp. 33-34) that 'how' questions can be treated as a particular kind of what question if how is translated as 'by what means', and thus also involves explanations. Sometimes it is possible to use the term explaining in the sense of interpreting as, for example, in explaining a text or one's behaviour. These aspects of the act of explaining are more open-ended and may come up against the condition requiring the underlying question of an explaining episode to have a 'correct' answer. However, it is the case that the former interpretation is constrained by the material in the text and, thus, only a restricted range of answers are likely to be acceptable, while the latter may involve, in addition to the giving of reasons, a cause and effect relation.

Most teachers would accept that the offering of explanations is a common occurrence in day to day teaching whether or not they view the act of explaining as of major importance. They would also agree that not all the explanations that they handle are associated with the subject matter of the specific lesson. Explanations may be required in response to strategic, topical and personal questions.

Of the questions that do arise from the subject matter it has been argued that the explanations so evoked to a considerable degree are determined by the characteristic nature of the subject area. In other words, the presence of a particular type of explanation and the frequency with which it appears reflects the notions and procedures that constitute the subject.

There is no generally accepted way of classifying the forms of explanations but some suggestions have been offered and discussed in Chapter 3 (see pp. 33-45) by Taylor and Green.

Taylor's (1970: 2-3) category of what explanations appear useful in relation to explanations in classroom contexts particularly with the category of 'by what means' which then incorporates answers to how questions.

Green (1971: 147) in offering his typology of why-explanations believes that some kind of classification is helpful to the teacher, arguing that a teacher would be guilty of an error if he tried to answer 'one kind of "why" with an explanation appropriate only to another kind of "why".'

Distinctions associated with conceptual characteristic within explanations have been discussed (see pp.45-47) and it is possible that these reflect the demands of a stage of development within the specific subject. An awareness of conceptual levels on the part of the explainer can also lead to the structuring of material on the assumption that some concepts are more readily acquired than others, or that the understanding of complex concepts depends upon the knowing and understanding of a number of prerequisite concepts. It is possible that these constraints may affect the character of an explanation.

It has been noted earlier that not all explanations arise from the subject matter of a lesson. Setting aside those that arise from personal and social matters there remain explanations that arise out of a pedagogical discourse of the lesson, for example, those concerned with classroom procedures and teaching strategies. Bellack's (1969 : 98) attempt to categorise the range of different kinds of meaning that could be communicated through the different functions to which pedagogical discourse is put in the classroom, is of use in understanding the range of meanings communicated. Mention has been made of this experiment in Chapter 4 (see p.134) and there has been brief discussion of the distinctive kinds of meanings that he reveals through his analysis and the dominance of specific categories within the samples of classroom discourse that were used. No attempt was made by Bellack to compare different subjects, but this could be a fruitful exercise. It is also the case that the study is concerned with secondary level teaching and the results for primary could afford a different pattern of dominance.

In respect of both explanation and meaning types it may be the case that features occur in the teaching of science which are peculiar to this activity. A comparative analysis of the explanations and meanings obtained from science lessons with those from other subject's lessons could reveal these distinctions. For example, if Taylor's view of what constitutes a scientific explanation is satisfactory, questions requiring answers of this type should arise in physics, chemistry, biology and mathematics as well as in those aspects of other kinds of subject which are scientific in nature and as, for example, diet within the context of cookery.

Bearing these points in mind the second category to be investigated contains questions about the range and extensiveness of use of explanation types in different subject areas; the appropriacy of the selected type for the kind of questions asked, and subject specific trends in relation to the nature and complexity of the concepts utilised within the explanations offered.

There is also the question of the extent to which the meanings communicated in pedagogical discourse are dominated by those related to subject matter rather than strategies and procedures in the lesson. The specific hypotheses to be tested are:

H4 That explanation types, both in relation to the kind of what and why questions they answer and their conceptual characteristics are randomly distributed throughout different subject areas and within the same subject at different developmental stages.

H5 That the meaning types communicated through the explanations that arise in pedagogical discourse are randomly distributed throughout different subject areas and within the same subject at different developmental stages.

1.3 Category 3 The Gap between Intended Meaning and Received Meaning

Understanding as well as explaining has been the subject of a variety of educational claims, some seeing it as the purpose of teaching and learning acquired through promotion of knowledge. One factor strongly influencing understanding is the ability of an explainer to convey his intended meaning. This raises a problem common to communications that abound in teaching and learning that has to do with a speaker's inability to communicate effectively to an audience unless he adheres to certain conventions and constraints. He must speak a language known to his audience, a notion that includes varieties of language within the same mother-tongue; he must comply with its phonological, syntactic and semantic rules, and talk in an audible voice. But many of the conventions he follows have to do with what he says as well as how he says it. He must talk about a topic at a level of conceptual development that matches that of the receiver, make his part of the dialogue coherent, and say something that has worth and relevance within the context.

The four maxims that Grice (1967) maintains should be taken account of by the speaker in contributing to what Grice calls the co-operative principle in communication are of use to the activity of explaining something to someone and take the following form:

Quantity: Make your contribution no more and no less informative than is required.

Quality: Say only that which you both believe and have adequate evidence for.

Relation: Be relevant.

Manner: Make your contribution easy to understand; avoid ambiguity, obscurity and prolixity.

Grice suggests that the speaker agrees to follow these maxims and the listener agrees to assume they have been followed.

Where the speakers concerned are pupils it is possible to recognise a variety of ways in which the co-operative principle could fail to operate that would have consequences for subsequent comprehension and understanding. It is also clear that the breakdown could occur with the speaker or the listener. A teacher could fail to take account of one or other of the four maxims, or a pupil fail to perceive the relevance of the communication. Whatever the causes of breakdown, educationists have always had to grapple with the problem of how best to facilitate comprehension of a communication, and this is particularly true of communications that contain an explanation that is to be understood by a pupil.

Other factors that influence the degree of understanding of an explanation that is achieved are to be found within the explainee. Where the explainee is a pupil the expectation is that his state of knowledge and intellectual development is not as well advanced as that of the teacher who is undertaking to explain something to him, although to meet possible objections to this contention it may be wise to qualify it by confining the expectation to those situations in which the teacher offering the explanation has specialist knowledge of the area from which the explanation arises. One of the internal factors that influence an explainee's understanding is memory. At the time when the explanation is being given, the pupil must be able to store information in the short-term memory as it is given, so that ideally, comprehension of what the information means occurs almost at the same time, or fairly rapidly after, the completion of the communication. However, in explaining, more than comprehension of the message is often required. Many explanations make exacting demands upon the reasoning processes of a pupil. Indeed, they challenge his general intelligence as well as his ability to make sense of verbal information. Examples of this are common in science and mathematics which tend to deal, commonly, with higher order concepts and rules.

It is within this context that claims concerning the need for an explainer to take account of the explainee's predicament and to do the necessary linguistic work upon an explanation before presenting it, are revealed as being crucial to understanding. Edwards and Furlong (1977 : 108) pose some pertinent questions:

> How much of what teachers say is being understood, or is already understood, by their pupils? How much knowledge is already within the appropriate frame of reference, and how much new knowledge is being taken? In normal class teaching, finding the answers to these questions is a haphazard business. A few pupils answer questions and this can give the impression that everyone understands. It is not until the teacher looks at the pupil's written work that he discovers how much of his cherished exposition went over the heads of many of his class.

Teachers attempt to get over this by asking questions around the class and noting looks and gestures with a view to assessing attention. This provides dubious evidence for pupils are adept at hiding the fact that they do not understand and teachers who <u>do</u> realise that their explanations are not picked up by all their pupils, vary greatly in their awareness of the <u>nature</u> of the gap that can exist between their intended meaning and that which is received by the pupil.

Bearing these points in mind, the third category to be investigated contains questions concerning the reliability of teachers' perception of their own success as explainers and their awareness of the range of messages they communicate, both, as intended and unintended communications. The specific hypotheses are:

H6 That teachers impressionistic assessments of their own success in explaining something to someone are an accurate source of information.

H7 That the understanding achieved by individual pupils of an explanation given by their teacher to the class demonstrates considerable variation.

1.4 Category 4 The Features that Contribute to or Detract from the Attainment of Understanding

It may be one thing to reveal a gap between intended meaning and understanding in a situation where a pupil is being given an explanation by someone (usually a teacher) and quite another to identify the factors that hamper or render impossible, clear understanding of the something being explained. As was argued in the last chapter, the factors can arise from a number of different sources. On the explainer's side, the explanation can fail to be understood for logical reasons such as the unintentional use of erroneous information or a confused interpretation of the facts. When it is possible to observe teaching going on in classrooms, examples of the kinds mentioned occur quite frequently, in particular, when teachers are handling a topic or subject area of which they have only very limited knowledge and experience.

On the explainee's side it is possible to cite such factors as: degree of interest, attention span and certain cognitive abilities, as exerting influence upon his motivation set and readiness to engage actively with the new material.

These factors, which are highly important are always in evidence when teaching and learning are taking place. However, it is not these which are the concern of the investigations envisaged by the present writer. It has been argued that explaining is a certain use of language, whereas teaching need not be. It is the 'certain use of language' in explaining something to someone that provides the focus for the studies. Martin (1970 : 122) discussing explaining as a use of language, supports the view that for a teacher to have explained something to someone, he must do the linguistic work himself. She argues that not only should he state the relevant facts, but he must relate them to one another and to the underlying question. In other words, he must arrange or pattern them for the pupil.

In explaining episodes, where the pattern of discourse is that of a dialogue, teachers' use and pupils' understanding of that use of language is of prime importance. The words used by teachers play a major part in ensuring the success or otherwise of their communications and, thus, their selections must be made with the vocabulary of the pupil in mind. If this is not done it is not too strong to say that pupils may be prevented from exhibiting and developing their knowledge because the language of the explanation they encounter blocks progress rather than facilitating it. While considering the function of words it is worth bearing in mind Taylor's point (see p. 94) that knowing the meaning of words refers to skills exhibited over fairly long periods and to the warnings of a number of other writers in the area of language and thinking, that labels, i.e. words, are only useful when they refer to classes of things that are known to an individual.

Bearing in mind the issues discussed above the final category with which the investigation is concerned contains questions about the nature of the features that cause confusion and appear to be a barrier to understanding. The specific hypotheses to be tested are:

H8 That features associated with teachers choice of vocabulary influence the level of understanding gained by pupils from a message and thus from an explaining episode.

H9 That factors arising from context and situation influence the level of understanding achieved by pupils in explaining episodes.

H10 That factors associated with pupils' conceptual development and their ability to comprehend and employ learned capabilities and mental operations influence the level of understanding achieved by them in explaining episodes.

2.0 PROBLEMS AND DESIGN STRATEGIES

In planning the design and analysis of material from an investigation that is concerned with use of language, one of the major problems confronting the researcher is the enormous quantity of language activity that goes on at all times. Thus, any sample that is examined or analysed is but a fragment of the material available, which raises the question of whether or not the sample can be regarded as typical of the body of language from which it is extracted. Moreover, small though the sample may be in relation to the total, it affords the researcher a very large number of words to cope with analytically. Twenty thousand words may constitute only half a novel, but to scan this number of words (say) for the purpose of analysing the style of discourse is a formidable task.

The proposed investigation narrows down the language functions with which it is concerned to one, namely, explain-

-ing. Notwithstanding, if teachers' judgements of their own activities are accurate a large quantity of explaining episodes occur every day, so the problem of obtaining samples that are typical is still considerable. Furthermore, attempts will be made to compare the explanations given in science subjects with those in non-science subjects which is likely to exacerbate the problems associated with deeming the sample of episodes from each subject area involved, to be 'typical' of the episodes in that area.

In addition to the points raised, the investigation is concerned with revealing certain trends that may exist and also with examining particular aspects of the act of explaining in depth. To ensure an adequate degree of validity and objectivity the former objective requires a large number of explanations while in the latter case constraints imposed by time force the researcher to make selections within selections.

Another difficulty, when examining a function that is in the nature of explaining, is to utilise empirical methods without reducing the underlying questions to those that have lost much of their interest and value for understanding the activity in question. More often than not a sensitive analytical description of a piece of discourse reveals features that are missed altogether when gross scrutiny of a large body of language to identify general features is undertaken. A solution to this dilemma demands the utilisation of both approaches to a degree that is feasible within the constraints of time and resources and with regard to those questions for which the respective approaches are appropriate.

A number of problems to be overcome in designing the proposed investigation occur because the questions that form the bases of the hypotheses, arise from a common context but vary considerably in character: a situation for which the theoretical section prepares the ground in its discussion of the range of factors involved in explaining something to someone. The effect of this is to put pressure upon the researcher to employ a variety of investigatory methods for obtaining material and likewise a variety of analytical models for working upon the material.

In the proposed investigation the major emphasis is upon explaining as an act going on between at least two individuals within the context of the classroom. It is assumed that an essential feature of the task confronting an explainer is the communication of intended meanings to an explainee such as to promote explainee understanding. of the explanation. This assumption is made for all acts of explaining irrespective of the educational stage of the pupils involved and the subject within which they occur. The point is worthy of note for although explaining in science is to be given particular attention its features will be examined in relation to a range of school subjects, a small proportion involving primary school pupils.

2.1 Investigatory Methods

The investigation is designed in four parts that are concerned with the four categories of hypotheses that were described and justified earlier in the chapter and which are:

(1) Identifying samples of teachers and pupils who value explaining and a sample of explaining episodes.

(2) Analysis of explaining episodes to identify types of explanation and meaning.

(3) The gap between intended meaning and received meaning.

(4) Factors influencing effective explaining and understanding.

Because a variety of methods and analytical models will be used in the studies, it is not proposed to describe the methodology for each study before going on to discuss treatment of material and outcomes for each study. In each case, for reasons of clarity and ready comprehension, methodology, treatment of material and outcomes will be described in relation to a specific study within the category that it occurs and under the head of its associated hypothesis. Outcomes from specific studies will be examined in conjunction with others in a subsequent chapter that draws them together for the purpose of interpretation.

The designs are cross-sectional and in the main analytical, a number of purely descriptive items being necessary on specific occasions.

The range of methods includes use of rating sheets, taping and transcribing lessons, designing specific situations, i.e. experiments, and applying analytical models to samples of explaining episodes.

The methods employed are given below, each alongside the hypothesis with which it is concerned:

Hypothesis	Method of Investigation
H1) H2)	Use of a rating sheet containing items from Green (1971) and Smith's (1969) Logical Acts of Teaching followed by collation and interpretation of information obtained.
H3	The obtaining of tapes of lessons from different classroom contexts for transcription and subsequent analysis using an appropriate model
H4 H5	The analysis of suitably large samples of explaining episodes from different subject areas using appropriate models.
H6 H7 H8	The setting up of experiments followed by collation and interpretation of the results.
H9 H10	The sensitive analysis of a suitably small number of explaining episodes from the main sample, using appropriate models.

2.2 Analytical Models

Like the investigatory methods, the models are widely differing in character and, indeed, in degree of sensitivity. While it has been possible to use certain models without any modification, it has been necessary to adapt others and to combine one with another in order to obtain the desired outcomes. There are also occasions when the categories employed in analysis is that of the present writer for reasons to do with the lack of any suitable alternative.

The models employed are given below each alongside the hypothesis for which it is utilised:

Hypothesis	Model
H1) H2)	Not required.
H3	Martin (1970) Hypothesis Six: Philosophical characteristics of explaining episodes.
H4	Combination of Taylor (1970) and Green (1971): Typologies of explanations. Vygotsky (1962) Adapted by Richards[(1)] Conceptual categories.
H5	Bellack (1969): Categories of communicated meanings.
H6	Not required.
H7	Richards: Categories of received meanings.
H8	Not required.
H9	Halliday (1975[b]): Situational factors as determinants of text.
H10	Gagné (1977) adapted by Richards: A hierarchy of intellectual capabilities.

(1) Richards is the present writer.

As can be seen from the outline, the models are numerous, each appropriate for identifying factors associated with a specific hypothesis. For this reason it is considered necessary to describe their characteristics and offer some justification for their selection.

2.2.1 Martin (1970) Hypothesis Six

Although it has been argued that philosophical accounts of explaining something to someone are incomplete because they exclude or give little consideration to a number of important characteristics that have to do with social and contextual factors, it is thought to be desirable to identify and subject to further analysis those explaining episodes that satisfy the requirements stipulated in these accounts. In so doing it may follow that certain episodes thought by the teacher concerned to be an act of explanation will not qualify as such. However, those that do qualify can be deemed to be explaining episodes with a reasonable degree of confidence. The model which sets out the essential characteristics of explaining something to someone has been discussed fully in chapter 3 and is set out there. (See pp.74-75).

2.2.2 Taylor (1970) and Green (1971)

For the purpose of identifying the occurrence and degree of use of explanation types within subject areas Taylor's categories will be modified and used in conjunction with Green's typology of'why'questions. This is necessary because the hypothesis requires a typology that can discriminate sensitively among different kinds of'why'questions (as does that of Green) while at the same time retaining the 'what' category that Taylor recognises. The latter's notion of a scientific explanation can also be utilised in order that the 'why' explanations that are scientific can be identified.

The categories offered by both Green and Taylor are discussed in Chapter 3 (see pp. 33-44) and an outline of the combined typology will be given when the investigation for which the model is required is discussed in Chapter 6.

2.2.3 Vygotsky (1962) Adapted by Richards

The conceptual characteristics of the explanations within different subjects are also to be examined in relation to the hypothesis H4. For the purpose of revealing the concept type, Vygotsky's distinction of 'spontaneous' and 'non-spontaneous' (or scientific) will be used. To these two will be added 'intermediate' and 'false' as it is likely that both these categories may occur in explanations, the former frequently and the latter from time to time. By 'intermediate' is meant those concepts which are moving towards the non-spontaneous or scientific but which are not yet fully formed. 'False' is a category for placing erroneous concepts that have been acquired by the pupil.

2.2.4 Bellack (1965)

The categories that Bellack identifies are appropriate for revealing the meaning represented by the content of the messages that teachers communicate to their pupils. Four functionally distinct types of meaning are proposed which are: the subject matter, the cognitive processes involved in dealing with the subject matter, the routine procedures within the instructional process and didactic verbal processes.

An assumption is made by the present writer that by 'subject matter' is meant the notions that constitute the topic or topics with which the lesson is concerned and this will inform the judgements to be made when categorising the meanings.

Bellack's model is discussed in Chapter 4 and a further outline of his typology given there (see p. 135-36)

2.2.5 Richards 1980

In order to reveal the range of meanings received by pupils from the explaining episodes that take place in the experiment set up to investigate the possible gap between utterer's intended meaning and receiver's meaning, it is necessary to define categories that take account of the major variations.

The method used to arrive at the definition involved setting up a situation in which a class of pupils were given an explanation of something, followed by oral and written questions which sought to establish the accuracy of their understanding of the message, as defined in terms of the utterer's intentions. The information so obtained revealed seven distinct categories, as follows:

A. Complete Pupils have an understanding of the message that matches the utterer's intentions.

B. Substantial Pupils understand the greater part of the message.

C. Partial Pupils understand about half the message.

D. Substantial with Misinterpretation Pupils understand a substantial part of the message but have misinterpreted certain items.

E. Erroneous Pupils have made sense of the message on the basis of erroneous interpretations of its meaning.

F. Fragmentary Pupils have made contact with fragments of the utterer's intended meaning but are unable to make sense of the message.

G. Absent Pupils have made no contact with utterer's meaning and cannot remember any part of the message.

These categories are considered appropriate for the concerns associated with hypothesis H7 and will be used in analysis of pupil understanding of acts of explanation. It should be noted that it is not assumed that the list is exhaustive.

2.2.6 Halliday (1975b)

Utilising Halliday's (1975b: 24) notion of text which is discussed in Chapter 4 as a semantic unit an explaining episode qualifies as a text because functionally it involves linguistic meaning and as a physical event it is an instance of 'linguistic interaction in which people actually engage.'

To reveal features associated with context and situation in explaining episodes Halliday's concepts of Field, Tenor and Mode will be used. This appears to be a highly appropriate model for analysing the episodes in view of his argument that a particular situation type can be interpreted as a semiotic structure that can be represented as a complex of these three dimensions.

The proposed model is as follows:

(1) Field of Discourse - Concerned with the ideational function.

- (a) Habitual collocations.
- (b) Special vocabulary.
- (c) Habitual collocation of voice with active and passive.

(2) Tenors of Discourse - Concerned with the inter-personal function.

- (a) Personal Tenor
  - i. Informal-formal
  - ii. Personal-impersonal
- (b) Functional Tenor

(3) Mode of Discourse - Concerned with the textual function.

(a) Spoken
i. spontaneous-non spontaneous
ii. conversing-monologuing

(b) Written to be spoken

Indicators in the text of specific features of the model will be elaborated when it is being employed in relation to the concerns of hypothesis H9 and the full model included in the Appendices (see p. 314).

2.2.7 Gagné (1977) Adapted by Richards

Of the five capabilities that Gagné (1977: 26-27) describes as categories of human performances established by learning, intellectual skills, cognitive strategies for problem solving, and verbal information are those likely to be involved in understanding explanations from different subject areas.

In all three of these capabilities certain cognitive processes, such as attending discriminating encoding, storing, retrieving and transferring are taking place at one time and another. Individual differences with regard to the skill with which these processes are operated influence the success pupils achieve in understanding explanations. For example, if faulty encoding occurs in relation to the meaning of a label, an erroneous item may be stored which will have repercussions for the learner when that item is called upon in subsequent learning.

On the other hand, lack of understanding can be attributable to factors concerned with the conditions necessary for learning to take place as, for example, when a pupil is faced with new learning that depends upon prerequisite concepts which at that time he has not experienced.

Bearing in mind the points raised above Gagné's model has been adapted by the present writer as follows:

<u>Operations</u>

(a) Attending
(b) Discriminating
(c) Encoding
(d) Storing
(e) Retrieving
(f) Transferring

<u>Learned Capabilities</u>

(1) Intellectual Skills
(2) Cognitive Strategies
(3) Verbal Information

The model will be used in relation to the concerns of Hypothesis H.10. The version showing all the features is included in the appendices (see p.315).

CHAPTER 6

1.0 PRELIMINARY EXPERIMENTS TO OBTAIN SAMPLES AND TO TEST HYPOTHESES H1, H2 AND H3

Within this preliminary section of the investigation the first two studies are concerned with identifying the status of explaining as an activity of teaching, i.e. with testing hypothesis H1 and H2.

In addition to testing these hypotheses, the responses of teachers and pupils to the questionnaire will be used to obtain a sample of teachers who set high value on explaining as an activity of teaching and who teach classes of pupils whose ratings of explaining match their own. This group is asked to co-operate in the third study by allowing a lesson (or lessons) to be recorded, transcribed and analysed for the purpose of testing hypothesis H3 and providing a sample of explanations for use in other aspects of the investigation.

1.1 Testing Hypothesis H1 and Obtaining Samples of Teachers who Value Explaining

The hypothesis formulated to reveal the status of explaining in teaching and to provide a sample of teachers who set high value upon this activity is:

H1 That the occurrence of an activity in the rankings made by teachers from a list of logical acts of teaching on grounds of centrality and importance, will be random

1.1.1 The Initial Sample

Making use of personal and professional knowledge of schools and individual teachers a group of 90 teachers from 48 secondary schools and 30 primary schools each willing to allow lessons to be tape recorded were identified.

1.1.2 Stimulus Material

This consists of a list containing 14 items defined by Green (1971) and Smith (1969) as logical or intellectual acts of teaching as follows:

> Amassing evidence, describing, defining, classifying, designating, concluding, comparing and contrasting, explaining, demonstrating, inferring, opining, reporting, stating, valuing, together with -

instructions for selecting and rating the acts in respect of their relative centrality and importance in teaching. (see p. 312 in the appendices).

1.1.3 Procedures

Each teacher was given a copy of the stimulus material by the researcher, or someone acting for the researcher, and requested to follow the instructions without reference to any other person and to complete the task in time for collection the following day.

1.1.4 Results

The results of the teachers rankings of explaining are given below in Table 1.

TABLE 1

Teachers' Rankings of the Centrality and Importance of Explaining as an Activity of Teaching

	Number of Teachers Ranking			
Rank Order	Infant Age (Possible 6)	Junior Age (Possible 24)	Secondary Age (Possible 60)	Total (Possible 90)
1	3	11	32	46
2	1	3	14	18
3	0	2	8	10
4	1	3	2	6
5	0	1	1	2
6	1	2	3	6

Number of Teachers Ranking

Rank Order	Infant Age (Possible 6)	Junior Age (Possible 24)	Secondary Age (Possible 60)	Total (Possible 90)
7	0	1	0	1
8	0	1	0	1
9	0	0	0	0
10	0	0	0	0
Not Selected	0	0	0	0

1.1.5 Discussion

The results show that just over half the teachers in the group rate explaining as the most central and important logical activity in teaching. The proportion reflects the choices of secondary teachers, but infant and junior teachers' choices were only slightly below this proportion. Taking first, second and third choices together, each of which is a high status position, well over four-fifths of the group perceive explaining as a central and highly important activity of teaching.

1.1.6 Conclusion

Explaining is selected by teachers as the most central and important logical act of teaching and, thus, hypothesis H1 is rejected.

1.2 Testing Hypothesis H2 and Identifying Pupils who Value Explaining

The hypothesis formulated to reveal the status of explaining among learners and which pupils set high value upon explaining is:

H2 That the occurrence of an activity in the rankings made by pupils from a list of logical acts of teaching on grounds of centrality and importance, will be random

1.2.1 The Initial Sample

Pupils in the classes of teachers who set high value on explaining in the previous study (H1) were utilised as follows:

From the classes of 2 infant teachers	20 pupils
From the classes of 12 junior teachers	302 pupils
From the classes of 45 secondary teachers	939 pupils
Total:	1,261 pupils

1.2.2 Stimulus Material

This consists of a list containing 8 of Green (1971) and Smith's (1969) 14 items defined as logical or intellectual acts of teaching, as follows:

amassing evidence, defining, describing, demonstrating, explaining, opining and valuing.

A simple statement about the nature of the activity and instructions for selecting and ranking the acts in respect of their relative centrality and importance for the learner. (see p. 313 of the appendices).

Reasons for the modifications of the original list are:

1. Pupils would find 14 items too many to manage.
2. Pupils would not understand what was involved in some of the less obvious activities.

3. The statements were intended to make clear to the pupil the nature of the activities included.

1.2.3 Procedures

Each pupil was given a copy of the stimulus material by the researcher or someone acting for the researcher and requested to follow the instructions without reference to any person other than the one conducting the study.

Help was given to pupils whose reading limitations inhibited completion of the task.

The responses were collected when all pupils in the specific group had completed the task.

1.2.4 Results

The results of the pupils' rankings of explaining are given in Table 2:

TABLE 2 Pupils' Rankings of the Centrality and Importance of Explaining as an Activity of Teaching

Teacher Type	Number of Pupils Ranking in each Position					
	1	2	3	4	5	Not Selected
Infant 1. (Poss 10)	5	2	3	0	0	0
2. (Poss 11)	4	6	1	0	0	0
Total Infant Selections - 21	9	8	4	0	0	0
Junior 1. (Poss 25)	10	3	10	1	1	0
2. (Poss 18)	8	4	4	0	1	1
3. (Poss 22)	9	9	1	1	1	1
4. (Poss 28)	12	7	7	2	0	0
5. (Poss 19)	6	3	5	2	3	0
6. (Poss 26)	7	5	10	3	0	1
7. (Poss 24)	8	9	1	5	1	0
8. (Poss 27)	5	13	6	1	2	0
9. (Poss 28)	13	5	3	5	2	0
10. (Poss 31)	18	3	8	1	1	0
11. (Poss 29)	7	7	5	5	4	1
12. (Poss 25)	9	6	6	0	4	0
Total Junior Selections - 302	112	74	66	26	20	4
Secondary						
1. (Poss 22)	7	5	5	3	2	0
2. (Poss 23)	8	4	9	1	1	0
3. (Poss 15)	4	7	0	3	1	0

Teacher Type	Number of Pupils Ranking in each Position					
	1	2	3	4	5	Not Selected
Secondary						
4. (Poss 21)	9	2	2	4	3	1
5. (Poss 27)	14	6	0	5	2	0
6. (Poss 17)	6	6	3	0	2	0
7. (Poss 21)	7	7	5	1	0	1
8. (Poss 24)	7	8	5	2	2	0
9. (Poss 26)	9	9	0	0	7	1
10. (Poss 19)	8	3	8	0	0	0
11. (Poss 23)	11	7	2	2	1	0
12. (Poss 22)	5	7	7	1	2	0
13. (Poss 25)	10	4	5	6	0	0
14. (Poss 22)	10	3	3	2	4	0
15. (Poss 23)	6	7	7	3	0	0
16. (Poss 15)	7	2	4	0	2	0
17. (Poss 21)	4	2	5	2	7	1
18. (Poss 22)	9	3	0	5	3	2
19. (Poss 24)	12	7	5	0	0	0
20. (Poss 26)	14	0	6	2	4	0
21. (Poss 15)	3	10	0	1	1	0
22. (Poss 19)	9	5	5	0	0	0
23. (Poss 19)	8	2	0	5	4	0
24. (Poss 30)	21	0	2	7	0	0
25. (Poss 22)	11	1	3	2	4	1
26. (Poss 18)	6	3	1	1	7	0
27. (Poss 20)	5	5	3	5	2	0
28. (Poss 24)	7	7	0	8	2	0
29. (Poss 12)	6	0	5	0	0	1
30. (Poss 21)	5	10	4	2	0	0
31. (Poss 17)	5	2	1	7	2	0
32. (Poss 19)	8	6	5	0	0	0
33. (Poss 24)	10	10	0	4	0	0
34. (Poss 25)	10	6	5	2	1	1
35. (Poss 16)	8	8	0	0	0	0
36. (Poss 21)	6	6	3	5	1	0
37. (Poss 20)	9	5	4	0	2	0
38. (Poss 20)	11	2	0	2	5	0
39. (Poss 27)	16	6	3	1	1	0

Teacher Type	Number of Pupils 1	2	3	Ranking in each Position 4	5	Not Selected
Secondary						
40. (poss 14)	2	8	2	0	0	0
41. (poss 26)	13	0	7	4	2	0
42. (poss 14)	9	2	1	1	0	1
43. (poss 24)	13	1	7	1	2	0
44. (poss 21)	6	7	4	4	0	0
45. (poss 19)	7	2	3	2	4	1
	381	203	149	106	83	11

Total Secondary Selections - 939

Total of all selections - 1,261

1.2.5 Discussion

The results show that over half the pupils in the group rank explaining as the most central and important logical activity in teaching. The proportion most closely reflects the secondary level pupils, but primary selections are only slightly below this. Taking first, second and third choices together, each being a high status position, just under four-fifths of the group perceive explaining as a central and highly important activity of teaching and learning. Moreover, only eleven pupils out of the sample of over one thousand did not rank it in one of the five positions.

1.2.6 Conclusion

Explaining is ranked by pupils as the most central and important activity of teaching and, thus, hypothesis H2 is rejected.

1.3 Testing Hypothesis H3 and Obtaining Samples of Explaining Episodes

The hypothesis formulated for the purpose of distinguishing explaining from telling and other similar activities and to provide a sample of explaining episodes for analysis in other aspects of the investigation is:

H3 That the activity teacher's identify as explaining meets philosophical and pedagogical criteria that is accepted as an account of explaining something to someone and which distinguishes it from telling and other similar activities.

1.3.1 The Samples

1. Teachers and Pupils

Teachers from among those providing the sample for the first study H1, (by reason of their willingness to allow lessons to be recorded) subsequently revealed in this study as setting high value on explaining and who teach a class or classes containing a high proportion of pupils revealed in the second study H2 as also setting high value on explaining constitute the sample, together with the classes of pupils in question.

2. Lessons

Lessons were provided by teachers engaged with their own classes as follows:

From the age range 6-7 years 2 teachers with 2 classes.
From the age range 8-11 years 8 teachers with 8 classes.
From the age range 12-16 years 45 teachers with 70 classes.

The subjects represented in the sample of secondary school lessons are:

Mathematics, Physics, Chemistry, Biology, English, Foreign Languages, History and Geography.

1.3.2 Procedure

1. Recording of Lessons

Arrangements were made for lessons to be recorded in accordance with the wishes of the teacher concerned which produced the following variations:

i teachers made their own arrangements to record their lessons, ii the recording equipment was set up by the present writer,

iii the equipment was set up and the lesson observed by the present writer.

In the last case pupil groups were recorded as and where the opportunity presented itself.

The recordings were made and collected over a period of six months and transcriptions made of relevant sections of the lessons.

2. Transcription of Recordings

Those parts of the lesson that are in any way involved in the lead up to an explanation, or where the activity of explaining something to someone is going on, were transcribed. The actual proportion of a lesson involved varies from a short isolated episode to most of the verbal interaction in the lesson.

3. Analysis of Transcriptions

The explaining within the sections transcribed were subjected to analysis using as the model Martin's (1969) Hypothesis Six (see p. 74-75) with the objective of revealing those episodes that meet the conditions defined by philosophical accounts of explaining something to someone.

1.3.3 Methodological Limitations

1. It is always possible that the presence of a tape recorder in a classroom during a lesson will influence the behaviour of teachers and pupils. To minimise the possible effects of this they were not informed at the outset which teaching activity was under scrutiny.

2. In utilising analytical models, it is necessary to make judgements against specific criteria. This introduces

a degree of subjectivity which, with certain exceptions, it is impossible to eliminate.

1.3.4 Results

The analysis of 161 explanations given by teachers to pupils is shown below. In the table the specific conditions are listed and beside each is shown the number of explanations that meet the requirements. Of the 110 explanations that satisfy all conditions the 106 to be used in testing hypothesis H4 are in the appendices (see pp. 323-90).

TABLE 3 Number of Teacher Explanations that meet the Requirements of Specific Conditions in Martin's Hypothesis Six

Conditions		Explanations (Poss No. 161)
(a)	Soundness of question	160
(b)	Tutor rational and understands question	158
(c)	Tutor perceives tutee's rational predicament with regard to the underlying question	146
(d)	Tutor states right answer to underlying question	150
(e)	Tutor answers subsidiary question	121
(f)	Tutor allows tutee to exercise his reason and judgement	141
(g)	Tutor by end of episode has organised and stated the answers to questions in (c) and (e)	117
	Final total of those meeting all requirements	110

1.3.5 Discussion

Some two-thirds of the activity deemed by teachers to be explanatory met all the conditions incorporated into Martin's Hypothesis Six. However, to obtain a more detailed picture of what this model reveals it is necessary to examine the figures for each condition in turn and to interpret the influence of one condition on the figures for another.

It is reassuring to note that all but one explanation is concerned with an underlying question that is sound. The one explanation that fails to meet condition (a) being given by a teacher operating in an unfamiliar area of knowledge with a primary class. This explanation fails to satisfy conditions b, c, d, f and g for the reason that the teacher in question does not understand the underlying question herself (although unaware that this is the case) and is in no position to appreciate the tutees predicament or to offer right answers to the underlying question and any subsidiary questions.

Condition (b) affords problems to the analyst for it cannot be judged with any degree of certainty. Furthermore, the judgement made has implications for condition (c) for the reason described above. In categorising 'doubtful' cases it was found helpful to scrutinise condition (d) and (e) as the quality of the answers to both the underlying question and a subsidiary question is a clear indication of the teacher's understanding of the underlying question.[1] An answer may not be wrong, but if it fails to fully answer the underlying question it may cast doubt on the teacher's understanding of the underlying question. Having considered these points, on the occasions that doubt remained the benefit of it was usually given to the teacher, and always to those operating within their own specialism.

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(1) When necessary advice from a colleague qualified in the appropriate discipline was obtained by the present writer.

Of the explanations that fail to satisfy condition (c) four are considered to be totally inadequate. The remaining eleven were judged inadequate because they fail to identify the pupils predicament with a satisfactory degree of specificity. The effect of this is to make the ensuing explanations too general to do more than partially remove the basis of the tutees predicament.

Condition (d) Out of the eleven losses five are wrong or unsatisfactory answers. Two of these are in error in respect of the subject matter involved and the other three unsatisfactory in that they only partially answer the underlying question. In the case of the remaining six explanations the teacher does not actually state the right answer at any time during the episode and, thus, not only fails to satisfy condition (d) but also condition (g).

Condition (e) removes more explanations than any other, with the exception of condition (g), which to some degree it determines. Indeed, condition (e) also affects the total in (f) for one of the ways in which a tutee is afforded an opportunity to exercise his reason and judgement is by a shift in question.

Although some teachers afford pupils an opportunity to exercise their reason and judgement thus fulfilling condition (f) through a shift in question, there are others who do this by allowing the pupil to state whether or not he accepts the explanation. This is done through questions like... O.K.?; clear?; or by leaving a gap in a sentence at the end of the explanation for the pupil to fill.

Explanations failing to fulfil condition (g) are largely those that have already failed to fulfil condition (e). The further losses are provided by those teachers who fail to state the right answer to the underlying question - condition (d) although they may state answers to a subsidiary question. It should be noted, however, that teachers whose explanations do not meet the requirement of category (g) do not necessarily refrain from asking subsidiary questions. Indeed, the style of the explaining episodes of these teachers is predominantly questioning in character. It is the omission of a statement of the right answer that is the cause of their failure to meet the conditions in question.

Overall most explanations fulfil all or most of the conditions. Of those failing to do so, forty are accounted for by condition (e) that requires that a tutor answers one subsidiary question in order that the question-shifting requirement is satisfied. This requirement and the possible implications of failing to take account of it will be considered in the general discussion of results to be undertaken in Chapter 8.

1.3.6 Conclusion

In view of the high percentage of explanations that meet all the conditions of Martin's Hypothesis Six and the points raised in the discussion the hypothesis H3 cannot be rejected. In allowing it to stand it is necessary to bear in mind the reservation associated with condition (e).

2.0 ANALYSIS OF THE EXPLANATIONS GIVEN IN THE FIRST SAMPLE OF EXPLAINING EPISODES. TO TEST HYPOTHESES H4 AND H5

2.1 Testing Hypothesis H4 - Types of Explanation

The hypothesis formulated to reveal the nature and distribution of explanations given in certain primary and secondary school classroom contexts is:

H4. That explanation types, both in relation to the kind of what and why questions they answer and their conceptual characteristics are distributed randomly throughout different subject areas and within the same subject at different developmental stages.

2.1.1 The Sample

A total of 106 explanations that satisfy the conditions of Martin's Hypothesis Six in the study associated with hypothesis H3 constitutes the sample. The distribution of primary and secondary contexts and of subjects and topics is: 18 explanations given by primary teachers within topics concerned with Mathematics, Humanities, Nature Study, Religious Education and Environmental Studies and 88 explanations given by secondary teachers within Mathematics, Physics, Chemistry, Biology, History, Geography, English and Foreign Languages.

2.1.2 Analytical Models

(1) Combination of Taylor (1970) and Green (1971): Typologies of Explanations

The categories used to analyse the sample of explanations are as follows:

What-explanations

i. Linking the thing or event to scientific laws from which the event or behaviour of the thing could be deduced (Sci).

ii. Supplying information and satisfying curiosity.(Inf.)

iii. Explaining by what means or how something came about. (How).

Why-explanations

i. Deductive explanations - where what is to be explained is logically deduced from statements that explain the phenomenon in question. (Ded).

ii. Probabilistic explanations - where the truth of the explanans does not guarantee the truth of the explanandum, but offers an account that is probable. (Pro).

iii. Genetic explanations - that describe how a state of affairs developed or by what process it came about. (Gen).

iv. Teleological and Functional explanations - that make reference to consciously held goals or purposes for which actions are taken and thus refer to the future. (Te/f).

(2) Vygotsky (1962) Adapted by Richards:Conceptual Categories

i. Spontaneous concepts - those acquired by an individual through experience before he is able to define them in words.

ii. Intermediate concepts - those which have started out as spontaneous concepts but have reached a stage at which they are developing into associated non-spontaneous or scientific concepts as a result of further experience and learning.

iii. Non-spontaneous or scientific concepts - those which can be acquired only through specific teaching because they start their development with a verbal formulation and their use in non-spontaneous operations.

iv. False concepts - those which an individual has acquired through experience or specific learning but which are erroneous.

2.1.3 Methodological Limitations

In utilising analytical models it is necessary to make judgements against specific criteria. This introduces a degree of subjectivity which with certain exceptions it is impossible to eliminate.

2.1.4 Results

The philosophical nature and distribution of explanations within five topics in primary teaching and eight school subjects in secondary teaching is given in Table 4 and the conceptual nature and distribution of explanations in the same sample is given in Table 5.

TABLE 4: The Nature and Distribution of Explanations within Primary and Secondary Teaching

No. of Explanations in Lesson or Topic	Explanations answering: What-Questions			Why-Questions			
	Sci.	Inf.	How	Ded	Pro	Gen	Te/f
Primary:							
(3) Mathematics		6	5				
(4) Humanities		4	2			1	
(4) Nature Study	2	5	2			1	2
(4) Environmental Studies		4	1			1	1
(3) Religious Education		5	1				
Secondary:							
(12) Mathematics	6	10	13				
(12) Physics	15	1	2	10		2	
(12) Chemistry	14	2	3	9		2	
(12) Biology	5	5	5	1		4	10
(10) English		10	4		5	2	2
(10) History		10	2			10	
(10) Geography	2	19	3	1	2	3	3
(10) Foreign Languages		14	8				1
Totals	44	95	51	20	7	27	19

TABLE 5: Nature and Distribution of Concept Types in Primary and Secondary Explanations

Subject		Spontaneous	Intermediate	Non-spon- taneous or Scientific
Primary				
Mathematics	(3)	7	9	8
Humanities	(4)	16	29	12
Nature Study	(4)	22	25	4
Environmental Studies	(4)	9	12	0
Religious Education	(3)	4	12	10
Secondary				
Mathematics	(12)	27	37	33
Physics	(12)	23	65	43
Chemistry	(12)	25	60	61
Biology	(12)	27	62	49
English	(10)	53	43	12
History	(10)	57	53	19
Geography	(10)	54	50	11
Foreign Language	(10)	31	23	24

N.B. No. of explanations analysed is in brackets after the subject.

2.1.5 Discussion

Examination of Tables 4 and 5 suggest distinctions do exist among the subjects with regard to their utilisation of explanation and concept types.

Table 4 showing the types of questions explanations are attempting to answer reveals that the distinctions that do exist are not limited to factors associated with being an art or a science subject. It is also clear that certain trends are common to all explanations irrespective of the subject area. For example, in all subjects except Biology (where what and why types are equally represented) what-questions predominate, as shown in the table below:

TABLE 6: Distribution of What and Why-Questions Throughout All Explanations

Explanations	What-Questions	Why-Questions
Primary		
(3) Mathematics	11	0
(4) Humanities	6	1
(4) Nature Study	9	3
(4) Environmental Studies	5	2
(3) Religious Education	6	0
Secondary		
(12) Mathematics	29	0
(12) Physics	18	12
(12) Chemistry	19	11
(12) Biology	15	15
(10) English	14	9
(10) History	12	10
(10) Geography	24	9
(10) Foreign Languages	22	1
TOTAL	190	73

In the case of the secondary explanations, no distinctions appear to exist between arts and science subjects in respect of their use of what-questions in general. In the sample the distribution is shown in Table 7 (over the page).

TABLE 7: Distribution of What-Questions Categories in Arts and Science Subjects - at Secondary Level

Explanations			What-Questions		
		All Types	Sci.	Inf.	How
(36)	Science	81	40	18	23
(30)	Arts	72	2	53	17
	TOTAL	153	42	71	40

It is difficult to identify arts and science in the primary level topics but it is clear that what-questions are much more common than why-questions.

Eighteen primary explanations generate 37 what-questions to 6 why-questions.

Examination of individual what-question categories shows that overall, what-information occurs most frequently, 71 of the total of 153 secondary what-questions being of this type. The primary pattern is similar, 24 of the total of 35 what-questions are of the what-information type.

The distribution of what-information questions throughout the explanations of specific secondary subjects shows considerable variation, Geography generating almost the same number as all the sciences added together.

What-how questions are evenly distributed through the arts and sciences, as shown in Table 7. However, considered individually, Mathematics and Foreign Languages utilise this category significantly more than others for reasons which would appear to reflect the nature of the teaching of these subjects where there is a particular concern to explain by what means, or the method whereby, a problem may be solved or an activity carried out. The primary Mathematics explanations follow an identical pattern in this respect.

Explanations generating what-scientific questions show greater variation than any other what-question type. The range is from 0 in the cases of Foreign Languages, History and English to 15 in the case of Physics. As might be expected, there is a distinction between arts and science subjects for this category. The exception on the arts side is Geography, which has two such questions. This again is not unexpected when the nature of the subject is taken into account. It has for convenience been included on the arts side and indeed most of the explanations in the sample analysed are descriptive in the tradition of Geography as an art. However, the quantifying approach, which is now popular, is apparent in certain explanations that consitute the Geography sample and it is these that have generated scientific-what-questions. It is also worth noting that Biology, in addition to its characteristic scientific nature, has a descriptive aspect that is similar to that of Geography and that this may account for the relatively small number of scientific-what-questions its explanations generate when compared with Physics and Chemistry.

At primary level, Nature Study has a similar pattern of what-questions to that of Biology and the topics which are predominantly arts orientated have no what-scientific questions.

Distinctions between arts and science groups in respect of all why-questions do not occur as can be seen from the table below:

TABLE 8: Distribution of Why-Question Categories in Arts and Science Subjects at Secondary Level

Explanations		Why-Questions				
		All Types	Ded	Pro	Gen	Te/f
(36)	Science	38	20	0	8	10
(30)	Arts	29	1	7	15	6
	TOTAL	67	21	7	23	16

The distinctions that are revealed occur within individual categories or in relation to specific subjects.

A large number of deductive-why-questions are answered in explanations on the science side, while on the arts side they are conspicuously absent. Closer examination of this category for individual science subjects reveals that 19 of the 20 deductive questions generated, occur in Physics and Chemistry, none occur in Mathematics and only 1 in Biology. (See Table 4). This distinctive pattern for Biology, by contrast with Physics and Chemistry, is maintained throughout the remaining why-question categories with the exception of the why-probabilistic category, while the Mathematics pattern is idiosyncratic relative to other arts and science subjects.

The probabilistic-why-question is utilised rarely. The explanations from two subjects, English and Geography, generate questions, in both cases interpretation of material (text, questionnaire or survey) is the source.

The genetic-why question is the most popular why-category. It appears that questions concerning the events or factors that have given rise to something are the concern of all disciplines from time to time. Worthy of note is the large number of these questions occurring in and the absence of other why-categories from the sample of History explanations which appear to reflect both the subject matter and the mode of enquiry. This interpretation is supported by the figures for Biology and Geography, both subjects which are at times concerned with questions of development or evolution and with those for the genetic category in primary explanations where the sources were respectively the historical, biological and geographical strands of the topics represented.

The teleological or functional why-question while not clearly associated with specific arts and science groupings is the category most utilised in explanations in Biology (see Table 4). This would appear to be accounted for by the centrality of 'function' in the subject which gives rise to questions concerned with the purpose or function of an organ, system, or chemical function: a trend which is also repeated in primary Nature Study. The distribution of concept types varies in respect of primary and secondary contexts, arts/science groupings and individual subject characteristics.

No clear developmental pattern is revealed in the explanations given at primary and secondary level that holds good for all subjects. Indeed, proportionately, a larger number of non-spontaneous and intermediate concepts occur in the explanations of the arts orientated primary topics than do in the explanations given in arts subjects at secondary level. This is not true of science subjects which show a clear developmental pattern towards increased use of both intermediate and non-spontaneous concepts at secondary level and a corresponding reduction in use of spontaneous concepts. Mathematics at primary level shows a pattern of conceptual usage that is identical with that of secondary level mathematics. This may have something to do with the characteristic nature of the subject and will be brought up later when this notion is examined.

The relatively large number of intermediate and non-spontaneous concepts present in three out of the five topic areas at primary level suggest a very high concept density. In fact, 11 explanations (4 Humanities, 4 Nature Study and 3 Religious Education) utilised 92 concepts. At secondary level this trend is paralleled only by science subjects where 36 explanations (12 each in Physics, Chemistry and Biology) utilise 340 intermediate and non-spontaneous concepts.

History is the arts subject that comes closest to demonstrating a trend similar to that of the sciences.

Here, 10 explanations utilise 72 intermediate and non-spontaneous concepts.

In the main, arts subjects at secondary level utilise more spontaneous concepts than do science subjects. Science subjects, on the other hand, demonstrate a preoccupation with intermediate and non-spontaneous concepts. Physics and Biology have an almost identical conceptual category pattern, with Chemistry having the same as these two for spontaneous and intermediate concepts but going well ahead in the number of non-spontaneous concepts utilised. A glance at Table 5 shows Chemistry as the only subject to utilise more non-spontaneous concepts than any other kind. In the cases of Mathematics, Physics and Biology, it is the intermediate category that is dominant.

Examination of the nature of the concepts to be found within the explanations (see Table 5 on p. 191) reveals certain trends that are associated with specific concerns of subjects in respect of content and method of enquiry.

In the main, most concepts that occur within the explanations from arts subjects are of the kind that start life at a spontaneous level and by a gradual process of increasingly precise definition reach the intermediate category as, for example, the concept of kingdom. A number of those in the non-spontaneous or scientific category are of this kind but there are also some concepts whose characteristics are culturally defined. Being abstract they do not arise spontaneously and it may be necessary to look to philosophical analysis rather than to a subject area for clarification of their meanings. An example of this sort that occurs in the explanations in the sample is 'democracy'.

A large number of the concepts revealed in the arts subjects sample appear familiar in the sense that they are encountered in common usage (see pp.407-11 in appendices), However, within the contexts of the explanations it is necessary for their meanings to be understood at an altogether more exact and well informed level than that which suffices in everyday use.

A number of concepts, as in the case of democracy that has been quoted earlier, cannot be confined to a single definition. Their understanding, therefore, is dependent upon the learners awareness of the range of definitions or descriptions that are possible within the very broad boundaries of a concept of this kind. The appearance of several such concepts in Humanities and Religious Education at primary level, with little or no specific presentation, suggests that teachers may not be always fully aware that a young pupil's conception of what appear to be familiar terms, is unlikely to match their own.

A last point worthy of note is that a great many of the arts concepts do not clearly belong to a specific discipline. Exceptions are concepts which have to do with the rules and grammatical terms associated with language work, which predominate in the explanations in Foreign Languages and to a much lesser extent in English. Progressions with age can be seen in the explanations given in Foreign Languages towards more complex grammatical rules, which in turn influence fluent usage. A similar trend is revealed in the language teaching aspect of English.

History and Geography explanations show no clear pattern of conceptual development and, indeed, some concepts occur at primary level that also occur in the upper part of the secondary school (see p.397 and pp.408-9 of the appendices). Where distinctions exist they appear to be associated with making the learner consider events or factors that may have had an influence upon some specific phenomenon, an objective that appears to become more dominant with gains in age and knowledge of the subject.

The characteristic nature of the science concepts is very different from that of the arts concepts on a number of points. They are more clearly defined and, in the main, are generated from the specific disciplines in which they occur. The greater proportion of those that occur in the intermediate and non-spontaneous categories are unfamiliar and unlikely to be encountered in common usage.

It has been noted earlier that the concept density is very high for Physics, Chemistry and Biology. It is also the case that there is considerable variation in respect of the range of phenomena represented in the 36 explanations given. Bearing in mind that non-spontaneous or scientific concepts are normally of a higher order of complexity than intermediate or spontaneous ones it would appear that the science explanations are making demands with regard to previous attainment of prerequisite lower order concepts and the intellectual capacity of the learner that exceeds those made in arts explanations.

Examination of the concepts occurring in Physics, Chemistry and Biology (see pp. 402-6 of the appendices) reveals a large number that are of a relatively high order. As the conceptual level rises there is increased use of precise definition and related concepts that have been formed at some earlier stage.

There appears to be a trend from the primary through the secondary stage towards an increase in the number and complexity of the concepts utilised in the explanations. However, this is not as clear as might have been expected as some of the distinctions are related to ability rather than age. A similar trend is revealed in mathematics, though here ability is clearly the dominant influence upon the conceptual level of the explanations given.

2.1.6 Conclusions

The analyses have revealed certain trends which point to the existence of distinctions between arts and science groups, primary and secondary stages and among explanations associated with specific subject areas.

The trends are as follows:

<u>Arts subjects</u> utilise:	<u>Science subjects</u> utilise:
Large proportions of what-information questions.	Small proportions of what-information questions.
Very low proportions of what-scientific questions.	High proportions of what-scientific questions.
Very low proportions of why-deductive questions.	High proportions of why-deductive questions.
High proportions of spontaneous concepts.	Low proportions of spontaneous concepts.
Low proportions of non-spontaneous or scientific concepts.	High proportions of non-spontaneous or scientific concepts.

<u>Primary explanations</u> utilise:	<u>Secondary explanations</u> utilise:
Low proportion of non-spontaneous or scientific concepts in science orientated topics.	High proportion of non-spontaneous or scientific concepts in science orientated subjects.
High proportion of intermediate concepts in arts orientated subjects.	High proportion of intermediate concepts in arts orientated subjects.

<u>Subject distinctions</u>:

Mathematics utilise more what-how questions than any other subject, has no why-questions and has an almost equal distribution of spontaneous, intermediate and non-spontaneous concepts.

Physics and Chemistry utilise high proportions of what-scientific and why-deductive questions, also intermediate and non-spontaneous or scientific concepts.

Biology utilises equal numbers of all what-question and why-genetic categories and a high proportion of why-teleological/functional categories and intermediate and non-spontaneous or scientific concepts.

History utilises a high proportion of genetic-why questions and a higher proportion of intermediate and non-spontaneous or scientific concepts than any other arts subject.

Geography has the highest number of what-information questions of any subject and the most varied pattern for all explanation types.

Foreign Languages has the highest propor tion of non-spontaneous or scientific concepts of any arts subject.

Taking account of the trends noted above, it is impossible to sustain the contention that question-types and concept types are randomly distributed throughout subject areas and at different levels in the same subject area and, thus, the hypothesis H4 is rejected.

2.2 Testing Hypothesis H5 - Types of Communicated Meaning

The hypothesis formulated to reveal the nature and distribution of meanings communicated in explanations given in certain primary and secondary school classroom context is:

> H5 That the meaning types communicated through the explanations that arise in pedagogical discourse are randomly distributed throughout different subject areas and within the same subject area at different developmental stages.

2.2.1 The Sample

A total of 106 explanations that satisfy the conditions of Martin's Hypothesis Six in the study associated with hypothesis H3 constitutes the sample. The distribution of primary and secondary contexts and of subjects and topics is: 18 explanations given by primary teachers within topics concerned with Mathematics, Humanities, Nature Study, Religious Education and Environmental Studies and 88 explanations given by secondary teachers within Mathematics, Physics, Chemistry, Biology, History, Geography, English and Foreign Languages.

2.2.2 Analytical Model

Bellack (1965) Categories of Communicated Meanings

The categories used to analyse the explanations are as follows:

Substantive with associated (Sub-Ass) - refers to the subject matter of the lesson in question.

Substantive logical (Sub-Log) - refers to the cognitive processes involved in dealing with the subject matter of the lesson.

Instructional with associated (Inst-Ass) - involves routine classroom procedures that are part of the instructional process.

Instructional logical (Inst-Log) - refers to distinctively didactic verbal processes such as explaining procedures and giving directions.

2.2.3 Methodological Limitations

1. Bellack applied his model to full lessons given by teachers for the purpose of explaining certain concepts. In this study the model is applied only to the acts of explanation, which is likely to result in a more limited range of meanings being revealed.

2. In utilising analytical models it is necessary to make judgements against specific criteria. This introduces a degree of subjectivity

which with certain exceptions it is impossible to eliminate.

2.2.4 Results

The nature and distribution of communicated meanings within the sample of explanations given in primary and secondary classes is shown in Table 9.

TABLE 9: The Nature and Distribution of Communicated Meanings within Primary and Secondary Teaching

Primary Explanations

Subject	No.	Sub-Ass	Sub-Log	Inst-Ass	Inst-Log
Mathematics	(3)	3	2	1	3
Humanities	(4)	4		1	4
Nature Study	(4)	4	1		4
Environmental Studies	(4)	4	2		4
Religious Education	(3)	3			3

Secondary Explanations

Subject	No.	Sub-Ass	Sub-Log	Inst-Ass	Inst-Log
Mathematics	(12)	12	10	1	12
Physics	(12)	11	1	3	12
Chemistry	(12)	11	4	2	12
Biology	(12)	12	2	2	12
English	(10)	10	5	1	10
History	(10)	10	1	3	10
Geography	(10)	10	5	5	10
Foreign Languages	(10)	10	4	3	10

2.2.5 Discussion

As could have been predicted for reasons to do with the first methodological limitation, all explanations communicate meanings that belong to the instructional-logical category because by definition (having satisfied Martin's Hypothesis Six) all are concerned with the didactic verbal process of explaining. This category, therefore, will not be taken into account when considering whether Hypothesis H4 can stand or be rejected on the basis of the evidence.

Setting aside the instructional-logical category a number of specific variations are revealed among and within the others. Substantive with associated meanings, i.e. those that refer to the subject matter of the lesson are communicated in all the primary explanations. The exceptions occur in Physics and Chemistry respectively and in both cases a pupil initiates the explanation by questioning an incidental procedure (see p.351 and p.354 of the appendices). Substantive-logical meanings occur in all subjects but it is clear that reference to the cognitive processes involved in dealing with the subject matter is a major concern in Mathematics where 2 out of 3 primary explanations and 10 out of 12 secondary explanations communicate meanings of this kind.

Instructional with associated meanings appear to be randomly distributed throughout the subjects. The primary explanations show a range of 0-1 and the secondary ones a range of 1-5. Geography with 5 such meanings is 2 ahead of any other subject which may have something to do with the use of maps, pictures and slides, which have to be positioned, etc., thus calling forth meanings that have to do with routine classroom procedures. However, this kind of activity is common in all practical subjects and is also likely to occur in History which suggests that the distribution of communicated meanings of this type is likely to be a matter of chance.

2.2.6 Conclusions

Substantive with associated meanings are clearly dominant throughout the explanations of all subject areas at primary and secondary level.

Substantive with logical meanings have a major role in Mathematics at primary and secondary level. Instructional with associated meanings appear to have a random distribution.

Taking account of the above points, it is impossible to sustain the contention that the nature and distribution of communicated meanings in explanations from primary and secondary subject areas in random and, thus, hypothesis H5 is rejected.

Summary of the Findings of the First Set of Studies

At this stage in the investigation certain points have been established from the evidence provided by the studies concerned with hypotheses H1 to H5 inclusive.

The act of explanation is seen by teachers and pupils as a central and important activity of teaching and learning. However, not all the activity that teachers believe to be explaining something to someone qualifies as such when set against the philosophical conditions outlined in Martin's Hypothesis Six. Most explanations that fail to qualify do so because they do not meet the requirements of one or two conditions. The condition that requires a shift in question is the one most often not met. When this is the case it follows that the condition requiring a tutor to state the answers to the underlying question and a subsidiary question, cannot be met either.

Two-thirds of all the explanations that were set against Martin's Hypothesis Six satisfied all the conditions. A further analysis shows them to be concerned with answering a variety of what and why questions and in doing so utilise different kinds of concepts. These are not randomly distributed throughout the subject areas. Certain question types and concepts are dominant in arts subjects (notably large use of what-informaticn questions and spontaneous concepts) others in the sciences.

Science subjects share a number of trends as, for example, large use of what-scientific questions, why deductive questions and non-spontaneous concepts. The pattern for Biology differs somewhat from Physics and Chemistry, the most notable feature being that why-teleogical and functional questions and why-genetic questions replace a large use of why-deductive questions. Patterns peculiar to other individual subjects also occur in which one question type occurs abundantly and another type is totally absent.

Finally, the meanings communicated in all the explanations are predominantly associated with the subject matter of the class. It is also the case that Mathematics communicates a large number of meanings that are concerned with the cognitive processes involved with dealing with the subject matter and that it also generates more what-how questions than any other subject.

CHAPTER 7

1.0 THE GAP BETWEEN INTENDED MEANING AND RECEIVED MEANING

1.1 Testing Hypotheses H6 - Teachers Assessments of their Success in Explaining Something to Someone.

1.2 Testing Hypothesis H7 - Variation in Pupils' Understanding of Explanations Given by their Teachers.

2.0 FACTORS INFLUENCING THE EFFECTIVENESS OF AN EXPLAINING EPISODE

2.1 Testing Hypothesis H8 - Vocabulary Features in Explaining

2.2 Testing Hypothesis H9 - Contextual Factors in Explaining Episodes

2.3 Testing Hypothesis H10 - Conceptual Factors in Explaining Episodes

1.0 THE GAP BETWEEN INTENDED MEANING AND RECEIVED MEANING

Within this section of the investigation the concern of the first study is to identify the degree of accuracy with which teachers assess their own success in explaining something to someone, such that understanding is achieved by the receiver, a question which is the concern of hypothesis H6. The second study seeks to reveal how much of what the giver of an explanation intends to communicate is actually received without distortion by the receiver, a question which is the concern of hypothesis H7.

1.1 Testing Hypothesis H6 - Teachers' Assessments of Their Success in Explaining Something to Someone

The hypothesis formulated to identify the degree of accuracy with which teachers assess their success as explainers is:

H6 That teachers' impressionistic assessments of their own success in explaining something to someone are an accurate source of information

1.1.1 The Sample

From within the group of teachers co-operating in the previous studies a number prepared to predict their success in explaining something to a class of pupils and to take part in the experiment were identified. Of these two failed to complete the experiment so that the sample consists of 10 primary and 26 secondary teachers, a total of 36 in all.

1.1.2 Procedures

Teachers co-operating in the study were asked to record their predictions of their own success in communicating intended meanings within an introductory explanation associated with a topic of their own choosing. The categories requested are the proportion of pupils who will (1) acquire all or much of what is intended (2) some of what is intended and (3) little or nothing of what is intended.

A set of guidelines was given to each teacher which they were asked to follow. These are set out below:

1. Decide upon a topic that arises within your normal programme that could be introduced readily through an explaining episode.

2. Identify not more than five concepts that pupils need to understand if they are to understand the topic in question and prepare an explanation around them such that they are explained during the episode.

3. Prepare the follow-up checks as indicated below.

   Check I: An instruction given to pupils immediately after the episode is concluded to try in their own words either to tell another pupil (while being recorded), or to write down what the teacher has been explaining. If this proves impossible to write down anything (however small or fragmented) they can remember about the explanation.

   Check II: A work sheet for use in the lesson, the satisfactory completion of which is dependent upon understanding the explanation given by the teacher.

   Check III: A short set of questions and/or statements to which pupils must respond given towards the end of the lesson that seeks to reveal their understanding of the essential concepts within the explanation.

4. Collate the outcomes, use a 10-point scale to assess the responses to each check and arrive at a score for each pupil.

5. Send the results and associated material to the researcher before the date appointed for the feedback session.

Teachers were asked to prepare and carry out the exercise within a period of six weeks. All but two managed to complete the work in this period and to attend the feedback session.

The results from the exercise were set beside the predictions made at the outset and discussed at the feedback session.

1.1.3 Methodological Limitations

1. It is likely that individual differences among pupils in respect of their aptitude for a subject, previous learning and past experience influence all learning situation and by implication the explaining episode in question. An attempt has been made to reduce these influences by ensuring that the teachers are making their predictions in relation to classes they know well or very well.

2. For reasons of convenience teachers will tend to take up the written option in Check I. This option may cause some pupils difficulties that have to do with use of formal language skills and not with their grasp of the explanation.

1.1.4 Results

In collating the results of the study it is intended to treat the sample as a group and not to be concerned with individual differences.(1) The assumption underlying this decision is that if the sample is typical of teachers in

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(1) Individual predictions and actual scores are given on p. 416 of the appendices.

general (and there is no reason to believe that it is not), the points at which the 36 sample teachers' predictions cluster are also likely to be typical.

Table 10 shows the numbers of teachers' predicting success at each interval of 10 between 0% and 100% for each category (Column A). The actual success is shown in the same manner (Column B).

TABLE 10: Teachers' Predicted and Actual Success Within Categories of Understanding

%	Category 1		Category 2		Category 3	
	A	B	A	B	A	B
100	0	0	0	0	0	0
90+	0	0	0	0	0	0
80+	1	0	0	0	0	0
70+	12	3	0	0	0	0
60+	12	11	1	0	0	0
50+	6	16	3	3	0	0
40+	4	5	7	9	0	0
30+	1	1	9	16	0	0
20+	0	0	16	8	0	1
10+	0	0	0	0	9	17
0+	0	0	0	0	17	18

No. in sample: 36

1.1.5 Discussion

Examination of Table 10 shows that all but 5 teachers expected 50% or more of their pupils to achieve the degree of understanding defined in category 1 as 'understanding all or much of what was intended'. Furthermore, 25 out of the sample of 36 teachers expected the proportion of pupils in this category to be between 60% and 80%. The actual scores for all but 4 teachers show the proportion of pupils in this category to be between 40% and 60%.

Differences between predicted and actual figures in categories 2 and 3 reflect this modification. In category 2 the bulk of predictions lie between 20% and 30%; the actual scores between 30% and 40%. In category 3 the predictions of 27 out of the 36 teachers in the sample lie between 0% and 10%, while half the actual scores are at 10% or more.

Bearing in mind that category 2 is defined as having some understanding and category 3 as having little or no understanding something approaching half the pupils in the classes involved did not acquire satisfactory understanding of the meanings communicated by teachers in the sample. This appears the more significant when it is remembered that the teachers selected their own topics for the exercise and that they were aware that the objective was to explain something to a class known to them as best they could.

The results as they stand do no more than indicate the existence of a gap between what the teacher intends to communicate in the explanation and what the pupils actually receive. To understand more about the nature of the gap it will be necessary to analyse pupil responses using an appropriate model and this will be attempted in the next study.

1.1.6 Conclusions

Teachers tend to overestimate the proportions of their pupils who achieve good or satisfactory understanding of their explanations. There is a corresponding under-estimation of the proportions of pupils who achieve only some, little or no understanding. Bearing these points and the actual scores in mind, it cannot be said that teachers' predictions are unreliable. On the other hand, they cannot be deemed an accurate assessment of the situation and, thus, the hypothesis H6 is rejected.

1.2 Testing Hypothesis H7: Variations in Pupils' Understanding of Their Teacher's Explanations

The study seeks to reveal more about the nature of the understanding that pupils acquire from an explaining episode, when they fail to receive the meanings intended by the giver of the explanation, in this case, the teacher. The hypothesis formulated to reveal the nature and distribution of any variations that may exist is:

H7 That the understanding achieved by individual pupils of an explanation given by their teacher to the class demonstrates considerable variation

1.2.1 The Samples

A group of 5 primary and 15 secondary teachers drawn because of their willingness to co-operate further from the sample of 36 teachers and their classes used in the study that tested hypothesis H6 comprise the sample.

The material for analysis comprises the relevant pupil responses to the 'checks' used in the last study to identify three categories of understanding.

1.2.2 Analytical Model

The analysis of pupil responses to an explaining episode carried out by the present writer and described on p. 170 provides seven categories of understanding, which are:

A. Complete
B. Substantial
C. Partial
D. Substantial with some misinterpretation
E. Erroneous
F. Fragmentary
G. Absent

1.2.3 Procedures

The sample of teachers were given directions on the use of the seven categories of the model, to analyse their pupils' responses to the checks used to assess understanding of the explaining episode undertaken in the experiment testing hypothesis H6. They were asked to analyse the material and cautioned not to assume that each category would necessarily be represented nor expect the list of different kinds of understanding to be exhaustive.

A feed back session was arranged one month from the briefing which all teachers attended for the purpose of discussing results before handing them in for collation.

The results were collated and implications discussed at a second feedback session, one month after the first.

1.2.4 Methodological Limitations

1. As teachers undertook the analysis of their own material it is possible that errors of judgement and inconsistencies of interpretation may occur. Feedback sessions help to reduce this as difficulties associated with problems of this sort can be talked out.

2. In utilising analytical models it is necessary to make judgements against specific criteria. This introduces a degree of subjectivity which with certain exceptions it is impossible to eliminate.

1.2.5 Results

The table overleaf shows the number of pupils within each class whose understanding is in one or other of the seven categories.

TABLE 11: Variation in the Characteristics of Pupils' Understanding of their Teacher's Explanation

Teacher No. and Type		No. of Pupils in Class	No. of Pupil Responses in each Category A	B	C	D	E	F	G
Primary									
Biology	1	25	4	4	8	0	2	5	2
Humanities	2	17	4	5	3	1	0	3	1
Mathematics	3	29	3	7	7	2	1	6	3
Topic	4	15	4	6	2	1	0	2	0
Topic	5	22	5	5	4	2	1	3	2
Secondary									
Chemistry	6	19	3	4	5	3	0	2	2
English	7	24	5	6	7	1	0	3	2
Biology	8	32	3	5	10	2	3	5	4
Mathematics	9	27	6	6	6	1	2	3	3
Physics	10	23	5	3	9	1	0	3	2
English	11	16	4	6	4	0	0	2	0
Biology	12	28	2	8	6	3	2	4	3
History	13	19	5	5	5	0	1	2	1
Geography	14	31	6	7	7	2	2	3	2
Chemistry	15	25	1	2	10	2	2	6	2
Geography	16	23	6	6	8	0	0	1	2
Mathematics	17	27	2	4	9	2	2	6	2
Foreign Language	18	12	4	4	3	0	0	1	0
Physics	19	29	3	6	9	2	1	5	3
History	20	15	5	3	3	1	0	2	1
Totals			80	102	125	26	19	67	37

1.2.6 Discussion

Examination of Table 11 revels that 9 teachers have all seven categories of understanding represented and a further 7 have all but one category represented.

Two teachers have two categories which are without representatives and the remaining two teachers have three categories that are likewise empty. Thus, on the basis of this evidence it appears that variation in relation to pupil understanding is a commonplace phenomenon.

Category totals indicate that about one third of all pupils in the sample achieve complete or substantial understanding. The remainder either have further to go to acquire a satisfactory degree of understanding (partial and fragmentary categories C. and F.), or require re-teaching in order that misconceptions may be rectified (substantial with misconception and erroneous categories D. and E.). Furthermore, just under 10% of all pupils have failed to understand the meanings their teachers intend to communicate to a degree that suggests they have no understanding of the explanation (absent category G).

One other point worthy of note has to do with class size. While no absolutely clear pattern is revealed it does appear that larger groups, i.e. 27 pupils or more tend to have all seven categories represented and in all cases less than half the pupils acquire an understanding of their teacher's explanation that is complete or substantial. On the other hand, smaller classes, i.e. 12-17 tend to have the opposite characteristics. They have between 1 and 3 of the seven categories <u>not</u> represented, over half the pupils have complete or substantial understanding and between 0 and 1 pupil in each class acquires no understanding.

These trends are not repeated in categories F, which denotes fragmentary understanding. The scores appear higher in the larger classes but the proportions in large and small classes is about the same.

Errors associated with both category D (substantial with misconception) and E (erroneous) tend to be absent with smaller groups and the greatest number of pupils falling into the latter category is found to occur in the largest class in the sample. While it is not possible to tell from the results why class size may exert an influence, the discussions with the teachers concerned at feedback sessions identified possible factors associated with: attention, opportunities for pupil-teacher dialogue and range of ability, as providing some reasons. These and other relevant implications will be examined in the general discussion of the outcomes of the investigation planned for the next chapter. A final point concerns understanding in relation to specific subject areas. For explanations given by secondary teachers in the sample those concerned with Science tend to have all seven categories represented and smaller proportions of pupils within the complete and substantial categories A and B. There is a correspondingly large proportion of pupils in all the other categories that for one reason or another fall short of being satisfactory.

1.2.7 Conclusions

In relation to the seven categories of understanding defined in the model there is considerable variation among individual pupils with regard to their understanding of explanations given to their class by the teacher and, thus, the hypothesis H7 cannot be rejected.

In allowing the hypothesis H7 to stand, points worthy of note are, first, that large classes show more variation than small ones and have less success in achieving complete or substantial understanding for their pupils and, secondly, that at secondary level explanations in Mathematics and Science produce more variation in pupil understanding and have less success than arts subjects in achieving complete or substantial understanding.

2.0 FACTORS INFLUENCING THE EFFECTIVENESS OF ACTS OF EXPLANATION

The studies of this section are concerned with the identification and description of factors that contribute to or detract from effective explaining. In all cases it is the teacher's explanations that are being scrutinised, but the whole explaining episode is perceived as a dialogue involving explainer, explainee, and a context within which the dialogue takes place. The assumption is, therefore, that factors from each and all of these component parts exert an influence upon the success or otherwise of the act of explanation,

The first study, associated with hypothesis H8 takes the form of an experiment and is intended to shed light upon the effect of vocabulary choice upon understanding in Chemistry and Biology. The two studies associated respectively with hypotheses H9 and H10 involve the analysis of a small number of explanations in a range of subject areas but with a bias towards sciences to reveal their contextual (H9) and conceptual (H10) features.

2.1 Testing Hypothesis H8 - Vocabulary Factors in Explaining

Explanations are constructed out of words and, thus, if explainee understanding is the goal for the explaining episode the explainer must select words that are able to carry the message clearly and accurately. This involves taking account of more than the demands upon language of the message itself, it involves making a judgement about the extent of the explainee's language experience within the context in question. Failure to do this increases the risk that the explanation will not be understood, although it may be couched in clear 'correct' language.

Teachers, when giving explanations, utilise large numbers of words and, particularly at secondary level, introduce both technical and non-technical terms that are not in everyday use. Science teaching is an appropriate example employing as it does a high proportion of such terms and, thus, these subjects will be the major focus of the investigation.

It can be argued that technical terms serve a useful purpose in facilitating accurate communication between individuals familiar with their definitions, but this cannot occur when the meaning of a term is unknown to one of the participants.

When acting as explainers, teachers are often more aware of the difficulties explainees have in understanding technical terms than they are of the problem of non-technical but unfamiliar vocabulary. One of the purposes of the study is to demonstrate that pupils can have their understanding blocked by being confronted with words that are non-technical but unfamiliar. The subjects used for this purpose are Chemistry and Biology.

Another purpose of the study is to reveal the extent to which technical words and what Gardner (1972) calls non-technical words not readily accessible to pupils, are present in the sample of explanations obtained for use with the previous studies.

The hypothesis formulated to examine the effect of vocabulary choice upon understanding is:

H8 That features associated with teachers' choice of vocabulary influence the level of understanding gained by pupils from a message, and thus from an explaining episode.

2.1.1 The Samples

Teachers

Teachers who had provided secondary science explanations for previous studies and who were prepared to co-operate further, constitute the sample, a total of 6 teachers.

Explaining Episodes

The explanations obtained for study H3 and comprising explanations in the secondary age range for Mathematics, Physics, Chemistry, Biology, History and Geography, a total of 68, and the explanations obtained for study H7, a total of 6, constitute the sample.

2.1.2 Stimulus Material

1. Cassels and Johnstone's (1978) modified examination papers in 'O' Grade Chemistry. These comprise paired test sheets of the same examination questions. On each test alternate questions have been modified such that questions modified on Test A are left unmodified on Test B and vice-versa. Modifications take the form of replacement of an unfamiliar word or phrase with a more familiar one using positives to replace negatives and reducing length to diminish linguistic 'noise' (see pp. 316-18 of appendices).

2. A pair of test papers prepared as described above, in C.S.E. Biology. (See pp.319-21 of appendices).

2.1.3 Analytical Model

Gardner's (1972) list of words not readily accessible to pupils, obtained from a study of the vocabulary skills of pupils in the early part of secondary schools will be used to analyse the sample of explaining episodes (see pp.432-35 of appendices).

2.1.4 Procedures

1. Giving the Tests

The sample of 6 science teachers were given copies of either the Chemistry 'O' Grade papers or the C.S.E. Biology papers in accordance with their particular specialism and asked to give the tests under normal mock examination conditions to two similar groups of pupils in the final year of the appropriate subject.

2. Scoring and Collating the Results

Teachers were asked to score the tests, giving 1 for each item correct as indicated on the marking scheme and return them to the researcher for collation within one month of receiving the papers.

Collation of the results involved comparison of modified and unmodified questions across similar groups and across the total number of pupils answering in each subject. Final results are shown as the percentage correct for modified and unmodified questions.

3. Analysing Explaining Episodes

Explanations from study H3 were analysed by the researcher for non-technical words not readily accessible to pupils, using Gardner's Word List. Explanations from study H7, together with pupil responses to checks on these explanations were similarly analysed by the researcher and attempts made to corroborate examples of unfamiliar words affecting understanding, using pupil responses as a source of information.

2.1.5 Results

The questions that influenced pupil attainment by more than 10% are shown overleaf in Table 12 for both Chemistry and Biology tests.

The number of occurrences in subject explanations of words on Gardner's (1972) list of words not readily accessible to pupils is given in Table 13.

TABLE 12: Pupil Attainment on Original and Modified Questions in Chemistry and Biology Tests

Question No.	Chemistry Original	Correct Modified	Gain %	Question No.	Biology Original	Correct Modified	Gain %
1	30	46	16	1	57	68	11
2	36	52	16	2	51	62	11
4	78	92	14	4	65	80	15
6	55	69	14	5	48	59	11
7	52	64	12	9	31	47	16
8	64	75	11	10	45	56	11
10	66	78	12				

TABLE 13: Occurrences of Non-Technical Words not Readily Accessible to Pupils in Subject Explanations

	Mat	Phy	Che	Bio	His	Geo
Number of Explanations	13	13	13	13	11	11
Number of Occurrences of Words	10	19	23	23	1	10

2.1.6 Discussion

The difference in pupil performance for original and modified questions does not arise from any disparities between the groups, as within any group the same pupils tended to do better on modified questions in proportions that reflect the total group percentages.

Not all modifications gave some gain. For example, 'anode' paired with positive electrode in Chemistry, question 5, and retaining or removing 'reside' in Biology, question 7, made very little difference. The removal of negative forms improved scores in Chemistry more than in Biology. However, there were differences relating to the length and complexity of the particular questions which coupled with the presence or absence of the negative form could have been influential. The Biology question in which the negative form is changed is short and simple, whereas in Chemistry the question in which the negative form is changed is lengthy and complex.

Shortening a question to reduce linguistic 'noise', as in Chemistry, question 10, and Biology, question 5, appears to be one of the most effective ways of improving performance. However, changing just one word can at times make a marked difference as is evidenced by the improved attainment in Chemistry, question 4, and Biology, question 9.

The largest gains in attainment are obtained when questions are conceptually demanding, as in Chemistry, questions 1 and 2, where the scores are 30% and 46% and 34% and 52% respectively and in Biology, question 9, where the scores are 31% and 47%.

In the analysis of explanations relating to Gardner's list of words not readily accessible to pupils, the number of occurrences of words is moderately high in the science subjects. The implications of this in relation to possible vocabulary problems has to be appreciated with reference to the large number of unfamiliar technical terms present in the episodes plus a number of words equally likely to be not readily accessible that are not included on Gardner's word list.

There are fewer occurrences of words from the list in Mathematics than may have been expected and this possibly reflects contextual factors which will be revealed by analysis in the next study.

The distribution of occurrences in Geography is noteworthy. Six out of ten words occur in the explanation given in the H7 sample. Examination of all the Geography explanations reveals the nature of this explanation as being considerably more scientific than any other. The distribution of occurrences in Physics, Chemistry and Biology is reasonably uniform throughout all the explanations, there being rather more occurrences with older age groups.

History is unique in generally not utilising words from the list. This appears to reflect its narrative style which does not save it from heavy use of complex technical terms but does not lend itself to the employment of words of the type in question.

2.1.7 Conclusions

Pupils can be prevented from exhibiting scientific knowledge because the language of the question blocks the process. The heavy use of unfamiliar vocabulary in science subjects puts strains upon the language facility of most pupils and can act to distort meanings that teachers wish to communicate in their explanations. Bearing in mind the points raised above, the hypothesis H8 is allowed to stand.

2.2 Contextual Factors in Explaining Episodes

It is possible to argue, as does Wittgenstein (1967), that utterances have meaning only in the stream of life and to claim that those who do not actively promote this view would agree that context is of fundamental and central importance to the successful communication of one's meaning to another. Assumptions of this kind underlie the view offered in relation to hypothesis H9 which claims that to be effective, explaining something to someone must go on within a context that can be shared by both explainer and explainee. Moreover, it seems likely that logical organisation of conceptual material within an explanation will fail to have the desired impact when contextual awareness is clearly lacking.

The hypothesis formulatedto reveal contextual factors likely to influence success in explaining is:

> H9 That factors arising from context and situation influence the level of understanding achieved by pupils in explaining episodes

2.2.1 The Sample

Explaining episodes and 'checks' used to ascertain pupil understanding obtained for the study associated with hypothesis H7, constitute the sample. Reference is also made to the sample of explanations that satisfy Martin's Hypothesis 6, obtained for the study of Hypothesis H3.

2.2.2 The Analytical Model

The contextual model which is outlined in Chapter 5 (pp.171-72) and given in full in the appendices (p.314) is that associated with Halliday (1975[b]). Each of the three major categories it supplies, i.e. field, tenor and mode will be applied in turn to all the explanations to enable contrasts and comparisons to be made among the subjects represented.

2.2.3 Procedures

In analysing the explanations and outcomes from the sample associated with hypothesis H7, and where appropriate referring to certain explanations from the sample that satisfy Martin's Hypothesis six, the procedure given below has been employed:

1. For each explanation analysed, a description of the manner in which the episode has arisen and slots into the lesson is given.

2. The explanations are analysed for the three functions in the order:
   field of discourse, tenor of discourse, mode of discourse.

3. Each separate occurrence of an item or feature is counted, but where the number exceeds 10 it is referred to as 'numerous'.

4. The approximate length of each explaining episode is given by indicating the number of lines of text

utilised.

5. Each explanation is scanned twice in relation to each feature. Phenomena that do not appear to be accounted for by the categories are listed under 'points worthy of note'.

2.2.4 Methodological Limitations

In utilising analytical models it is necessary to make judgements against specific criteria. This introduces a degree of subjectivity which with certain exceptions it is impossible to eliminate.

2.2.5 Results

2.2.5.1 The Manner in which the Explanation arises in and slots into the Lesson

Mathematics: The explanation which lasts for approximately 72 lines of around 10 words each arises at the start of the lesson, the teacher using an anecdote from her own life to pose the question 'How can I say, they must have been selling at a loss?' The episode is sprawling in character, being a mixture of supplying information and of getting pupils to co-operate in working out examples. It is brought to a close by pupils being asked to complete the working out of a simple operation. Most of the rest of the lesson is taken up with pupils working out other examples and the teacher going round checking their understanding. A short conceptual test is given in the last ten minutes.

Physics: Pupils have been working for approximately twenty minutes on pieces of apparatus, following instructions given at the start of the lesson by the teacher and having written down what they had to do as 'method'. The teacher calls them back to their places and uses the outcomes from the practical exercise to answer a question about the nature of frictional force. There is much reference to the apparatus and pupil observations and the episode extends to 40 lines of 10 words. Pupils are asked to complete their results tables and to write a conclusion for the experiment before putting the apparatus away. The teacher gives a final resume of the work in the last five minutes of the lesson.

Chemistry: Arising as a new topic within a complex area of work ('liquids'), the explanation arises at the start of the lesson and extends to 34 lines of 10 words. The teacher 'warns' the class that the work is new and important for later work in Chemistry. Checks are made on previous knowledge and use is made of this to answer the question 'What is an acid?' The episode is terminated with short recall questions and the pupils form groups to attempt to set up apparatus that could be used to produce hydrogen, using the information supplied in the lesson.

Biology: Pupils have been checking experiments that were set up in the previous lesson. This involves simple tests for iodine and glucose respectively. The teacher calls pupils to their places and spends the first five minutes asking revision questions that lead up to the question with which the episode is concerned, i.e. 'Why is starch changed to glucose?' Further recall is promoted by requests to pupils to bring to mind the experiment, and the tests with which the lesson began. The teacher attempts in the next stage of the lesson to get the pupils to infer from the evidence of the tests the crucial difference between the molecular structure of starch and glucose and the implications this has for the process of digestion and absorption. The episode which extends to 51 lines of approximately 10 words, ends with a brief reiteration of the key points and pupils are asked to complete results, write their own conclusions and clear away their apparatus.

History: The explanation arises about one third of the way through a lesson. Pupils have been completing notes and are called by the teacher to attend so that they may acquire information seen as helpful in relation to a visit arranged for the following day. The teacher is concerned with making clear some of the events that lead up to the battle of Worcester and the form of the explanation is correspondingly ordered - a large number of points being made briefly and at a level that avoids going into depth. The episode extends to 51 lines of approximately 10 words and is completed with the promise that further discussion will take place after the visit. Pupils are asked to make their own lists of the events as they happened, which lead up to the battle of Worcester.

Geography: The explanation is introduced at the start of the lesson and leads up to answering the question 'What is our largest source of energy that is not fossil fuel?' The explanation goes on for 40 lines of approximately 10 words and attempts to make clear both how much energy comes from the sun and what happens to it. The episode closed with a reference to plant energy and then pupils are asked to try to draw their own pictorial representation of energy radiating from the sun and what this causes on earth. A short set of slides about solar energy is set up while pupils are working on their 'pictures' and these are run for the class until the end of the lesson.

2.2.5.2 Field of Discourse

Ideational Function

Although the manner in which each explaining episode arises within the context of the lesson and runs its course may differ, essentially the ideational function is the same for all. All explanations are concerned with phenomena arising within a subject discipline and are of the kind with which the subject would expect to deal, thus affording no surprises for learners or for the teachers themselves. The manner in which the ideational function is realised does differ both for reasons that have to do with individual teachers and the distinctive nature of the underlying question which the explanation seeks to answer. The range with regard to the latter are shown below:

TABLE 13: Showing Underlying and Subsidiary Question Types in Subject Explanations

Subject Explanation	Underlying Question	Subsidiary Questions
Mathematics	What-How	Numerous what-Information
Physics	What-Scientific	1 What-Scientific 1 Why-Deductive 1 What-Information
Chemistry	What-Scientific	1 What-Scientific 1 Why-Deductive 2 What-Information
Biology	Why-Functional	1 What-Scientific 2 Why-Functional 4 What-Information
History	Why-Genetic	1 What-How 2 What-Information 1 Why-Genetic
Geography	What-Information	1 Why-Deductive 2 What-How 2 What-Information

The features Halliday identifies as indicating the ideational function or field of discourse are given below for each subject in turn.

TABLE 14: Ideational Function in Subject Explanations

Habitual Collocations	Special Vocabulary	Habitual Collocations of Voice
Mathematics:		
In 40 out of 72 lines habitual collocations occur. Specific words occur between 1 and 3 times.	Present are 5 technical and 8 special non-technical words. Approximately half the words are familiar but have a highly specific meaning within the context. The degree of unfamiliarity of the remainder is high to moderately high.	The active voice is employed on all but 1 occasion. Non-finite verbs number 13.
Physics:		
In 26 of the 40 lines habitual collocations occur. Specific words occur between 1 and 5 times.	Present are 8 technical and 20 special non-technical words. The degree of unfamiliarity is high for both types of words.	The active voice is employed on 8 occasions. The passive voice on 4 occasions. Non-finite verbs number 12.
Chemistry:		
In 28 out of 34 lines habitual collocations occur. Specific words occur between 1 and 6 times.	Present are 11 technical words and 15 special non-technical words. The degree of unfamiliarity is moderately high.	The active voice is employed on all but 1 occasion. Non-finite verbs number 3.
Biology:		
In 35 out of 51 lines habitual collocations occur. Specific words occur between 1 and 6 times.	Present are 10 technical words and 17 special non-technical words. About half the words are moderately familiar but have a highly specific meaning within the context. The degree of unfamiliarity of the remainder is also moderately high.	The active voice is employed on all but 1 occasion. Non-finite verbs number 3.

Habitual Collocations	Special Vocabulary	Habitual Collocations of Voice
History:		
In 22 lines out of 51 habitual collocations occur. Specific words occur between 1 and 6 times.	Present are 9 technical words and 10 special non-technical words. Most words are familiar but have a highly specific meaning within the context. A moderately high degree of unfamiliarity occurs twice.	The active voice is employed on all but 2 occasions. Non-finite verbs number 21.
Geography:		
In 24 out of 40 lines habitual collocations occur. Specific words occur between 1 and 5 times.	Present are 5 technical words from the subject in question, 8 technical words from other disciplines (notably physical science) and 14 special non-technical words. Approximately one-third are familiar but have a highly specific meaning within the context; one-third are moderately unfamiliar and the remaining are unfamiliar	The active voice is employed on all but 2 occasions. Non-finite verbs number 8.

N.B. Lists of technical and special non-technical words are in the appendices. (See pp.436-37).

2.2.5.3 Tenors of Discourse

TABLE 15: Inter-Personal Function - in Subject Explanations

a) Personal Tenor Features	Subjects Mat	Phy	Che	Bio	His	Geo
Informal						
Contractions	22	5	5	7	3	8
Phrasal Verbs	7	2	0	6	11	2
Idioms and 'slang'	1	2	1	4	4	1
Formal						
Unspecified origins	7	6	7	8	6	7
Unspecified Destinations	23	1	0	1	1	23
Source and address irrelevant to message	3	14	8	11	29	3
Personal						
1st and 2nd person reference	37	12	5	15	9	11
1st and 2nd person pronouns	13	1	4	3	1	3
3rd person reference to named individuals	0	8	6	7	4	4
Impersonal						
3rd person evading reference to author and addressee	1	12	10	6	24	7
Passive voice	1	4	1	1	2	2
Non-finite verbs	13	12	3	3	21	8

b) Functional Tenor

The situational factor involved in this tenor of discourse are related to what the user is trying to do with language in a way that is different from the ideational function in the field of discourse. In each episode in the sample the user is involved in teaching and, furthermore, in the activity of explaining. However, this does not lead to identical patterns of significant situational and linguistic variation as can be seen from examination of the analytical outcomes concerned with this category that are given as follows for each subject:

TABLE 16 : Functional Tenor in Subject Explanations

Mathematics:

T	Offering exemplar from everyday life.
T	Questioning (subsidiary to underlying question).
P1	Responding correctly.
T	Confirming and enlarging.
T	Explaining - how, exposing.
T	Questioning, (subsidiary to underlying question).
P2	Questioning, seeking clarification.
T	Responding, offering apology and clarifying.
P2	Responding correctly.
T	Confirming and enlarging.
T	Explaining-how, exposing.
T	Questioning for feedback.
P3	Responding correctly.
T	Confirming and Explaining-how.
T	Questioning for feedback.
P4	Responding correctly.
T	Confirming and enlarging.
T	Explaining-how, exposing.
T	Propositioning.
T	Questioning.
P5	Responding correctly.
T	Confirming and rewarding.
P5	Responding.
T	Confirming and rewarding.
T	Showing how.
P6	Responding correctly.
T	Responding and giving instructions.

Physics:

T	Controlling.
T	Questioning for feedback.
T	Questioning - (underlying questions).
P1	Responding - correctly.
T	Confirming and enlarging.

T Questioning (underlying question).
P2 Responding correctly.
T Questioning - seeking opinion.
P3 Responding incorrectly.
T Responding to pupil response and confirming earlier correct response.
T Explaining - (What-scientific) and exposing.
T Questioning (subsidiary to underlying question).
P4 Responding correctly.
T Questioning (subsidiary to underlying question).
P4 Responding correctly.
T Questioning (subsidiary to underlying question).
P5 Responding, admitting ignorance.
T Admonishing and giving reason.

Chemistry:

T Introducing.
T Reviewing previous knowledge.
T Questioning. Checking on previous knowledge.
P1 Responding correctly.
T Confirming and enlarging.
T Questioning checking on previous knowledge.
P2 Responding in part correctly.
T Confirming part, questioning further by qualifying.
P2 Responding and accepting qualification.
T Questioning, seeking greater specificity.
P3 Responding correctly.
T Confirming and enlarging.
T Questioning subsidiary to underlying question.
P4 Responding correctly.
T Confirming and enlarging.
T Explaining underlying question (what-scientific) and exposing.
T Questioning for recall.
P5 Responding correctly.
T Confirming and enlarging.
T Questioning for recall.
P6 Responding.
T Confirming and modifying.

Biology:

T Controlling.
T Reviewing previous learning.
T Questioning for recall.
P1 Responding correctly.
T Confirming and enlarging.
T Questioning for recall.
P2 Responding correctly.
T Confirming and enlarging.
T Questioning for recall.
P3 Responding correctly.
T Confirming and enlarging.
T Questioning for recall, subsidiary to underlying question.
P4 Responding correctly.
T Confirming and enlarging.
T Recapitulating with regard to practical work.
T Giving directions.
T Questioning. Nature of underlying question.
P5 Responding correctly.
T Confirming and asking for response to underlying question.
T Pointing out evidence.
T Questioning. Subsidiary to underlying question.
P6 Responding correctly.
T Questioning. Subsidiary to underlying question.
Ps Responding correctly.
T Controlling.
T Questioning. Subsidiary to underlying question.
P7 Responding correctly.
T Confirming.
T Questioning. Subsidiary to underlying question.
P7 Responding correctly.
T Confirming.
T. Questioning. Subsidiary to underlying question.
P5 Responding correctly.
T Questioning. Underlying question.
T Motivating pupils to respond.
T Explaining underlying question (why-functional) and exposing.
T Questioning. Subsidiary to underlying question.

P Responding.
T Confirming.
T Giving directions.

History:

T Introducing and preparing for future event.
T Questioning. Subsidiary to underlying question.
P1 Responding in part correctly.
T Modifying pupil response.
T Questioning. Repeat of previous subsidiary question.
P2 Responding correctly.
T Confirming and explaining (What-genetic) - employing expository function for 21 lines.
T Questioning. Subsidiary to underlying question.
P3 Responds correctly.
T Confirming and Explaining - Employing expository function for 6 lines.
T Questioning. Underlying question.
P4 Responding correctly. Offering further information.
T Confirming expected response.
T Explaining - employing expository function for 5 lines.
P5 Questioning, seeking discussion of future events.
T Responding, promising discussion after visit.

Geography:

T Introducing.
T Questioning, checking on previous knowledge.
P1 Responding correctly.
T Confirming and enlarging.
T Questioning, checking on previous knowledge.
P2 Responding correctly.
T Confirming.
T Questioning. Underlying question (What-information).
T Explaining and exposing.
P3 Questioning - Seeking information.
T Responding - Explaining and exposing. Underlying question.
P4 Questioning. Seeking information.
T Responding. Explaining and exposing underlying question.

T Questioning. Seeking to know what further information is needed.
P5 Questioning. Seeking confirmation.
T Confirming and enlarging.
T Questioning. Subsidiary to underlying question.
P6 Responding correctly.
T Confirming and enlarging.

2.2.5.4 Mode of Discourse

Textual Function

(a) Spoken.

All episodes consist in spoken text and all involve a teacher and pupils. Distinctions exist among the subjects represented with regard to the proportion of the dialogue that is uttered by the teacher, whether the activity is spontaneous or non-spontaneous, and if it is conversing or monologuing. Details of these features are given below.

Although the language used in the episodes is not considered to be 'written to be spoken' - category (b), it is possible that teachers have made notes or, indeed, written out sections of their explanations in record books or as lesson notes. Thus, the likelihood that the written mode has influenced the style of discourse cannot be discounted and will be discussed in the next section.

TABLE 17: Analysis of Mode of Discourse - (a) Spoken in Subject Explanations

Feature	Subjects					
	Mat	Phy	Che	Bio	His	Geo
No. of words in episode	702	339	270	429	462	384
No. of words in teacher's contribution	682	289	244	373	431	348
No. of words in pupils' contribution	20	50	26	56	31	36
No. of pupil initiated sequences	1	0	0	0	2	3
No. of spontaneous sequences	1	0	2	3	3	4
No. of lines of text used for conversing	47	20	23	45	17	21
No. of lines of text used for monologuing	25	20	11	6	34	19

2.2.6 Discussion

The material set out in the results includes features that are shared by all episodes as well as a number of distinctions peculiar to subjects because they reflect their characteristic modes of knowing or processes and methods. It is also the case that teacher style, possibly reflecting personality and individual perception of role, also influence language behaviour and, thus, certain categories, notably tenors and mode of discourse.

The manner in which the explanation arises and is slotted into the lesson follows one of two patterns. All but two teachers utilise the start of the lesson for introducing the episode. Feedback from teachers suggests that one of the reasons for this is that pupil attention is greater at this point and another stresses the dependence of the rest of the work planned upon the pupil's grasp of certain key ideas.

Physics and Biology set up a practical session as a means of providing information that is fundamental to their explanations and which they utilise during the episode. In Chemistry on the other hand, the explanation is offered before pupils start work on an experiment. This is common practice in Chemistry and may reflect the teacher's awareness of the problem pupils face in inferring with any degree of confidence what is actually taking place during a reaction without having some information about its nature. Looking back over the explanations obtained for Hypothesis H3 (hereafter referred to as the H3 sample) the episode is typical of Chemistry explanations.

Two features that occur frequently as part of the structure of the episode are a period of questioning by the teacher that seeks to reveal relevant previous knowledge and towards the end of the episode a period of questioning that summarises the points that have been made while obtaining some feedback about pupil understanding.

The episodes are concerned with answering different types of underlying questions, but each one is highly typical of the kind of explanation that the discipline seeks to offer. The pattern of the subsidiary question types is also interesting. Chemistry and Physics have the same types, which reflect their scientific nature. Biology continues to demonstrate its concern with why-functional questions and Geography has a why-deductive question which reflects the scientific element in this explanation.

In realising the ideational function, variations in the manner in which each subject employs the features tend to be matters of degree rather than difference. The incidence of habitual collocations and special vocabulary is high for all subjects but particularly so for the sciences. With the exception of the Mathematics episode which has relatively fewer technical and special non-technical words than other subjects, the major distinction among subjects relates to the degree of unfamiliarity of the vocabulary. In Physics it is very high and moderately high for Chemistry and Biology. Explanations from these subject areas in the H3 sample show similar degrees of unfamiliarity in their vocabularies.

Geography adds to its own five technical and fourteen special non-technical words, eight more which are unfamiliar from other subject areas, notably Physics and Mathematics, and, thus, adds to its vocabulary burden; a situation that may well occur whenever Geography inculcates a large element of scientific phenomena into its field of interest.

History shares with Mathematics the distinction of having a vocabulary that consists of more familiar words. However, these words tend to have a highly specific meaning within the context. This is a problem common to all subject episodes and to the explanations in the H3 sample. Where the word in question is a defined concept as is often the case in History, the problem is exacerbated because of the difficulty of agreeing positive and negative instances.

Habitual collocations which occur in all episodes are in the main highly subject specific. There are, however, groups of words like information, apparently, causes, category, indicate, produces, which appear in many episodes and may, in fact, be associated with offering certain kinds of explanation.

The inter-personal function and the situation function revealed through analysis of the tenors of discourse are common to all the subject explanations, but this does not mean that they are realised in each episode in exactly the same way.

Inter-personal relations contain a degree of formality and impersonality sufficient to indicate that the participants are neither intimates nor of equal status. The use of 'Sir', 'Miss' and 'please' before answering or asking a question denote a degree of ceremony. This may occur in lessons where the teacher used Christian names, or surnames (usually only for boys), or neither, and thus reflects as much the pupils' perception of their role and status in relation to the teacher as any desire on the teacher's part to promote ceremonial in order to highlight differences in status.

Only Mathematics adopts a more generally personal style, reflecting its conversational mode but this does not eliminate all formal structures as is evidenced by the presence of twenty-three unspecified destinations. The remaining subjects adopt a moderately personal style and a moderate to high degree of formality, the latter tending to occur during the period when the underlying question is being explained. What use of passive there is tends also to be associated with this period, while non-finite verbs are more generally used throughout the episodes. The functional tenor clearly confirms the teacher as controller of the language acts in the episodes. In the main this is done by questioning followed by the confirming of and enlarging upon pupil responses. Pupils are expected to respond in a predictable manner that gives evidence of their understanding of what is being explained.

On the few occasions that pupils initiate a sequence a question is asked that seeks clarification of something the teacher has done or requests further information. There is one occasion in History when a pupil attempts to offer information but this is not taken up.

The subject patterns associated with what the teacher is doing with language at any given time have much in common and a number of variations.

The pattern of; questioning, followed by the confirming of a pupil's response, followed by some enlargement of what has been said to include points not made by the pupil is common. However, Mathematics tends to ask more questions to obtain immediate feedback in relation to one step in the total operation of explaining - how.

Physics, Chemistry, Biology and, in the particular episode used in the analysis, Geography tend to use subsidiary questions that have some bearing on the underlying question, thus clarifying the degree of understanding the pupil has of the underlying question as well as the subsidiary question that is being put. This is also typical of the science explanations in the H3 sample and reflects their conceptual complexity.

Teacher's responses to pupil initiated questions demonstrate a concern both with answering the immediate question and then enlarging on it, often so as to relate it to the underlying question.

Most teachers employ an expository mode when giving their explanation of the underlying question. This was also employed in relation to subsidiary questions requiring further elaboration to link them with the underlying question.

All episodes employ the same mode of discourse which is for reasons outlined before the analysis considered to be spoken but with possible influence from the written-to-be-spoken category upon some of the features.

Undoubtedly, teachers utilise most of the talking time in an episode. The highest proportion of talk contributed by pupils is around 15%. What may be somewhat unexpected is that this percentage occurs in Physics where conversing and monologuing are equally represented. Mathematics, on the other hand, has the lowest proportion of pupil talk, around 2%, although using the conversing mode almost twice as often as the monologuing mode and with the highest proportion of personal and informal features of any subject in the sample. Other points worthy of note are that Chemistry and Biology employ conversing for the greater part of their episodes, while the History episode is largely monologuing.

Spontaneous teacher produced sequences tend to occur when a pupil responds unpredictably, or fails to respond at all. He may ask a question, offer information or say he doesn't understand all activities that call for some ad hoc response from the teacher. Otherwise, most of what the teachers say in the episodes has been thought out before or prepared earlier, possibly by being written down, and cannot be regarded as spontaneous. Indeed, if non-spontaneous is taken to cover anything that has been thought about and organised in advance then most statements central to the underlying question would not qualify as spontaneous. Indeed, the more the teacher has 'rehearsed' the explaining in order that the main points can be presented in some logical sequence helpful to the learner, the less spontaneous the spoken words of the explanation will be.

2.2.7 Conclusions

Teacher initiated explanations arise and are slotted into lessons in a limited number of ways, two common ones being to introduce an explanation at the start of a lesson or to follow practical work that provides relevant information for the explanation.

The type of underlying question with which the explanation is concerned influences: the range of the subsidiary questions generated, most features in the field of discourse, the degree of formality in the personal tenor and, to a lesser degree, spontaneity and the monologuing features in the mode of discourse.

The ideational function is realised in all subjects through habitual collocations and technical and special non-technical words. Many of these are unfamiliar, the special non-technical words appearing to be as difficult for pupils to understand as the technical vocabulary.

The inter-personal function is characterised by frequent use of personal features and the presence of colloquial features. The level of formality is moderately high and for the sciences this is consistent with the level in the H3 sample.

Teachers in controlling the functional tenor of discourse use questioning, confirming, enlarging and exposition. Teacher and pupil contributions are not of equal proportion, pupils rarely contribute more than ten percent of what is spoken in an episode. The teacher fulfils the role of initiator of spoken sequences, pupils the role of receiver and responder.

Employment of a high proportion of conversing as a feature of the mode of discourse does not necessarily produce a corresponding increase in the size of the pupils' contribution. A relationship does exist between conversing and large use of personal features, and between monologuing and large use of formal features.

2.3 Testing Hypothesis H10 - Conceptual Factors in Explaining Episodes

Within this section of the investigation the concern is with intra-organism functions in that it seeks to understand the intellectual cognitive and verbal demands made upon pupils' thinking by the learning involved in understanding a specific explanation and to evaluate their appropriacy for the pupils in question. In doing so the age and conceptual development of the pupils is taken into account and the assumption made that to be effective explanations must be pitched at a conceptual level to be decided by the stage of development and state of knowledge of the pupils and not by the teacher's specialist knowledge and understanding of the subject field.

The specific hypothesis formulated to examine how factors of this kind influence pupil understanding of explanations is:

H10 That factors associated with pupils' conceptual development and their ability to employ learned capabilities and mental operations influence the level of understanding achieved by them in explaining episodes.

2.3.1 The Sample

Explanations, together with the checks used to reveal pupils' understanding, obtained for the study testing hypothesis H7, constitute the sample of material to be analysed.

Reference is also made, as considered necessary, to the explanations that satisfy Martin's Hypothesis six, obtained for the study testing hypothesis H3. These explanations will be referred to in the study as the H3 sample.

2.3.2 Analytical Model

The adaptation of Gagné's model of learning, outlined on p.173 and given in full in the appendices (see p.315).

provides the categories for the analysis.

2.3.3 Procedures

1. For each subject in turn, the explanations are divided into sections and each section scanned in order to reveal the occurrence of intellectual, cognitive and verbal features.

2. The features obtained from the initial scanning are grouped into the categories identified by Gagné as 'learned capabilities', i.e. intellectual skills, cognitive strategies, and verbal information.

3. The sections are scanned to reveal the mental operations required of pupils during the explaining episodes, i.e. attending, discriminating, encoding, storing, retrieving and transferring.

4. A number of pupil responses to the checks used by teachers to assess their understanding are scanned in relation to the features of the learning capabilities and the mental operations, with a view to identifying specific problems influencing understanding.

2.3.4 Results

The outcomes from the conceptual analysis of explaining episodes are given in Table 19 and the outcomes from the analysis of wrong responses given by pupils are given in full immediately after the check with which they are associated.

TABLE 19: Conceptual Analysis of the Learning Demands of Subject Explanations

Subject	Features	Learned Capability	Operation
Mathematics			
Section 1	Discriminations Concrete concepts Defined concepts	Intellectual skills	Attending Discriminating

Subject	Features	Learned Capability	Operation
	Identifying a problem type Identifying appropriate rules	Cognitive strategies	Retrieving Transferring
	Facts Connected discourse	Verbal information	
Section 2	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Encoding Storing
	Identifying appropriate rules Applying appropriate rules	Cognitive strategies	
	Facts Connected discourse	Verbal information	
Section 3	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Discriminating Retrieving Transferring Encoding Storing
	Identifying appropriate rules Applying appropriate rules		
	Facts Connected discourse	Verbal information	
Section 4	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Discriminating Retrieving Transferring
	Applying appropriate rules	Cognitive strategy	
	Facts Connected discourse	Verbal information	
Physics			
Section 1	Defined concepts Rules Higher order rules	Intellectual skills	Attending Discriminating Retrieving Transferring
	Identifying problem Identifying appropriate rule	Cognitive strategies	
	Facts Connected discourse	Verbal information	

Subject	Features	Learned Capability	Operation
Section 2	Discriminations Defined concepts Rules Higher order rules	Intellectual skills	
	Bodies of knowledge	Verbal information	Attending Discriminating Encoding Storing
Section 3	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Retrieving Discriminating
	Applying appropriate rule to problem	Verbal information	Transferring Encoding Storing
	Facts Connected discourse Bodies of knowledge	Verbal information	
<u>Chemistry</u>			
Section 1	Defined concepts Rules	Intellectual skills	Attending Encoding Storing
	Bodies of knowledge	Verbal information	
Section 2	Defined concept Rules	Intellectual skills	Attending Discriminating Retrieving Transferring
	Identifying a problem type Identifying appropriate rules	Cognitive strategies	
	Facts Connected discourse	Verbal information	
Section 3	Defined concepts Rules Higher order rules	Intellectual skills	Attending Discriminating Retrieving Transferring
	Bodies of knowledge	Verbal information	Encoding Storing
<u>Biology</u>			
Section 1	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Discriminating Retrieving
	Facts Connected discourse	Verbal information	

Subject	Features	Learned Capability	Operation
Section 2	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Discriminating Retrieving Transferring
	Identifying a problem type Identifying appropriate rules Applying appropriate rules	Cognitive strategies	
	Facts Connected discourse	Verbal information	
Section 3	Defined concepts Rules Higher-order rules	Intellectual skills	Attending Discriminating Encoding Storing Retrieving Transferring
	Identifying a problem type Applying appropriate rules	Cognitive strategies	
	Bodies of knowledge	Verbal information	
History			
Section 1	Concrete concepts Defined concepts	Intellectual skills	Attending Discriminating Encoding Storing Retrieving Transferring
	Identifying a problem type	Cognitive strategies	
	Connected discourse	Verbal information	
Section 2	Concrete concepts Defined concepts	Intellectual skills	Attending Encoding Storing
	Bodies of knowledge	Verbal information	
Section 3	Concrete concepts Defined concepts	Intellectual skills	Attending Discriminating Retrieving Transferring Encoding Storing
	Bodies of knowledge	Verbal information	

Subject	Features	Learned Capability	Operation
Geography			
Section 1	Concrete concepts Defined concepts	Intellectual skills	Attending Discriminating
	Identifying a problem type	Cognitive strategy	Retrieving Transferring
	Facts Connected discourse	Verbal information	
Section 2	Concrete concepts Defined concepts Rules Higher order rules	Intellectual skills	Attending Discriminating Encoding Storing
	Bodies of knowledge	Verbal information	Retrieving Transferring
Section 3	Concrete concepts Defined concepts Rules	Intellectual skills	Attending Discriminating
	Identifying a problem type Applying an appropriate rule	Cognitive strategies	Encoding Storing Retrieving Transferring
	Bodies of knowledge	Verbal information	

The outcomes from the analysis of pupil responses to teacher checks after explaining episodes follow. They are not the responses of one pupil, they have been selected from a range of unsatisfactory responses given by pupils in each subject sample:

Conceptual Analysis of Unsatisfactory Pupil Responses to Each Question of Checks, for the Subjects Represented

Mathematics

CHECK III. Mathematics Explanation

1. What is another way of writing 8 out of 100? 100 - 8
2. What is an improper fraction? One with a number and a fraction.
3. Which is usually larger, the cost price or the selling

price? Cost price.

4. What do we call money a shopkeeper makes on the goods he sells in his shop? Cash.

5. If a shopkeeper wants to make 20 percent on each item that he paid £1 for to the manufacturer, what must he sell each one for? -

   What is his selling price as a percentage? 25%

6. In deciding what percentage to set the selling price, what is always considered to be 100%? the price.

7. What do we call a fraction which consists of a whole number and a part of that number? improper

8. Put down the sum as you would if you were finding 75% of £15. (Do not work it out). $\frac{75}{15} \times 100$

9. What do you know about the selling price of an article when a shopkeeper sells at a loss? It's cheaper.

1. Inability to discriminate. Pupil has not yet grasped the defined concept of 'percentage' and is confusing the notion of 'out of' with minus or from, which has led to faulty encoding.

2. Faulty discrimination between two distinctive fraction types.

&

7. In 2, association of mixed with number and fraction is not being made while the pupil confusing 'improper'(fractions) has failed to build into the encoding process an identifying clue that would avoid confusion with 'mixed'.

3. Faulty discrimination. Failure to discriminate between cost price and selling price suggests that the pupil has failed to form defined concepts central to the explanation.

4. Failure to attend to the significant clue provided by the word 'makes' which indicates the nature of the word to be retrieved.

5. The inability of a pupil to answer anything to this question suggests a level of understanding that is at best fragmentary. This has affected encoding to a degree that has made storage and retrieval impossible.

   Part 2 of question 5 appears to be a guess, the percentage chosen can be attributed possibly to the large use of 25% in the explanation given by the teacher. The choice is made by the teacher to keep numbers simple to work out on the spot, but the repetition of similar numbers may have caused discrimination problems for pupils.

8. This shows a discriminatory confusion about percentages similar to that in question 1. The pupil has also failed to understand, encode and store the rule and, thus, cannot retrieve it and apply it to the problem.

9. Failure to take account of the specific technical nature of the words 'loss' and 'selling price' within the context. The answer is acceptable in an everyday sense but mathematically the pupil demonstrates no awareness of the link between the words and their further relationship to the unstated 'cost price', although from the explanation they would be encoded as an habitual collocation.

Physics

CHECK III. Physics Explanation

1. In Physics, friction is considered to be a... problem.
2. What do polished surfaces look like under a microscope? shiny.
3. When one solid rests on another what has to happen in order that the upper one can be supported? It has to take the pressure.

   What is there at the places of contact? ____ points.
   What must happen before one surface can move over another? You have to push it.

4. When you start something moving on the apparatus used in the experiment when is the reading on the spring balance greatest? When it's moving fast.
   What does this tell us about friction at that point? It's very strong.
5. Does friction remain constant? Yes.
6. Is it possible to get rid of friction completely? -
7. If the difference between the peaks and troughs of a surface are measured - what sort of scale is used? A microscope.

1. The response though not incorrect gives prominence to a peripheral attribute and fails to offer the significant criterial attributes with which the explanation is concerned. This may be to do with either the attending or discriminating operation.

2. Failure to encode and store significant information that is fundamental to understanding the explanation.

3. In parts 1 and 2 lack of specificity generates doubt as to whether or not the pupil has understood the nature of the defined concept 'friction' well enough to encode the information accurately. In part 3 there is failure to discriminate between the method of investigating and the implications of the evidence.

4. An example of a misconception which is the very opposite of the relationship that the experiment demonstrates. This is confirmed in the second part of the question, answered by the same pupil.

5. As all the experimental evidence points to variation in frictional force, failure to respond correctly suggests lack of understanding of the defined concept 'constant'.

6. Inability to offer an answer suggests an inability to

transfer what has been encoded and retrieved to a specific problem. This could mean that encoding has been faulty or that the pupil has difficulty with the mental operation of synthesis.

7. Pupil has failed to encode and retrieve the concept 'atomic microscope'.

Chemistry

CHECK III. Chemistry Explanation

1. Some liquids are acids, as what other categories can the remaining liquids be classified? Poisons.

2. Why is it important to know in which category a liquid belongs? It could be dangerous.

3. State a test for an acid. A bit of pink paper turns red colour.

4. What substances do acids corrode? Metals.

   What is happening during the fizzing that takes place when the process of corrosion is going on? It burns them away.

   What is left when the fizzing stops? Nothing.

5 Complete the definition - An acid is a substance which generates gas. ______

6. What do liquids that are of the opposite sort to acids generate? - ______

7. If you dropped some acid on your skin, what would be the best thing to do to prevent a burn? Put a burn dressing on.

1. Failure to discriminate between significant classes of criterial attributes and peripheral information which

causes faulty encoding.

2. Failure to encode significant criterial attribute in relation to underlying question of the explanation.

3. Faulty discrimination of an essential distinction between similar phenomena, or failure to build into encoding procedure some clue to facilitate recognition of the appropriate information.

4. Either there is a failure to form satisfactorily the defined concept of 'corrosion' or failure in attending to the last part of the message where the process of corrosion is mentioned. The second part of the question is answered by the same pupil and tends to support the former proposition as there is a clear lack of understanding of the process which is fundamental to the underlying question.

5. Insufficient specificity points to shaky conception formation in relation to the defined concept of 'acid'.

6. Inability to offer a response may be due to inability to retrieve the concept of alkali or the pupil may retrieve this concept successfully but have failed to encode successfully the significant criterial attribute of an alkali.

7. Inability to synthesise using available scientific information suggests that concepts of acidity, alkalinity and neutrality still not sufficiently well formed to be encoded with an appropriate degree of prominence.

Biology

CHECK III. Biology Explanation

1. How do teeth help the process of digestion? By chewing.
2. What is produced in the mouth when we chew? Spit.

Give two ways in which it helps us in the digestion of food.

i. Makes food soft.

ii. -

3. What happens to starch in the mouth? It's chewed up.

4. Which of the solutions in the parchment diffusion shells entered the water in the beaker? Fehlings.
What did you use to test for it? Blue colour.
How did you know it was present? Went black.

5. Why can one solution go through the parchment shells and not the other? --
Where in the process of digestion is it necessary for this process to happen? In the mouth.

1. Lack of specificity contributes to the superficiality of the answer which fails to get to grips with the consequences for digestion of the action of the teeth.

2. The term saliva has not been encoded but the pupil has made some contact with the location and function of the concept at a more familiar everyday level which does not extend to accurate encoding of the bio-chemical processes involved.

3. Failure to form the defined concepts of the bio-chemical processes with which the question is concerned. Understanding and subsequent encoding of this phenomenon is fundamental to the success of the explanation as it is the underlying question of the episode. The response in question at best reflects only fragmentary understanding.

4. Failure to discriminate between the indicators and the phenomena being indicated adversely influences accurate encoding of the implications of a practical demonstration.

The second and third part of the question as answered by the same pupil confirms that the use of two different indicators each paired with a specific solution for comparative purposes has caused confusions which have not been resolved during the encoding operation.

5. In offering no response to the question either the pupil has failed to infer and thus to encode, the implications afforded by the experimental evidence, or, in encoding, has failed to build in a satisfactory discriminatory clue to aid recall when retrieving the results of the two tests. The former seems most likely as in the latter case the pupil is likely to make a guess at the response.

   In the second part there is a failure to discriminate between the process described in the question and the first stage of digestion. As this is the same pupil answering who failed to offer a response to the first part of the question, this appears to confirm the interpretation that the pupil has not encoded successfully the evidence of the practical experiments.

History

CHECK III. History Explanation

1. How is our country governed today? Our country is the Queen's.
2. How is our government chosen? By the Prime Minister.
3. Can you give any reasons why King Charles was so unpopular. He was unpopular when he had his head cut off.
4. What is a civil war and why is it worse than other wars? A lot of people get killed.
5. What was another name for the Cavaliers? Horsemen.
6. Why were they called this? They fought on horseback.
7. Who were the Roundheads? Men with short hair.

8. Who was their leader? King Charles.
9. What happened to Charles the First? He got big-headed and was killed.
10. What happened later that led to the battle of Worcester? He came back with an army.

1. Failure to attend to teacher's description of the position of the Queen and to encode the defined concepts 'ruler' and 'nominal head'.

2. Problems of discrimination exist in this question. The pupil has chosen to take the defined concept 'government' in the sense associated with the notion of a Prime Minister forming a government. The teacher intends the question to be one about the electoral system. The confusion might have been avoided if the teacher had used the term 'Parliament'.

3. The defined concept 'unpopular' has not been fully acquired and it is not possible from the response to ascertain with any degree of certainty what the pupil thinks the term means.

4. Failure to discriminate and encode the major criterial attribute associated with the concept 'civil war'.

5. & 6. The question is answered correctly, but this is the only pupil to make this response; all other pupils responding as the teacher intended with 'Royalist', and in the second part 'because they followed the king who is Royal'. Examination of the episode shows that the pupil making this answer (Mitchell) answered a question during the explanation about cavalry and this has clearly influenced his selecting and encoding.

7. Prominent in the pupil's mind is some previous explanation of the origin of the term 'Roundhead'. This appears to have blocked the associated defined concept 'Parliamentarian'

given in the teacher's explanation and, thus, it has not been encoded.

8. Failure to discriminate correctly the pairing of each group of followers with the appropriate leader causes encoding of wrong information.

9. Failure to discriminate a word sound converts be-headed, probably somewhat unfamiliar into bigheaded, a change which influences the sense of the rest of the statement and, thus, the encoding.

10. Failure to discriminate between Charles 1st and his son. Some pupils may not appreciate that Charles 1st was beheaded before the battle. Both errors would cause misconceptions which could be encoded and stored.

<u>Geography</u>

<u>CHECK III Geography Explanation</u>

1. Give 2 examples of fossil fuels. <u>Coal</u> <u>Wood</u>.
2. What is the largest alternative source of energy to fossil fuels? <u>Gas.</u>
3. About how much energy is released from the sun each year? <u>Enough to fill a supertanker</u>.
4. What happens to the energy that does not reach the earth? <u>It stays around in the clouds</u>.
5. Put down two things that are created by solar energy. <u>The sun</u>. ______
6. What happens when our atmosphere absorbs solar energy? <u>It would get hot</u>.
   What does this cause? <u>An explosion</u>.
7. How are clouds formed? <u>From water</u>.

1. Pupil has not fully acquired the concept 'fossil' nor formed a scientific concept of the nature of coal.

2. Inability to discriminate among phenomena in relation to a specific class possibly because the concept of that class has not been fully formed, or because concepts of particular members of the class have not been acquired.

3. Attention has been diverted to the analogy given in the explanation resulting in a failure to encode the salient information.

4. A misconception possibly caused by failure to attend to and encode salient information.

5. It is possible that the defined concept 'created' is unfamiliar in this context and thus blocks the retrieving process. Another possibility is that the defined concept of 'solar energy' is not fully acquired and encoding is limited to a tenuous notion that solar energy is something to do with the sun.

6. The first part of the question appears acceptable, but the same pupil's response to the second part casts doubt upon the level of understanding of the phenomenon that has been achieved.

7. The lack of specificity suggests that the association between clouds and water has been perceived but a concept of the process involved has not been acquired and stored.

2.3.5 Discussion

Within all subject episodes the full range of mental operations identified in the model are utilised. In the main, attending and discriminating occur throughout, retrieving and transferring tend to be associated with periods of questioning, while encoding and storing are prominent in the expository mode of monologuing periods.

The three learning capabilities identified by Gagné are in evidence in all episodes but there are small distinctions associated with the degree of use.

Mathematics utilises cognitive strategies considerably more than most subjects. This is to be expected in view of what has been revealed about its characteristic concerns and approach.

Taking each capability in turn and dealing first with intellectual skills, demands upon this capability show a degree of variation among the subjects represented. Mathematics is concerned with rules, but not high order rules and utilises a large number of concrete concepts. Physics makes large use of high-order rules, Chemistry and Biology considerable use, Geography some use and History little or no use. These characteristics hold true for the subject explanations in the H3 sample. All subjects utilise many defined concepts, those of History being more loosely defined and open to interpretation than is true for Mathematics and the Sciences and to a considerable degree in Geography.

Cognitive strategies are most in evidence in Mathematics, which utilises all aspects of this capability and, indeed, is preoccupied with identifying a problem, identifying an appropriate rule and applying the rule. These activities appear in other subjects, notably Physics and Chemistry but frequently go no further than the identification of a problem, in an overt sense. It is likely that pupils are expected to infer from the evidence the appropriate rule and to do their own applying of the rule.

Verbal information is common in the subjects, (all but Mathematics which makes much use of connected discourse) being concerned with bodies of knowledge.

Gagné's model is characteristically hierarchical within each of the learned capabilities. In all episodes analysed the preoccupation is with the upper levels of the hierarchies, i.e. with defined concepts, high order rules and bodies of knowledge. This is particularly true of Physics, followed by Chemistry, Biology and Geography. Scrutiny of the H3 sample confirms this pattern with the exception of Geography which can be very variable relative to topic within its loosely defined field.

History has peculiar problems related to the nature of its sizeable body of knowledge and the complexity and variability of its defined concepts.

The analysis of unsatisfactory pupil responses confirms the contention that with episodes operating at a conceptual level, that is at the top of Gagné's hierarchies there will be frequent occasions when pupils are unable to cope with the material confronting them. The strain this puts upon the discriminating function which, in turn, is dependent upon attending is great, moreover, failure of this operation has repercussions for all the other mental operations that depend upon it.

Effective encoding is only possible with at the very least partial understanding, while storing for easy retrieval because of the need to build in clues demands a satisfactory level of understanding.

Many concepts occurring in the episodes do not appear to have been formed let alone fully acquired by pupils. Numerous technical terms will take years to become really established, but the results show that words like create and unpopular are less familiar to pupils than teachers realise.

There is also some lack of appreciation of the centrality of certain processes and concepts relative to others. If pupils fail to perceive the significance of criterial attributes relative to peripheral aspects of the concept the effect may be to encode and store in such a way as to give prominence to the peripheral rather than to the fundamental and central. The longer term effect of this is that the pupil fails to retrieve the latter but may well be able to retrieve the former which in most related situations will be much less useful to him.

Most of the concepts utlilised in the episodes, and notably in those containing scientific material, could not be readily understood and, thus, formed without the backing of prerequisites. For example, the concept of 'friction' depends upon the formation of the concept 'force' which, in turn, is highly complex and abstract in character.

The Biology episode was not understandable without some knowledge of the concepts of diffusion, absorption, molecular structure, chemical reaction, indicators, etc. Yet these concepts were not being presented and explained in the episode.

Not all the conceptual factors influencing understanding within an episode reflect difficulties associated with the mental operations and learning capabilities of the recipients of the explanation. There are occasions when the utterer fails to put across the message adequately.

Conceptual confusion is generated by failure to mark clearly the relative importance of one piece of information compared with another, indiscriminate use of unfamiliar terms without presentation or expansion, use of 'noisy' exemplars that divert attention from the underlying question or use of exemplars that are too similar thus making it difficult for pupils to discriminate one from another. It is also true that teachers' commitment to the bodies of knowledge that constitute their subjects appears at times to have a greater influence upon their speech acts than does their commitment to the rational predicaments of their pupils.

Conclusion

Explaining within subject teaching makes heavy demands upon the mental operations of pupils, notably upon attending and discriminating throughout episodes and upon encoding when the teacher is monologuing in order to expose bodies of knowledge.

The level of intellectual skills demanded is moderately high for all subjects and where scientific material is involved the level becomes higher.

With the exception of Mathematics cognitive strategies are not utilised in the episodes as much as the other learning capabilities. Verbal information, again with the exception of Mathematics which employs much connected discourse, consists in bodies of knowledge each subject with its special vocabulary and habitual collocations which tend to be unfamiliar when set against everyday speech.

Teachers contribute to the overall conceptual demand upon pupils through a number of different practices that detract from the clarity of the explanation given and appear to be 'overcome' by the perceived demands of the subject to the detriment of their awareness of pupil needs.

Bearing in mind the points raised above rejection of the hypothesis H10 is not contemplated and, thus, is allowed to stand.

C H A P T E R 8

1.0 DISCUSSION OF RESULTS IN THE CONTEXT OF PROFESSIONAL PRACTICE AND THEIR IMPLICATIONS

1.1 The Status of Explaining and the Nature of Explanations

1.2 Communicating Meaning in Explaining Something to Someone

1.3 Effective Explaining

2.0 CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH

2.1 The Act of Explanation in Teaching and Learning

2.2 The Act of Explanation in Teaching & Learning Science

2.3 Areas of Further Research

1.0 DISCUSSION OF RESULTS IN THE CONTEXT OF PROFESSIONAL PRACTICE AND THEIR IMPLICATIONS

The classes in the studies constitute a wide range of pupils from primary, middle and secondary stages of school life and the lessons in which the explanations have arisen cover eight subject areas. Although the act of explanation is examined in each subject, particular reference has been made to teaching and learning science and the practice will be followed in this final chapter.

The investigation has concentrated upon those aspects of the act of explanation that are highly relevant to an understanding of its place and function in classroom teaching and learning. As a result, a number of distinctive studies have been necessary, each contributing one or other aspect.

The early studies have taken up the question of whether or not in current practice explaining is much used and valued and perhaps more important if teachers are explaining when they believe themselves to be doing so.

Setting up an investigation to examine the above aspects was less complex than attempting to reveal and describe how successful acts of explanation are in facilitating pupil understanding. However, the latter aspect is of such importance in the context of teaching and learning that no investigation into the act of explanation in classroom contexts could afford to ignore it. This is particularly so in the case of science subjects which have as their 'stock in trade' explanations which can be simple or complex, conceptually demanding or highly demanding, limited or extended in character and concerned with a very wide range of phenomena.

If any justification is needed for going beyond a description of the act of explanation and attempting to identify factors that can contribute or detract from its success in achieving its objective, it is pedagogy that is able to supply it. It can be summed up shortly as the need felt by all 'good' teachers to become more effective at replacing the rational predicaments pupils find themselves in in relation to some underlying question, with understanding; the ultimate key to learning.

The ensuing discussion brings together findings from the ten studies that constitute the investigation into a coherent statement about the act of explanation in a classroom context and examines their implications for teaching and learning. It will also refer to issues raised in the theoretical sections and examine them afresh in the light of the evidence provided by the investigation.

1.1 The Status of Explaining and the Nature of Explanations

In the first chaper of the thesis, making specific reference to Green (1971), Komisar (1969) and Smith (1969) it is argued that explaining is one of a number of logical acts of teaching, sharing many of the characteristics of teaching in general but distinct from it in certain ways that reflect its peculiar philosophical nature.

Closer examination of it utilising the views of philosophers such as Martin (1970), Scheffler (1969) and Hempel (1965) shows it to be an activity similar to telling and describing but having certain characteristics that they do not, notably, the rational predicament of the explainee and an underlying question which the explanation seeks to answer.

An issue arising from these theoretical considerations concerns the importance of explaining as an activity of teaching. The logical and strategic activities of teaching that Green, Smith and Komisar recognise are not of equal status, some being more peripheral than others. However, changes over recent years have tended to act against the achievement of consensus regarding what is or is not important in teaching and learning. Thus, the first two studies were set up to reveal the current position of explaining within teaching with regard to two perspectives which are: the value of the activity to teachers and pupil, and its centrality in the classroom.

Evidence from these studies firmly establishes explaining as a valuable and central activity of teaching and learning in the eyes of both teachers and pupils at primary and secondary stages of school life. Indeed, the strength of the positive response to it is somewhat unexpected when considered in conjunction with an increasing number of activities going on in school which include some that would have difficulty qualifying as either logical or strategic acts of the kind identified by Green (1971).

Nor is the enthusiasm for explaining confined to any particular group of teachers or pupils. Similar numbers of high ratings are found among infant, junior and secondary teachers, the last group from the typical range of subject disciplines to be found in secondary schools. The same is true in the case of the pupils and, in addition, there is no difference between able and less able groups in their perception of the value and centrality of explaining. Over half the teachers of science rated the activity as the most important and no one in this group rated it lower than third.

Establishing the value that teachers and pupils set upon explaining is one thing, to ascertain the nature, quality and effectiveness of an act of explanation is another. In defining the nature of explaining a philosophical conception of explaining based on conditions offered by Bromberger (1965) but modified by Martin (1970) to produce her Hypothesis six is employed. It is used for the question appertaining to whether or not what teachers consider to be acts of explanation meet acceptable criteria for deciding that they are. Moreover, as the teachers and pupils providing the explaining episodes set high value on explaining, the study is able to furnish information about their conception of what is involved in the act in which they are well practised.

Some two-thirds of the explanations meet philosophical criteria for deeming an activity to be explaining. However, this should not encourage complacency particularly as one in three so-called explaining episodes do not qualify as such; which constitutes a sizeable minority.

The reasons for their failure to qualify are important for understanding what is involved in the activity. Few teachers (11 out of 161) fail to state the right answer to the underlying question which suggests that teachers do appreciate the need for responding appropriately to what or why questions with something more than would be adequate for telling or describing. By and large their failure is a failure to meet the rational constraint upon teaching and thus explaining and to take account of the pupil's rationality. This involves the condition that requires an explainer to shift the question, which in turn is realised through the asking of one or more subsidiary questions.

The number of failures caused by this condition suggest that many teachers do not appreciate the necessity for or the potential gains from, question shifting. It does much to make the pupil a partner in the episode instead of being just a receiver and supplies the teacher with valuable feedback on how his meanings are getting through to the pupil and what the pupil makes of them. Question shifting also goes some way to meeting claims from those like Scheffler (1960) that the teacher must at some time submit himself to the independent judgement of the pupil or he won't be teaching. It should also be effective for increasing reciprocity as subsidiary questions give pupils opportunities for influencing the course, form and subsequent interaction of the explaining episode.

In science the need to put subsidiary questions is very strong. These explanations tend to require the perception of relationships while being packed with often difficult and relatively unfamiliar concepts that must be understood if the pupil is to see the relationship. Subsidiary questions can help to bring out the required relationship and give examples of positive and negative instances of the essential concepts associated with it. In this way, the concepts become securely formed in the pupil's mind and are more readily available for use in subsequent learning that requires them.

Examination of pupil responses to checks used in revealing the gap between intended meaning and received meaning (the study associated with hypothesis 7) provides evidence that <u>subsidiary questions are instrumental in promoting understanding</u>. They serve to reinforce certain of Cicourel's (1974) interpretative procedures notably the retrospective sense of occurrence(1) that something will be said subsequently that clarifies what at the time is an ambiguous utterance.

A point worthy of note is that the acts of explaining which provide the sample of philosophically acceptable explanations took place in a variety of subject contexts and with different age groups but neither subject area nor age appear to have had any influence upon the success of an explanation in satisfying <u>all</u> the conditions. This suggests that what is offered as explaining reflects

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(1) This procedure is outlined on page 110.

individual perceptions that teachers have of what constitutes a good explanation. Moreover, it raised the question of whether effective explaining must needs start with the explainer having a clear understanding of the nature of the activity particularly those aspects that distinguish it from telling and describing. Certainly it is not a simple activity and there could be many advantages in learning how to explain.

Support for the idea is provided from work undertaken by the present writer at the outset of the investigation using pupils as explainers. Of the small sample obtained only two meet the conditions of Martin's Hypothesis six and both were near the top of the secondary school. Other than these the explaining episodes that got closest to satisfying the conditions were generated by pairs of pupils neither of whom had achieved understanding of a particular phenomenon but who achieved understanding by talking together and pooling their knowledge.

Although this aspect of the work is not followed up within the present thesis, which concentrates upon the teacher as explainer, it is potentially a rich area for further research.

Of particular use to subject based teaching are the issues generated by the typologies of explanations furnished by Green (1971) and Taylor (1970).

In the first instance, interest centred on the range of question types utilised by teachers in their explanations followed by a concern to reveal possible relationships between a subject area and a specific question type. It was then thought to be likely that if a relationship exists between a subject and its question types, it would exert an influence upon the concepts utilised and the meanings communicated. Specifically, concept distinctions of the kind associated with Vygotsky's (1962) theories of the development of language and thought were thought to be of interest while in the case of communicated meanings Bellack's (1969) categories seemed appropriate.

The three typologies applied in turn to the explanations obtained for the study associated with hypothesis H3 did reveal a number of general trends and relationships within the studies associated with hypothesis H4 and H5 respectively.

One general trend common to all explanations is the answering of greater numbers of what-questions than why-questions. Bearing in mind Green's (1971) notion of explaining as answering a certain kind of why-question, this may seem unexpected. However, the analysis of questions carried out by Barnes (1961) and Richards (1978) confirm that teachers share a preoccupation with putting across bodies of knowledge and this appears to generate a concern for knowing what is so, rather than why something is so. This same concern is probably largely responsible for the clear dominance of substantive with associative meanings; i.e. those meanings that refer to the subject matter of the lesson in question, throughout the sample.

When question types, concept types and communicated meanings are taken together relationships between particular characteristics and subject areas show up clearly. For while all explanations share common features such as the philosophical characteristics that identify them as such and an ultimate goal, understanding, the influence of the origin of the something being explained is considerable.

In the first instance, subject origins of explanations influence the kind of underlying questions that teachers have to take on in their role of explainers. In some the influence is very strong as has been brought out in the discussion of the results of the study in question. Examples in relation to why-questions are the dominance of deductive questions in the sciences, of functional questions in Biology and of genetic questions in History. As would be expected the underlying question has a direct influence upon the conceptual character of the explanation, a clear example being the association of high order rules and principles with deductive questions and to a lesser degree with functional questions. Moreover, all these characteristics are realised through the language use so this, too, reflects the methods processes and concepts of the subject of origin.

Subjects distinctions tend to be somewhat blurred at primary level although in the upper part of the junior stage they begin to emerge, notably distinctions between arts and science orientated topics. At secondary level the distinctions are much sharper notably between arts and sciences so that it is possible to say that the nature of the explanations in one subject can bear little or no resemblance to those of another. Science explanations show a relationship between question type, concept type and language selections as, for example, when dealing with a causal relationship in a deductive why-question that involves a high order rule couched in technical terms to avoid ambiguity. These question types are unlikely to occur in the expressive arts.

How aware teachers are of these distinctions is a matter for speculation. What cannot be assumed is that they know of their existence or even that they know and understand the distinctive character of their own subject's explanations.

This raises the question of whether or not teachers' explanations would be improved by knowledge of their characteristic nature. By and large greater knowledge and understanding contribute to human competence so it would appear to be advantageous. It is also possible that communicating this information to pupils at a stage at which they are capable of understanding it could help them to utilise appropriate strategies and modes of thinking when faced with specific kinds of explanations.

1.2 Communicating Meaning in Explaining Something to Someone

So far discussion has centred upon the nature and influence of the something being explained during the act of explanation which is perceived by teachers and pupils alike to be a central and important activity of teaching. Unfortunately, satisfying all the conditions that philosophers consider must be met before an activity can be called explaining and being aware of its characteristic nature, does not guarantee understanding for the explainee. It is this problem that the two studies associated with hypotheses H6 and H7 have as their concern, i.e. the probable gap existing between what a teacher intends to communicate and what in fact a pupil receives.

This section of the investigation is seen as particularly important because it demonstrates unequivocally that despite warnings about the problems of accurate communication from linguists such as Rommetveit (1979) and Saugstad (1977) naive assumptions about the extent to which intended meanings reach their destinations and are understood are much in evidence.

This is not to say that teachers are unaware that some parts of the messages they wish to communicate do not reach their destinations, their predictions in the study associated with hypothesis H6 show that, in general, they are aware that they can expect only a certain proportion of the pupils with whom they are communicating to understand the message satisfactorily. There are, moreover, distinctions among teachers with regard to their confidence in their own ability to communicate meanings, as is indicated by the range that is demonstrated in the predictions which includes moderately low proportions and very high ones.

What most teachers in the group fail to appreciate (and there is no reason to think that the group is untypical) is the size of the gap that exists in certain cases and the relatively modest number of pupils who achieve satisfactory understanding. If the results obtained from this experiment is a true reflection of what happens during acts of explanation in teaching and learning, and if anything teachers in the experimental sample may unconsciously have put in more time and effort than is normally the case, some realistic reassessment of the expected outcomes is necessary.

It is not difficult to see how teachers form wrong impressions about pupil understanding, bearing in mind the common practices of asking if everyone has understood or checking the responses of one or two pupils to questions about the meanings communicated in the episode. By and large pupils who lack understanding try to hide the fact and, thus, are party to the deception.

Perhaps the most important implication that these issues generate is that teachers should start from a different base line in assessing what they have communicated. Ordinary everyday explanations are not very readily communicated and those that abound in school learning are all the more difficult because they deal with unfamiliar phenomena and utilise high order concepts. Possibly, it would help pupils to admit their lack of understanding if the characteristic teacher response at the end of an explaining episode were to be a show of surprise that anyone should have understood it at the first attempt. Certainly this kind of approach would be likely to generate a larger number of subsidiary questions than one which appears anxious to confirm that all but a few have achieved understanding but further questions will be put if necessary. Moreover, the quality of interaction between teacher and pupils would probably improve.

Mathematics and Science are subject areas that would benefit most from a teaching approach to explaining of this kind not least because characteristically they tend to be sequential and where subsequent learning is heavily dependent upon previous learning a small gap in understanding that is not remedied can become a chasm in a small space of time. Indeed, the high degree of unfamiliarity and complexity typical of much of the phenomena of science are such that understanding of them proceeds in a very gradual fashion, thus ensuring that <u>whenever an act of explanation is in progress only some of the pupils will be following most of what is being said</u>, the remainder will be coming in as and where they can between partial understanding and no understanding at all.

The size of the problem identified in the practical investigation reinforces the view expressed in the theoretical sections of the thesis that philosophical accounts fail to cover adequately certain dimensions that influence the act of explanation. All the explanations employed in identifying the gap between intended meaning and received meaning are able to satisfy Martin's Hypothesis six but satisfactory understanding was not attained by a relatively high proportion of pupils. Perhaps it is because many philosophers do not make achievement of understanding a necessary condition of explaining that they are satisfied with accounts that pay scant attention to contextual and interactional features as integral to the act of communicating meaning. Within this thesis they are seen as essential to the understanding of the nature of explaining something to someone as a phenomenon and as a likely source of information about factors that may be blocking understanding.

1.3 Effective Explaining

Although this section is discussed under the head of effective explaining this is done by considering the information obtained from sociolinguistic and psycholinguistic analysis, about features of explaining that are not brought out by purely philosophical accounts.

One reason for this approach stems from the stance that these are the features which exert a crucial influence upon what actually takes place when an explainer is communicating meanings to an explainee within an explaining episode. Moreover, this activity subsequently affects the eventual outcome in terms of the understanding achieved by the explainee. Another reason for proceeding on these lines is that gaining some awareness of what is taking place in a typical episode looks to be a sensible first step in a consideration of what contributes to or detracts from effective explaining.

As the notions and processes of subjects are communicated through language an obvious starting place appeared to be their vocabularies. The word selections of explainees within an explanation may have potentiality for furnishing the explainee with a clear statement of what he needs to know, i.e. it is adequate in the sense that it meets the demands of what Halliday's (1975[b]) refers to as the field of discourse concerned with the ideational function of the communication. However, as was argued with reference to Rommetveit (1979) in the theoretical sections of the thesis, linguistic competence cannot be conceived of as devoid of variation and ambiguities. It has to do with human discourse under continually varying conditions.

In setting up the studies associated with hypothesis H8 note was taken of points brought out in the discussion of the influence upon communication of what is explained by Cicourel (1973) and Stubbs (1976). In particular, their concerns regarding occasions when an explainer's word selections include a high proportion of those words that rarely occur in the normal vocabulary of the explainees, or the context is an unfamiliar one with its own special habitual collocations, informed the design of the experiments.

The position was taken that, in the main, concern for possible vocabulary problems is directed at the technical word and bearing in mind the large number revealed by the conceptual analysis of explanations associated with hypothesis H4 there appears to be a great need for this to be so. However, as Stubbs pointed out the technical term serves a useful purpose but there are many words used by teachers in their explanations that are not of this sort which are equally difficult and unfamiliar and which could be readily replaced with a simpler and more familiar word. It is these words which are the focus of the experiments carried out with pupils learning Chemistry and Biology. The words are non-technical and not readily accessible to pupils, but frequently teachers fail to recognise them as giving pupils problems of meaning. Moreover, they are in common use in the subjects involved in the experiment and, with variations related to range and frequency, in use with most other subjects taught in secondary schools. An assumption made when setting up the experiment that appeared reasonable is that problems of word meaning contribute to problems of understanding although as Cassels (1978), whose work provides the blue-print for this H8 study, reminds us, many teachers do not entertain the notion that greater understanding can at times be achieved by changing one word.

Whatever may be the typical view of teachers concerning the effect words of the kind described have upon pupil understanding, the evidence of the study confirms the view that non-technical words that are not readily accessible to the pupil can and do block pupil understanding.

In certain modified questions, simplifying one word improved pupil performance by fifteen percent. This is not an enormous increase but taking the total of pupils who sit the examination in question each year, it is a large number and for the individuals concerned it can make the difference between success and failure.

It is doubtful that those who set examination papers are aware of the depressing effect upon scores of negative forms unless they take a sadistic pleasure in asking questions in a form that they know gives pupils more problems of understanding than the alternative form which is positive.

The ease with which modified questions were produced by replacing the original words or phrases with others, simpler or more direct, is something of which teachers should be convinced. In particular, the possible gains within an activity like explaining which concentrates every effort upon getting the meanings through to the explainee, cannot be too clearly stressed. Indeed, teachers should be pressed to do more than be aware of the knowledge, they should be expected to act upon their knowledge.

More specifically science orientated subjects which meet the problem described rather more than do most other subjects, often in conjunction with a very heavy load of technical words, could tackle this problem which is made that much more difficult when pupils are expected to remember a wide range of unfamiliar phenomena over a long period of time as, for example, five years of course material in Nuffield Science.

A point worthy of note is that all the evidence comes from pupil responses to multiple choice questions and undoubtedly challenges the belief that tests of this kind provide for pupils who are not among the highly able, easier options with regard to the language functions they have to understand and perform. It is true that they are not called upon to express anything in their own words or, indeed, to utilise the written form at all except to place a tick in a box or circle a letter. However, the first stage in being able to respond to any question is understanding what that question is asking. If pupils cannot get beyond this stage the so-called advantage of not having to express themselves in writing loses its point.

One of the problems of question papers of this kind is that the language is under strong pressure to make without ambiguity, yet concisely, (for with four options to include, the questions can become lengthy thus increasing the number of sheets necessary to carry the test) a statement that will inform pupils which option is correct and which are not. This technique is necessary for some of the options are similar to one another and only attention to specific information in the initial statement will ensure that the correct solution is identified.

In responding to these pressures, when the initial statement is kept short the concepts are very tightly packed, a short sentence will carry a lot of information. Pupils who do not unravel these before making a response often miss crucial information, while if several unfamiliar words appear in close proximity to one another they fail to make any sense of the sentence.

Where initial statements are longer negative forms, and, or, chunks of additional explanatory information tend to have been introduced. Although the latter is intended to be helpful it can obscure the point to which pupils are supposed to be responding, while the former practice causes confusion although it is not clear why. Perhaps like the additional information it increases the burden placed upon the mental operations of discriminating and encoding.

The implications for teaching and the act of explanation in particular of the issues that have been discussed are self-evident. Moreover, that the words that have been the focus of attention are not the technical vocabulary of the subject brings the points home with greater force and reveals yet more sharply the burden of vocabulary with which pupils learning Science are expected to cope.

It is true that, traditionally, Sciences are perceived as having a large technical vocabulary and it is tempting for teachers of other subjects to think that they do not have problems of this kind. However, this is to deceive themselves, for every subject has a technical vocabulary and it is likely to be brought out most fully when teachers are engaged in explaining a phenomenon with which the subject is concerned. Furthermore, although there may be a greater number of everyday or familiar words than is the case in the Sciences, within the subject discipline these words take on an altogether more precise and specialised meaning and, thus, are equally likely to cause problems of understanding for pupils.

In the case of the words with which the study is concerned, no teacher can assume that the implications do not apply for him. All the words are non-technical and in common use throughout the subjects taught in secondary schools which carries the implication that they do occur in subject explanations. There would seem to be advantages to be gained, for teachers in terms of their effectiveness as explainers and for pupils in terms of better understanding, from acting upon the evidence that the study provides in any way that is possible.

Arguments made with reference to the work of writers from the fields of sociolinguistics, philosophy and psycholinguistics, notably that of Rommetveit (1979) Cicourel (1973) and Halliday (1978 and 1975[b]) provided the stimulus for the contextual analysis undertaken in the study associated with hypothesis H9.

Although Halliday furnishes the model for the contextual analysis, the interpretative procedures that Cicourel considers of such importance in the communication of meaning are taken into account in seeking to uncover the social and contextual influences operating in explaining episodes. These were seen as highly relevant to the study not least because although crucial in understanding a communication they are learned only over a relatively long period of time. It was considered therefore that they have potentiality for contributing to understanding, but if they are not operating effectively the opposite effect could be produced.

For example, an adverse effect could readily occur in an explaining episode over lack of reciprocity of perspective, which is the taking for granted that explainer and explainee have the same interpretation of what is going on in the situation. Another is the et cetera assumption which it was thought could greatly influence ultimate understanding being concerned with the filling in by explainer and explainee of what is necessary to promote the meaningfulness of an utterance.

The retrospective sense of occurrence which was mentioned earlier in this chapter in relation to the function of subsidiary questions in explanations is yet another example, this time, concerned with the assumption speakers and hearers have when engaged in interaction, that ambiguous utterances will be clarified at some later time. These phenomena are of the kind Rommetveit had in mind when referring to dynamic residuals in human communication which he considers to be the same as Wittgenstein's (1962) bottom level of interpretation, thus it seemed reasonable to hope that much of value both to an understanding of the dynamic nature of an act of explanation and to the interpretation of the features in relation to their effect upon understanding, would be uncovered by the analysis.

The hope proved to be anything other than a vain one for material obtained from the analysis is wide ranging and relatively sensitive. Moreover, it does shed light on the concerns that were identified in the theoretical sections.

In conducting explaining episodes <u>teachers as explainers tend to utilise a somewhat narrow range of procedures, regardless of subject</u>, the exception being when very young children of primary age are involved. Explanations are slotted into lessons usually in the manner dictated by the teacher although there are occasions when an episode is initiated by a question or demand from a pupil.

<u>The habitual practice of using questions to revise material already taught</u> may have the effect of bringing to the front of the pupil's mind a relevant conceptual frame thus meeting some of the conditions of learning that are contained in Gagné's model of learning that is

used in relation to hypothesis H10. It can also establish for the pupils the ideational context and thus facilitate interpretative procedures starting with reciprocity of perspective and the et cetera function in the explanation proper.

A problem associated with the effectiveness of this practice is the relatively small number of pupils who are given the opportunity to respond directly to a question, in contrast with the numerous others who may or may not be attending to the dialogue and going through the motions of organising their thinking in order to be able to respond if necessary.

The same problem exists for the practice of asking questions towards the end of episodes to obtain feedback on understanding this time in relation to the retrospective sense of occurrence and it would appear to be some advantage to all concerned if the numbers of subsidiary questions with their potentiality for providing further information and removing existing ambiguities, were increased.

Explanations reflect the concerns of the disciplines from which they arise and, thus, there are subject distinctions associated with phenomena. It is in realising the ideational function of the field of discourse that they draw upon technical and special non-technical vocabularies and subject-specific habitual collocations. The degree of difficulty and unfamiliarity reaches its peak in the sciences while groups of words of the kind identified in the study associated with hypothesis H8 occur in the episodes of all subjects and appear to be associated with the 'explaining language' of teachers. There are, therefore, examples of the phenomenon Cicourel has in mind when he speaks of teachers who seem unable to employ ordinary everyday words in their language use even when they are readily available.

Inter-personal relations are an interesting mix of personal and formal features, the former level being slightly more towards the personal pole than the impersonal, while a moderately high degree of formality is demonstrated for the latter. It does not necessarily follow that the more personal tenor is associated with a lower level of formality although this could have been expected in view of the tendency for impersonal, formal and complex features to cluster together as do personal, colloquial and simple features. Perhaps this happens only when tenors of discourse remain relatively constant, which is not the case in teaching which dodges around between the polarities.

Ceremonial features are in evidence though not on a grand scale. However, they support the interpretation of the inter-personal tenor evident in all episodes as being between participants of unequal status in which the message itself is the focus of attention and not the source (i.e. the explainer) or the destination (i.e. the explainee). This suggests that the field of discourse or the ideational function has the dominant influence upon the act and not the personal tenor of discourse.

This point also can be made in relation to the functional tenor which confirms the teacher as the controller and initiator within the context, in the sense that field, i.e. the subject discipline, exerts a very strong influence upon his perception of what must be said and how it is to be communicated.

The influences of the teachers' perceptions, constructs and frames of reference are plain to be seen in the episodes, as are their expectations that generally pupils will not initiate but remain acquiescent responding in predictable ways when called to do so.

Whether this pattern suits the needs of pupils, particularly with regard to the furthering of their understanding, is a matter for speculation. Everything points to an imbalance in respect of pupil representation compared with teacher representation. Any shift will have to be initiated by teachers for they are in the controlling position. Indeed, pupils with their lower status in the hierarchical structure of the school, their more limited experience and knowledge of the subject and their lack of understanding of the something to be explained start from a position that is so much weaker than that of the teacher that without dedicated and informed attempts by the teacher to create contexts in which their pupils' perceptions, constructs and frames of reference can operate effectively, for many pupils, satisfactory understanding will be an unrealistic goal, for numerous explaining episodes.

Although in the study teachers' discourse is classified as the spoken mode concerned with monologuing and conversing the influence of the written to be spoken mode is considerable. It removes a great deal of spontaneity from the talk and at times teachers sound as if they are reading from a text. Clearly, they utilise texts when planning lessons and although there are many reasons for declaring this to be good practice it does throw up this problem if care is not taken to translate the content into language that can be shared by pupils. On the other hand, this could be an example of what Barnes (1969) and Stubbs (1976) describe as the specialist teachers' inability to separate their own use of language from the written everyday language without loss of meaning.

There is no doubt that conceptual difficulties increase when teachers fail to modify subject language in a way that allows pupils to utilise their own language competences.

A familiar problem is the facility pupils have for parroting the teacher's language without having formed the concepts represented by the words. Where as is commonly the case in the sciences the concept density is often very high, an act of explanation could readily confront pupils with more concepts that are not formed or only partially formed than with concepts that they have acquired and used in past learning. Moreover, in these areas (and again science is a good example) where the concepts in common use are of an high order of difficulty and complexity, any attempt to explain them or use them to explain other equally or more complex concepts without defining what they really mean, where possible by relating them to real experience, can expect to fail miserably.

Before the mental operations of pupils can get to grips with the business of encoding and storing for future retrieval inputs from teachers, they must be in possession of a certain minimal amount of information so as to be able to make some sense of the meanings coming their way. If they do not have even this minimum, they are not in a position to encode.

Conceptual confusions generated by teachers' failures to say clearly what they mean occur with a frequency sufficient to dispel any assumptions that all misunderstandings arise from pupils' errors or lack of expertise, but these confusions will only come to light when pupils are encouraged to take a more active part in the dialogue.

Taken altogether, the evidence from the study associated with hypothesis H10 exposes the heavy demands that are made upon the mental operations and intellectual and verbal capabilities of pupils and adds weight to the contention that if teachers are to be effective explainers they must accept responsibility for the inter-personal function in acts of explanation with a commitment that exceeds that which at present they reserve for the ideational functions.

2.0 CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH

2.1 The act of Explanation in Teaching and Learning

Group 1 Conclusions

In spite of changes in professional methods and approaches teacher and pupil set very high value upon the contribution that the act of explanation makes in teaching and learning. Teachers view it as the most central and important activity of all but sometimes fail to appreciate its characteristic nature, notably the need to take account of the pupil's rationality while, at the same time, facilitating interpretative procedures such as the retrospective sense of occurrence, by putting and responding to subsidiary questions, which the investigation has shown to be a most powerful influence in facilitating understanding of an explanation in all subjects and at all stages of formal education.

The putting of subsidiary questions also gives pupils more opportunity to become involved in the dialogue of the explaining episode.

Recommendations:

Teachers should be made aware of the importance of and advantages to be gained from putting and receiving from pupils subsidiary questions that are related to the underlying question of an act of explanation. They should be encouraged to increase their own use of such questions and to give pupils more opportunities to exercise their rationality through the questions they put to the teacher.

Group 2 Conclusions

The specific nature of explanations reflects the peculiar concerns of the subject from which they arise which, in turn, influences the kind of concepts utilised, and the meanings communicated to pupils. The characteristics of one subject's explanation can be very different from those of another, the most pronounced distinctions being between expressive arts subjects and empirical sciences. Pupils seeking to understand subject explanations must needs become aware (albeit unconsciously) of the distinctions in order to respond appropriately.

Recommendations:

Teachers should be persuaded that they stand to improve their own performance as explainers and their pupils' performance as explainees by having some understanding of the characteristics of the explanations that arise in their subjects and making their pupils aware of what these are.

Group 3 Conclusions

Teachers are aware that they do not always succeed in communicating the meanings they intend in acts of explanation, but do not appreciate the degree and scope of pupil failure to achieve satisfactory understanding. Indeed, in many cases, their expectations are totally unrealistic and demonstrate lack of awareness of the differences that exist between their own frames of reference and those of their pupils.

Recommendations:

Teachers need to be convinced that understanding of explanations of the kind that abound in formal education is a long term process that is highly dependent upon factors that have to do with individual development and experience. There appear to be considerable advantages to be gained, with implications for effective explaining, from starting with the more realistic assumption that most pupils will <u>not</u> attain understanding by the end of the first explaining episode and proceeding on this basis.

Group 4 Conclusions

Between them, influences from language use, contextual features and conceptual factors are largely responsible for the success or failure of an explanation to facilitate understanding.

4.1 Teacher's use of language and the opportunities they give pupils to verbalise their own interpretations of explanations are shown in the investigation to be of major importance in the quest for understanding.

Non-technical words that are not readily accessible to pupils can and do block pupil understanding in much the same way that technical words do. The burden of both types of vocabulary is a heavy one, particularly in subjects that have a scientific orientation. Choice of vocabulary by the teacher, therefore, exerts a strong influence upon the success of an explanation.

Recommendations:

Teachers need to be convinced that there are advantages to be gained, with implications for effective explaining, from defining and re-defining technical words over long periods and of replacing those non-technical words that do not need to be used with more familiar everyday words.

4.2 Contextual features are among the most influential and varied in the ways in which they contribute or detract from effective explaining.

The ideational function tends to dominate in most acts of explanation at secondary level and notably in subjects that have a scientific orientation and this can lead to the demands of the subject being taken more account of than the demands of explainees.

The inter-personal functions do not always proceed with the grain of pupil conceptions and competences and when this happens understanding is severely impeded, or can break down altogether. The utilisation of pupil competences is the key to successful explaining for it exerts a compelling influence upon language use and conceptual features.

Recommendations:

There are important advantages, with implications for effective explaining from giving pupils a greater share in the dialogue and of promoting the inter-personal tenor of discourse as the first priority. This would give pupils increased opportunities for responding within their frames of reference rather than trying to accommodate that of the teacher.

4.3 Conceptual difficulties are exacerbated by features related to language use and by the demands made upon newly formed, or partially formed concepts. The presence of large numbers of defined and abstract concepts which depend for their inception upon verbal formulations also greatly adds to the problem.

The burden upon mental operations and learned capabilities is heavy and can cause breakdowns in the discriminating and encoding function which makes understanding impossible, both at the time and in subsequent learning where the concepts are crucial.

Recommendations:

There are advantages to be had with implications for effective explaining from providing pupils with ample exemplars of the concepts that occur in explanations. Where the concept density is high, every attempt should be made to reduce the effects to proportions manageable by the pupil, possibly through the use of strategies like advance organisers which bring the necessary concepts into the 'front' of the mind and by promoting the interpersonal tenor of discourse as a first priority.

2.2 The Act of Explanation in Teaching and Learning Science

Although the act of explanation in science has to contend with problems that are essentially similar to those of other subject areas, it is clear from the general conclusions and recommendations that characteristics and trends in science explanations are very clearly marked and largely consistent.

One reason for this is that the natural focus of science is upon explanation. Its methods are concerned with finding, testing and demonstrating causal relationships and its bodies of knowledge are what have been referred to in an early chapter as explanations of the success[(1)] kind. A large part of the work of science teachers is to explain (in the task[(2)] sense) these scientific explanations to pupils learning their subject; a situation which helps us to understand why 'subject' pressure is so strongly felt in teaching the sciences.

Group 1 Conclusions

Teachers of science and their pupils set particularly high value upon explaining and utilise it frequently in the teaching and learning that goes on in science lessons. They tend to be as aware of the characteristic nature of explaining as teachers of other subjects and are more inclined to ask at least one subsidiary question.

The number of subsidiary questions asked is altogether too few, for when set beside the explanations of other

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(1) and (2) Distinctions made by Ryle (1949)

subjects, science explanations are consistently conceptually difficult and highly demanding of cognitive and linguistic skills.

Recommendations:

Teachers of science even more than other subject teachers need to be made aware of the invaluable functions that subsidiary questions can perform in facilitating understanding and promoting concept formation.

Group 2 Conclusions

The characteristic nature of science explanations is that they are concerned with what and why questions that require deductive, functional or genetic explanations that demand a wide variety of specialised and relatively high order concepts which are realised linguistically through the use of technical terms.

Recommendations:

It is important for science teachers to understand the unique demands of science subjects so that they can appreciate the problems pupils have in understanding the explanations given. They should also initiate pupils into the methods and concerns of science so that they can learn to respond appropriately.

Group 3 Conclusions

The gap between what teachers hope to communicate in their explanations and what, in fact, they succeed in communicating is widest in the explanations given in science teaching. As there is no reason to believe that the teachers giving the explanations are less effective as explainers it is assumed that the specific nature of the explanation is an important factor.

Recommendations:

Teachers of science must be persuaded that pupils find many science explanations difficult to understand and that the process of understanding will necessarily be a lengthy one. They can help the process by defining and re-defining concepts and through the use of advance organisers.

Group 4 Conclusions

Teachers use of language both in relation to style of discourse and vocabulary place a considerable burden upon pupils' understanding of science explanations.

There is over much formality that has no useful function and the ideational function is dominant at times to the detriment of the inter-personal function.

Conceptual difficulties are more common and of an higher order than is the case in other subject areas.

Recommendations:

Teachers of science need to take somewhat less account of the pressures from the subject they teach and more account of the constraints that reflect the cognitive development and frames of reference of the pupils who are the ex-plainees in explaining episodes. There is also a strong need to give pupils a larger part in the dialogue that should be going on in the act of explanation.

2.3 Areas for Further Research

Taken altogether the studies expose a formidable range of features that may and do influence the nature and effectiveness of an act of explanation. However, there is always more to uncover and certain promising areas for further research suggest themselves as follows:

1. Pupils as explainers in a number of different situations.

2. Identifying what constitutes the minimum of information that a pupil can possess in relation to a specific communication to achieve at least partial understanding.

3. The extent to which any one or all of the possible advantages suggested in the general conclusions of the thesis do enable explainers to communicate their meanings more effectively in the act of explanation.

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A P P E N D I C E S

A P P E N D I X A1

METHODOLOGICAL MATERIAL

A1.1.1 TEACHERS RATINGS OF THE CENTRALITY AND IMPORTANCE OF CERTAIN LOGICAL ACTS OF TEACHING (BASED ON GREEN 1971 AND SMITH 1969) - TESTING HYPOTHESIS H1

The activities listed below occur in teaching. Examine each in turn and select ten that you consider to be most central and important in teaching. Record your choice by crossing out the four you reject.

Rank the ten activities selected in order of importance by putting 1 beside the activity you rate most highly and so on down to 10 which will be the activity you rate least highly.

Amassing evidence	Comparing and contrasting
Defining	Explaining
Describing	Inferring
Designating	Opining
Demonstrating	Reporting
Concluding	Stating
Classifying	Valuing

Please tick as appropriate:

Infant age teacher ____________
Junior age teacher ____________
Secondary age teacher ____________
Subject(s) taught:

A1.1.2 PUPILS RATINGS OF THE CENTRALITY AND IMPORTANCE OF CERTAIN LOGICAL ACTS OF TEACHING (BASED ON GREEN 1971 AND SMITH 1969) - TESTING HYPOTHESIS H2

Below is a list of things that teachers do when they are teaching you.

(1) Look at each one and cross out 3 that you do not think are very important.

(2) Look at the 5 things left and number them in what you think is the order of their importance. Put 1. beside the most important, 2. beside the next and so on until by the least important you put a 5.

Defining	-	saying what something is as the dictionary does
Describing	-	saying what something is like
Demonstrating	-	showing how something is done
Explaining	-	getting you to understand something
Classifying	-	putting things into groups
Opining	-	giving opinions
Amassing evidence	-	getting together facts
Valuing	-	saying if something is good or bad

Put how old you are here - ☐

A1.2.1 Halliday's (1975[a]) Model for Contextual Analysis of Subject Explanations - Hypothesis H9

(1) Field of Discourse - Ideational function realised through:

(a) Question type
- i. Underlying question
- ii. Subsidiary question

(b) Linguistic features
- i. Habitual collocations
- ii. Special vocabulary
- iii. Habitual collocation of voice with active and passive

(2) Tenors of Discourse - Inter-personal function:

(a) Personal Tenor

i. Informal Features	- Formal Features
Contractions	Unspecified origins
Phrasal verbs	Unspecified destinations
Idioms and slang	Source and address irrelevant to message
ii. Personal Features	- Impersonal Features
1st and 2nd person reference	3rd person evading reference to author and addressee
1st and 2nd person pronouns	
3rd person reference to named individuals	Passive voice Non-finite verbs

(b) Functional Tenor.

(3) Mode of Discourse - Textual function

(a) Spoken
- i. Distribution of teacher and pupil verbal contributions
- ii. Spontaneous - non-spontaneous features
- iii. Conversing
- iv. Monologuing

(b) Written to be spoken.

A1.2.2 Model of Conceptual Analysis of the Learning Demands of Subject Explanations (Hypothesis H10)

Operations

(a) Attending - Control skills in attending to and selectively perceiving

(b) Discriminating - Identifying similarities and distinctions.

(c) Encoding - Using strategies that make sense of new material so that it can be absorbed into existing structures.

(d) Storing - Using methods such as class attributes to store new information with related existing phenomena

(e) Retrieving - Using cues and systems to find and bring back information

(f) Transferring - Bring previously learned information to bear upon new phenomena

Learned Capabilities

(1) Intellectual Skills

(a) Associations and chains
(b) Discriminations
(c) Concrete concepts
(d) Defined concepts
(e) Rules
(f) High-order rules

(2) Cognitive strategies for problem solving

(a) Identifying a problem type
(b) Identifying appropriate rules
(c) Applying rules

(3) Verbal Information

(a) Labels
(b) Facts
(c) Connected discourse
(d) Bodies of knowledge

A1.3 Modified Test Sheet - Hypothesis 8

A1.3.1 Chemistry Test A

1. Which statement is true about the ions $^{8}_{3}Li^{+}$ and $^{8}_{4}Be^{2+}$?

    A. They contain the same number of neutrons
    B. Their atoms contain the same number of protons
    C. They will combine with the same number of F- ions.
    D. They contain the same number of electrons

2. Which one of the following requires a liquid other than water to dissolve it?

    A. Salt
    B. Sugar
    C. Sodium nitrate
    D. Sulphur

3. Elements in the same column of the Periodic Table have the same number of

    A. Protons
    B. Electron shells
    C. Neutrons
    D. Outer electrons

4. Which one of the following is a choking gas?

    A. Carbon dioxide
    B. Nitrogen
    C. Sulphur dioxide
    D. Methane

5. When a concentrated aqueous solution of sodium bromide is electrolysed the product at the positive electrode is

    A. Bromine
    B. Hydrogen
    C. Oxygen
    D. Sodium

6. Which one of the following sulphides is easiest to break down to its elements?

    A. Lead sulphide
    B. Sodium sulphide
    C. Calcium sulphide
    D. Zinc sulphide

7. A fused compound conducts electricity but when solid does not conduct, this suggests the bonding in the compound is

    A. Covalent
    B. Polar covalent
    C. Metallic
    D. Ionic

8. To tell the difference between nitrogen and helium you could use:

A. a burning taper
B. a large balloon
C. a glowing splint
D. bromine water

9. Which element would form the same number of bonds as nitrogen?

A. Hydrogen
B. Beryllium
C. Boron
D. Oxygen

10. The atomic weight of chlorine is 35.5. Why is it not a whole number?

A. Ions are present
B. Impurities are present
C. Unequal numbering protons are present
D. Isotopes are present

A1.3.1 Chemistry Test B

1. $^{8}_{3}Li^{+}$ and $^{8}_{4}Be^{2+}$ have the same number of:

A. Neutrons
B. Protons
C. Charges
D. Electrons

2. Which one of the following requires a non-aqueous solvent to dissolve it?

A. Salt
B. Sugar
C. Sodium nitrate
D. Sulphur

3. Elements in the same group of the Periodic Table have the same number of

A. Protons
B. Electron shells
C. Neutrons
D. Outer electrons

4. Which one of the following is a pungent gas?

A. Carbon dioxide
B. Nitrogen
C. Sulphur dioxide
D. Methane

5. When a concentrated aqueous solution of sodium bromide is electrolysed, the product at the anode is

A. Bromine
B. Hydrogen
C. Oxygen
D. Sodium

6. Which is the least stable sulphide among the following?

A. Lead sulphide
B. Sodium sulphide
C. Calcium sulphide
D. Zinc sulphide

7. A melted compound conducts electicity but when solid does not conduct, this suggests the bonding in the compound is

A. Covalent
B. Polar covalent
C. Metallic
D. Ionic

8. To distinguish between nitrogen and helium you could use:

A. a burning taper
B. a large balloon
C. a glowing splint
D. bromine water

9. The valency of nitrogen is the same as that of

A. Hydrogen
B. Beryllium
C. Boron
D. Oxygen

10. The atomic weight of chlorine is usually quoted as 35.5. It is not a whole number despite the fact that protons and neutrons have very closely integral atomic weights because

A. Ions are present
B. Impurities are present
C. Unequal numbers of protons and neutrons are present
D. Isotopes are present

A1.3 Modified Test Sheets - Hypothesis H8

A1.3.2 Biology - Test A

1. Which one of the following parts of the human gut is mainly concerned with the absorption of our digested foods?

   A. Stomach
   B. Ileum
   C. Colon
   D. Rectum

2. Which type of weather will cause the rate of water loss in a leafy shoot to speed up most?

   A. Cold and windy
   B. Warm and wet
   C. Hot and still
   D. Hot and windy

3. Which of the substances listed below is not one of which mammalian blood is composed?

   A. Plasma
   B. Urea
   C. Platelets
   D. Red Corpuscles

4. Where in the body is starch first changed into sugar?

   A. Stomach
   B. Mouth
   C. Duodenum
   D. Colon

5. Which blood vessel carries de-oxygenated bllod to the heart?

   A. Pulmonary veins
   B. Hepatic portal vein
   C. Aorta
   D. Inferior vena cava

6. At which of the following is a ball and socket joint located?

   A. Knee
   B. Shoulder
   C. Elbow
   D. Ankle

7. Auxins responsible for a plant's response to light are in

   A. The root
   B. The flower
   C. The shoot
   D. The leaf

Biology Test A (continued)

8. Which of the following is not an invertebrate?

A. Crab
B. Worm
C. Snake
D. Snail

9. The tissue that passes water up a plant is known as:

A. Xylem
B. Cortex
C. Phloem
D. Pith

10. The function of the intercostal muscles is to aid:

A. Focussing
B. Movement in the neck
C. Breathing
D. Blinking

A1.3.2 Biology - Test B

1. Which one of the following parts of the human gut absorbs most of our digested foods?

A. Stomach
B. Ileum
C. Colon
D. Rectum

2. Which climatic condition of the environment will cause the rate of water loss in a leafy shoot to speed up most?

A. Cold and windy
B. Warm and wet
C. Hot and still
D. Hot and windy

3. Which of the substances listed below is not one of which mammalian blood is made?

A. Plasma
B. Urea
C. Platelets
D. Red Corpuscles

4. Where in the body is starch first converted into sugar?

A. Stomach
B. Mouth
C. Duodenum
D. Colon

Biology - Test B (continued)

5. Which of the following blood vessels is concerned with the transportation of deoxygenated blood to the heart?

   A. Pulmonary vein
   B. Hepatic portal vein
   C. Aorta
   D. Inferior vena cava

6. Which of the following has ball and socket joint?

   A. Knee
   B. Shoulder
   C. Elbow
   D. Ankle

7. Auxins responsible for a plant's response to light reside in:

   A. The root
   B. The flower
   C. The shoot
   D. The leaf

8. Which of the following is an invertebrate?

   A. Crab
   B. Worm
   C. Snake
   D. Snail

9. The tissue responsible for conducting water up a plant is known as:

   A. Xylem
   B. Cortex
   C. Phloem
   D. Pith

10. The job of the intercostal muscles is to aid:

   A. Focussing
   B. Movement in the neck
   C. Breathing
   D. Blinking

APPENDIX A2

EXPLANATIONS AND THEIR OUTCOMES

A2.1 EXPLANATIONS THAT SATISFY MARTIN'S HYPOTHESIS SIX

A2.1.1 Primary Explanations

Subject: MATHEMATICS

1. Age: 10-11 years Ability Range: Mixed Ability Group

T What way do we usually group shapes?..... Oh come on..... think about it.... Well, let's show you some..... What's this?.... Jane?

P1 A triangle.

T Right..... now this Andy?

P2 ... er ..... Square ....

T No... Look at it again...

P2 I mean a rectangle.

T Right.... and this? ..... Yes Kevin?

P3 A hexagon.

T Right... now any ideas? ...... Oh you are slow today. How many sides has this one Anne?

P4 Three.

T And this Sarah?

P5 Four.

T Right.... So the number of sides is one of the things we look at .... All three sided figures are called triangles although their shapes may look different. There are lots of four-sided figures. Can you tell me the names of some....... Yes.

P6 Square.

T Yes.... and another

P2 Parallelogram.

T Good..... any more? ..... Well there is the rhombus rectangle of course and the trapezium...... Can anyone draw the last? .... Yes John. (Pupil draws on board).

T Good.....These are different because they are not regular like the others.

2. Age: 9-10 years Ability Range: Mixed Ability Group

P How do you find the vertex?

T Does anyone know what the vertex is? ...... Well it's the top of the triangle..... here..... (uses diagram)

T If I want the height of a triangle I have to draw a line from the base at right-angles to it... up to the vertex... Sandra would you point to the vertex on this triangle? (Pupil does so).

T Good... Now Samantha.... How about this one?.....

P There...

T Good.

3. Age: 9-10 years Ability Range: Mixed Ability Group

P1 Miss Seedsman. I can't do this one.....

T Which number is it Linda?

P1 Er.... three.

T Ten books cost £4.50. How much for seven books?..... What do you need to know if you are going to do this by dividing and multiplying.... What must you know before you can find how much seven cost?

P2 Miss..... I know....

T Never mind.... Nigel.... you get on..... Now Linda.... Look, is it easier to find how much one book costs?

P1 Er...... yes.

T Right.... find out what one cost by dividing £4.50 by ten... like this (writes on pupil's book).... You can do that can't you?

P1 Yes Miss.

T Now.... when you know what one costs..... how will you find the cost of seven?

P1 One times seven.....

T Yes.... the cost of one, times seven will give you the answer.

Subject: HUMANITIES

1. Age: 10-11 years Ability Range: Mixed Ability Group

T First of all, who can say how our country is ruled or governed today?

P By the Queen.

T By the Queen?

P By the Government.

T That's right. We have a Parliament of just over 600 men and women. These men and women are elected. We vote for them. Anyone over the age of 18 can vote at a special time.

P A general election.

T Right. - At a General Election when men or women are chosen or elected to represent us in Parliament, there are three major parties - which are?

P Mrs Thatcher, Mr Steele and Mr..er...er...Mr ...

P Callaghan.

T Well, those are the three leaders of the parties. What are the names of the parties?

P Conservative, Labour and Liberal.

T That's right. Then the party with the most votes form a Government. The men and women who form the Government make big decisions as to what we should do, they make the laws of the land, the laws of the country. They run the country in the same way that perhaps Kevin's father runs a factory or I run the school, but on a much bigger scale.

Now, the Queen has to agree to any change in law, or any decision that the Government makes. She is still, in a way, the leader of the country, but there is no way in which she can really refuse to sign a new act. She has no real power. She is what we call 'nominally' in charge, the leader in name only.

2. Age: 9-10 years Ability Range: Mixed Ability Group

T Now in 1642, a terrible thing happened. The king then was Charles 1st. The first King Charles. He had a parliament, he had a government who were supposed to give him advice and help him rule the country. But he told them what do do. He ignored their advice. He voted himself extra money when he ran into debt. He got angry when Parliament criticised him, that is when Parliament told him he was ruling badly. He believed that he had been chosen to rule by God. God had made him king and so he could do anything he wanted and people dared not object. This made the people angry. He then married a young French princess who was a Roman Catholic, although he was a Protestant.

(Break for interruption)

His wife, Henrietta, encouraged Charles in his demands for obedience from the nation, from the people in the country, and the people hated her. She had a bad influence on him. He wanted to please her as well. King and Parliament had many arguments, and in 1642 the quarrel between them got so bad, a terrible war broke out. A Civil War. Can anyone tell me what a Civil War means?

P When people fight each other.

T Yes, but in any war people fight each other. Does anyone know what is so special about Civil War?

P The Americans had one. North against South.

T That's right, but what was so special about that?

P They were all on one side, er... they were all in one country.

T Good - but go on. All the fighters were in one country so....

P They were fighting their own.

T Fighting against their own what?

P Countrymen. Their own people.

T Right. Civil War is far worse because you are fighting your own countrymen.

So, we had on one side King Charles with his followers. He believed he had right on his side because God had made him king. He believed he could rule the country exactly as he wanted to because God had made him king. He wanted to govern the country without the help of Parliament. On the other side was Parliament, the men who represented the people of the country. Although it was their duty to give advice when asked, they did not believe the king had the right to rule as he pleased. They thought it was their duty to tell him when he made a bad or wrong or unfair decision. They wanted to rule the country without so much power from the king. The quarrel got worse and both sides prepared for war.

3. Age: <u>8-9 years</u> Ability Range: <u>Mixed Ability Group</u>

T Well, you all seem to enjoy eating.... and what a lot of different 'favourite' foods you have. Not all children can enjoy eating lots of different things. Can you think why this is so?

P1 If you are ill you can't.

T Good..... but I was thinking of children who live in countries where there is not enough to eat or where the harvest fails because of lack of rain... or.... even where the weather and soil are good but the people don't know how to be good farmers. Can you see that all these things could stop lots of different foods that most of you can choose to have any day..... Just ask yourself if your favourite food would be one of them..... Derek, what would you say?

P2 They wouldn't have sausages would they, Miss Warner?

T I doubt if they would have any, and certainly not ones like we eat.... They wouldn't have any foods that had to go through a special process before they go into the shops.... like baked beans in tins......

4. Age: 7-8 years Ability Range: Mixed Ability Group

T Reading:

A long time ago Red Indians of North America would make the boys of the tribe go through a period of training before they could be acknowledged as braves.

A time came when a boy who had passed some of the easier tests was taken deep into the forest until he reached a region he did not know and there he was left by himself all through the night.

T That would be very frightening, don't you think?

P I wouldn't like to do it.

T I don't think I would either... What do you think they were trying to prove?

P2 ...If he was... er .....scared....

T That's part of it, but I think they knew he would be scared. ....The important thing was... that he stayed there.... though he was scared.... he showed courage and reliability.... I expect too they would expect him to try to make himself as comfortable and safe as possible... How would you do that, Gary?

P3 I would.... er.... I would light a fire to scare wild animals away.

T Good.... and it would help to keep you warm.

Subject: NATURE STUDY

1. Age: 7-8 years Ability Range: Mixed Ability Group

T "The Very Hungry Caterpillar" by Eric Carle. (L970) Hamish Hamilton. London.

T "In the light of the moon a little egg lay on a leaf. One Sunday morning the warm sun came up and - pop! - out of the egg came a tiny and very hungry caterpillar. He started to look for some food. On Monday he ate through one apple. But he was still hungry. On Tuesday he ate through two pears, he was still hungry. On Wednesday he ate through three plums, but he was still hungry. On Thursday he ate through four strawberries, but he was still hungry. On Friday he ate through five oranges, but he was still hungry. On Saturday he ate through one piece of chocolate cake, one ice-cream cone, one pickle, one slice of Swiss cheese, one slice of salami, one lollipop, one piece of cherry pie, one sausage, one cupcake, and one slice of watermelon. That night he had a stomach ache! The next day was Sunday again. The caterpillar ate through one nice green leaf, and after that he felt much better. Now he wasn't hungry any more - and he wasn't a little caterpillar any more. He was a big, fat caterpillar. He built a small house, called a cocoon, around himself. He stayed inside for more than two weeks. Then he nibbled a hole in the cocoon, pushed his way out and...... he was a beautiful butterfly!"

T What part of this story is true of the butterfly in this picture...... (shows picture of cabbage white)?

P It does turn into a butterfly..... a caterpillar does.

T Right, but caterpillars don't usually eat lollipops and things, do they?....... What do they eat?

Ps No........ they don't......(noise)

T Sh..... Now let's see how the caterpillar turns into this butterfly (indicates cabbage white).

T The mother butterfly lays as many as 300 eggs at a time and the eggs are usually glued onto a leaf or a twig. The eggs are not much bigger than the head of a tiny pin but they are covered with beautiful patterns. The eggs of the Large White Butterfly look like little yellow skittles with ridges down the sides.

After about ten days - when the eggs have been laid for about ten days - they are ready to hatch, and tiny pale green caterpillars bite their way out of each egg. When a baby caterpillar hatches out of its egg, it nearly always starts off life by eating its own eggshell. After that it is still hungry; just like the caterpillar in our story, so it looks around for the next meal! Fortunately, for the caterpillar, it doesn't have to look very far because mother butterfly takes great care to lay her eggs on the caterpillar's favourite foodplant. The Large White Butterfly lays her eggs mostly on cabbage plants. A caterpillar hardly ever stops eating; it eats and eats all day long, and it grows so fast that it keeps bursting out of its skin. Now this happens as many as five times. The caterpillar eats and eats and eats - its skin grows tight - the skin splits, and out pops the caterpillar wearing a new skin, and during the next few weeks another change will take place inside the pupa. The remains of the old caterpillar will be rebuilt into the body of a butterfly, ready to climb out into the light and fly away.

2. Age: 7-8 years Ability Range: Mixed Ability Group

T The caterpillars of the Large White Butterfly, by the way are very good at hiding. They are green to match the cabbage leaves on which they feed. What can you remember about someone else, about whom we've been talking recently, who was very good at hiding? - because he dressed in green to match his surroundings....

P Robin Hood.

T Robin Hood. Can you tell us a bit more about Robin Hood, Arthur? How did he fool the Sheriff?

P He was hiding from the Sheriff's men in the forest.... so he was dressed in green.... so that he would match the trees.

P2 And he was green to match the grass.

T Yes, because he'd got to be camouflaged, like that crafty crocodile..... who was pretending to be a rock.... all slimy and green, like the rocks in the river.... he tricked the monkey..... but he didn't catch him.
Well, the crafty crocodile; Robin Hood; and the Cabbage White caterpillars are all masters of disguise.

3. Age: 9-11 years Ability Range: Mixed Ability Group

T Right. If you look at that picture on the back of the door, what is that? (pause) Yes, Carolyn?

P A leopard.

T It is a leopard. Well done - I think - what else might it be?

P Cheetah.

T Cheetah, but it is a leopard. We know that because it says so on the back. (Pause for laughter). Now if we look at it, in many ways, that big cat is ideally suited for the kind of life that it has to lead. If you look at it carefully, you can see the power in its back legs. It appears to be ready to.... to what, would you say; I mean it doesn't seem to me to be ready to go to sleep. Gordon?

P Pounce.

T Yes, it appears to be ready to pounce (inaudible on tape) .... coiled like a spring. Its eyes are fixed on its prey, fixed on - fixed on Gordon Brown, just about (laughter). Why do you think it needs such powerful legs? ...... (noise on tape)

P Mr Powell, it's going to pounce on the photographer.

T Yes, it's a very good photograph. Now then, we've mentioned this before. Most animals, indeed all animals, I suppose, are suited to the way that they have to live, remarkably well, and if you look above the door to the poster of animals of Africa - um, all those animals there look entirely different and they are entirely different, even though they all live in almost the same part of the world. They are different (hesitation) because they all have to lead a different kind of life, they eat different things, Garth. They live in different bits of Africa in the sense that some live in the water, and some in the trees and some live on the deserts and so on. So they are different for those reasons.

4. Age: 9-11 years Ability Range: Mixed Ability Group

T What's that called?

P An elephant.

T An elephant - that's right - what's perhaps the most striking thing, do you think, when you first look at the picture? Yes, Kim.

P Their ears.

T The ears - well, we'll start with the ears - I want to try and solve the question of: why should an elephant (which is an incredible creature in many ways), why should this elephant have such very big ears? You know when we ask people to decide the difference between the two elephants, which I think most of you know, the African and the Indian, Kim, or the Asiatic, people always go for the ears. Well, the African has got which one..... which is the one with the big ears?

P African.

T African, yes. The Indian doesn't have such big ears - now why should the African have such big ears? Anybody like to make a guess?.... (pause) ..... (a loud hiccup). I'm wondering what an elephant with hiccups must be like. (laughter) It couldn't be worse than you, Sally Rogers. Yes, Joanna?

P To fan itself, to keep itself cool.

T Yes. You're quite right. The African elephant, big animal, doesn't use its ears for hearing, it does hear with its ear-flaps (indistinct on tape)...... it does listen with them, um, we don't have such big flaps because we don't need to fan ourselves with our ears, to keep cool. (laughter) but an elephant does - so - that is it uses its ears as a great cooling device to cool itself down. It can stand and use them as two kinds of great fans and a.... (hesitation) a stream of cool air is shot over its back. Go and have a drink of water, Sally, will you. Now then, why should the African elephant have such big ears and the Indian or Asiatic elephant not so big? Yes, Paul?

P The Indian elephant's country isn't so hot, so they don't need so much cooling.

T Yes..... India is pretty hot, in fact, let's get this right. Indian elephants come from Asia...... (indistinct on tape, but the teacher used the globe to show the parts of Asia where Asiatic elephants might be found).....
The fact is that there are jungles there and in jungles you can find shade, in the African bush you can't always and so elephants have got this kind of built-in fan to keep themselves cool, so that explains partly, the big ears.

Subject: <u>RELIGIOUS EDUCATION</u>

1. Age: <u>8-9 years</u> Ability Range: <u>Mixed Ability Group</u>

T Do you remember I told you about Jesus' Goodbye Party.

Ps Yeah.

T Then about His dying on the very first Good Friday.

Ps Mmm.

T And then, what happens on Easter Day?

P1 He came alive.

T He came alive again; that's right. God raised Him from the dead. And Jesus was really alive and He went into the room where His frightened disciples were and He comforted them. Another time He had breakfast with some of His disciples on the beach.

P2 Oh yeah.

T And one time He appeared to over 500 of His disciples. Well, 40 days after Easter Day, that's nearly, that's about 6 weeks, Jesus came to His disciples again and He walked with them up a hill called Mount Olivet and He talked to them there. And He told them this: He said "I want you to go everywhere and tell people about Me." And then He promised them something very wonderful. He said "I'll always be with you."

2. Age: <u>8-9 years</u> Ability Range: <u>Mixed Ability Group</u>

P1 We can't be in two places.

T No, we can't be, can we? We're here now and because you're here in my room now, you're not in your classroom. So, how can Jesus be in heaven and on earth at the same time?..... Perhaps Jesus is in His body in heaven now, and when we go to heaven we'll see Him with our eyes.........

P2 And our body will be ...

P1 Cor... (....... I can't wait to get up there.
(P2..... down here.

P2 Our body will be left in our grave but we will go up to heaven.

T What.......?

P3 No.

T What bit of us will go to heaven?

P1 Spirit.

T Yes.

P1 The body will be left and buried.

T Jesus' Spirit is on earth everywhere. He's with us in this room and He's with your Mums and Dads at work or at home. He's with your friends in your classroom. We can't see Jesus' Spirit, but Jesus is always near us.

P2 Will we see Jesus' Spirit up in heaven.

T Will we see Jesus' Spirit? What do you think, Andrea?

P3 His body - er - his body ..... er --
Cos His Spirit will be in the earth.

T His Spirit will be in the earth, His body is in heaven. Sometimes we can feel He's near us and we feel peaceful, or if we're doing something we shouldn't because He's with us it makes us feel bad.

3. Age: 9-11 years Ability Range: Mixed Ability Group

T Imagine yourself a member of the early church under Roman persecution. You would have to meet in secret and if you were found out you would be charged with being a Christian and if you admitted you were, you would be executed.... People who were prepared to die for their faith were called what..... Annette?

P1 Saints.

T They may have later been called saints but there is a special name.... No? ..... Well, it's 'martyr'... you say it like m-ar-ter.... Do you think there are martyrs today?..... Yes?

P2 No, Miss Hemsley.... You can be what you like.....

T Can you 'be what you like' in all countries in the world?

Ps (confused) No.... no, Miss... In Russia you - no.....

T Sh... Diane.... what do you think?

P3 There are some countries where you can't be a Christian.

T Yes. There are some where you may have to suffer and even die for what you believe.... so I think there are martyrs... even today.... not all of them Christian, of course.

Subject: ENVIRONMENTAL STUDIES

1. Age: 8-9 years Ability Range: Mixed Ability Group

T Do you understand what 'arms' are?

P1 A knight wears arms.

P2 A coat of arms.

P3 And we've got arms.

T Yes, follow up what you first said, David.

P1 Knights wear arms to protect their body.

P4 A king has arms.

T You're on the right line, but you're thinking of armour. What else does a knight have?.... Soldiers nowadays have arms. Policeman sometimes. The word can be used for a large number of things that people have to protect themselves. Can you think of some?.....

P3 Guns?

P1 Oh yes, guns and weapons.

Ps Oh yes.

2. Age: 7-8 years Ability Range: Mixed Ability Group

T A factory is a building where they make things. Where who makes things? If you asked the men coming out of a car factory - can you make a car? Each one would answer 'no'. No-one working in a car factory says he can make a car. Now why not?

P1 Because they all do different bits.

P2 Oh yes.

T That's right. Today in car factories, and many other factories, each worker has his own special job. He doesn't know how to do all the things that must be done to build a car. But he's good at his own job. It would take a long time to teach a man everything he'd have to know to build a car. But when a man has just one special thing to do, he can learn his job quickly and well. Then lots of men working together can make a car. Each worker in this car factory is part of an assembly line. This is a line of workers putting the parts of something together. Now, suppose you people were working in a toy factory, what part would you want to work on?

P3 We'd be able to play with some toys.

P4 So we would.

3. Age: 9-10 years Ability Range: Mixed Ability Group

T Right. So, we get a piece of wool. I'm going to ask one or two of you to feel it. I want you to tell everybody else what you think. Darran.

P1 Soft.

T Soft. Paul, what do you find?

P2 Greasy.

T It feels greasy - things are happening to his fingers. It feels greasy. It is greasy, because in that we have a substance called lanolin. Incidentally, we use lanolin, girls, in quite a lot of make-up when we get bigger, so it is a very important thing. Why do you think sheep's wool has got grease in it? Why should it have the grease in it?

P To keep all the rain out.

T Yes, to help the water drip off like the shiny side of a leaf..... it won't mix.

4. Age: 9-10 years Ability Range: Mixed Ability Group

T When I've got a long thread I then put it into skeins.

Ps Ugh! Eh! A skein?... What's a skein?

T A long skein of wool which is how I used to buy wool when I was your age. In skeins and when we've got it into a skein like this - (makes a skein) like that we can then dye it. Change its colour. It's all the different colours that we need. Dye. D Y E (children join in the E). Do make sure you can try and remember to spell it the right way because otherwise you'll be telling me the wool dies like you do when you stop breathing. (laughter)
Right, so 'dye' while we are changing the colour of wool has to be 'ye'.

P Has to be 'ye' ...... How do we dye it?

T Well, let's dye the wool and see. We put it into vats with special substances in, colours. Nowadays we can go to a shop and we can buy a dye, a tin of dye and a tin of fixer and do it. If you had lived in those Welsh mountains or on the Scottish Islands you'd have gone and collected your plants to dye your wool.

A2.1.2 Secondary Explanations

Subject: MATHEMATICS

1. Age: 15-16 years Ability Range: 'O' Level Group

P1 Please, sir - I don't know how to answer number 6.

T Pythagoras .... we've just done that .... very basically. You need to narrow it to two things, that's all. You've got a right-angled triangle. O.K.?

P1 Yes.

T Yes, right. The square of the hypoteneuse is equal to the sum of the squares of the other two sides. That means if we draw a square on that, draw a square there and there, add the area of that square to the area of that square, the two will combine to equal the area of that square.... right. Which is the longest side of a right-angled triangle..... Well, which is the hypoteneuse? Yes?

P2 Ehm, the diagonal.

T The diagonal?

Ps The longest one (much mumbling from pupils).

T The longest one... and the longest one is always what? If any-body says hypoteneuse...

P3 The one opposite the right angle.

T The one opposite the right angle. Right. There's two sorts of questions you can be asked on this. First of all.... you might be told the area of the squares. You may be told in your exam. that the area of that square is 101.... 171 square centimetres, and that one 73 sq.cms. What is the area of that square.... and half the population of the second year will start squaring these. You're given the areas of the squares. How would you find the area of that square? Paul.

P4 Add those two together.

T Add those two together. What is the information you're given before you start squaring things? The only situation in which you start squaring things....

P4 The length of the sides.

2. Age: 15-16 years Ability Range: 'O' Level Group

T Right.... If you're given the length of the sides, for example, if you're told that that's 12 cms. and that's 5 cms. then you've got to square them. Why? (Pupil's name)

P1 To find the area of the square.

T To find the area of the squares on those particular sides. Only two different sorts of questions you can be asked. Given the areas of the squares or given the lengths of the sides. That's all. Be careful in this case to do what with your square?..... Ian.

P2 Add it together.

T You add it together. If you're given the hypoteneuse, you've got to be careful you know which you're taking away, from which and what and why. John?

P3 You're taking the shortest side away from the other to get the other side.

T You're taking away the square of the shortest side, the square.

Age: <u>11-12 years</u> Ability Range: <u>'O' Level Group</u>

P1 What happens if..... the answer is wrong?

T It won't balance.

You'll get a ridiculous statement ...... and <u>this</u> is a ridiculous statement.

46 = 60. 46 = 0 - that is another ridiculous statement.
For you to have the right answer..... this has got to come to what this side says it is..... nothing. Now then... I haven't got as far as the answer here. I can't substitute anything yet because I haven't got a solution.
Right, Kelly..... read that out for me.

P2 x + 3, x + 2 = 0.

T Louder.

P2 x + 3, x + 2 = 0.

T Fine. Now, can you explain exactly what that means? Anybody explain that.... what that means?

P3 An unknown number + 3 (multiplied ? by) an unknown number and 2 = 0.

T An unknown number + 3, good; an unknown number + 2 ... what happens between the two numbers?

P3 Should balance.

T No.

P4 Joined.

T How are they joined? ...... Are they joined by adding, taking away?

P. Multiplying.

T Ah, by, now that's the important thing, isn't it? By multiplying. They're joined by multiplying. If I add 3 to an unknown number, Kelly, and add 2 to the same unknown number.... the unknown number is of a certain value. That value means that when I multiply the two answers together I get nothing. Now what do I get when I multiply 7 by 1?

P6 7.

4. Age: <u>13-14 years</u> Ability Range: <u>'O' Level Group</u>

T Right then, I said we were going to start off with, em, with number patterns, right? First of all, Pascall's triangle; em, without looking at those things on the board, how do you make up Pascall... Pascall's triangle? Yes?

P1 Ehm, by having the, say eight, hex, hexagon numbers and we have, ehm, a row coming down (?) and then a row roming down the other and you end up with one one, and then one two one, then one three five three one or something like that.

T He's talking about these figures at the bottom. First of all one (calend?) and two (calends), four, eight, sixteen and, er, (calends) come together and they all get (split up?). You can do that but in an examination where you're going to be asked to write down part of Pascall's triangle you're not going to start drawing cars and lorries. Yes?

P2 Two numbers above the eh.... the number you want and then you get the answer.

T Is that after the number one and you do what to it?

P1 You double it.

P2 You double it.

T No, you don't double it. Paul?

P2 You add nothing to it.

T You're gonna get nothing, aren't you?

P3 You add the number that's before it.

T What do you mean before it? Yes?

P3 You add the number... er .... to the right of and and er... the left.

T No, not to the right nor to the left. There's quite specific instructions.

P4 You have, er, a one and a nought and then underneath that you put one and then underneath that you put nought.

T ....(working on B.B.)..... That's the next answer that's wrong. Now what's the next? Susan...

P5 One, two, one.

T One, two, one. How did you get that? (B.B.)

P5 Well, you add the one and use.... well, it's nothing into that makes one and then the two ones, it makes two and then you've one over.

T So, for any one space you take the number to the top right and the top left and add them. O.K.? Well, how did we get a one there? Gillian!

P6 We added a one, two and I think (?)

T Right, we add this one which is top left to the nothing which isn't there, is that right? So all of the numbers down here we're going to get one, because you're going to be adding the one to the top right of it and the nothing which isn't there to the top left of it. Right, so the next line would be what?

P7 One, three, three, one.

T One, three, three, one. Next line, John. (B.B.)

P8 One, four, six, nought, one. (B.B.)

T Next line, John Prestwick.

P9 Eh, one, five, ten, nine, five, nought.

T Good. One more line. Yes?

P10 One, six, fifteen, twenty, fifteen, six, one.

T I've missed the middle one.

P11 Twenty.

T Right, we'll stop there. That's how we compile Pascall's triangle........

5. Age: <u>11-12 years</u> Ability Range: Mixed Ability <u>(C.S.E. & 'O' Level)</u>

T Next subject..... fractions. Just interested in one thing and that is terminating and recurring decimals. If we're given a fraction there is one basic technique used for turning a fraction into a decimal.... Which is, to divide the bottom number into the top number.... O.K.? There's two different fractions as far as we're concerned, terminating and recurring.

First, terminating fractions - this means that you can divide the fraction and it stops.

Right.... and now recurring decimals.

T You get a sequence of numbers repeated. Right, we'll try this one 4/7. Sevens sevens into 4.... a decimal point instead of noughts. (B.B.) Decimal point in the answer (pupil's name)... rapid calculation...

T Uh, uh....

P1 6......7

T Uh, uh.

P1 1

T 1...... (?) that's thirty.

P2 4

T 4...... 28 remainder 2.

P3 2.

T Remainder 6.

PS 8......... 7......... 6

T 8, 7, 6.......8, eight sevens are 56..... that leaves a remainder of 4.

Sssh..... 5 fives are 35, that's a remainder of 5.

P4 7 (with other mumbled numbers)

T 7, remainder of 1.

PS One.

T Right then, we've now got 5, 7, 1, 4, 2, 8, 5, 7, 1. We've found the recurring sequence eh? The first number is 5 and the last number is 8 before we come up against the next 5. Now there's a mistake made.... here. Where to put the dots. Some people put them above there. That's when you did that test in class and stacks of people did it wrong. Some people put it above the 5 and the 5 to show that that was the next.... the first 5 in the next sequence. Well, what that means is that this fr.... this decimal's going to be .5714285571428 so.... you put a dot above the first and the last of the recurring sequence so that your dot goes there and the dot goes above there..... right? If we had a recurring sequence like this... (B.B.) there's various ways of being able to do it. It's a three figure recurring sequence .... 0,1,7,9.... four, sorry, 0,1,7,9. There's no need if you don't want to put the dot above the 0 and the 9. If you want to you can put them above the 7......

6. Age: 11-12 years Ability Range: Top C.S.E. Group

T What is that as a percentage?..... Yes?

P1 Er - one hundred....er....

T I'll start right from the beginning again.

I've just sold something for six pounds. I've written it as six hundred pence, which is going to equal it. Every time we will have an amount of money and a percentage which are equivalent to each other. That selling price of six hundred pounds included a twenty-five percent profit.

Now.... the cost price as money we don't know, but what was it as a percentage? You quite correctly said it was a hundred percentage. We know this as an amount of money, but what is it as a percent? One hundred and twenty-five equals a hundred and twenty-five percent. I now want to know what the cost price is. Anybody any inspiration how we can find the cost price?

P2 Is it five hundred?

T Don't try to guess what it is.... Pupil 2 - work it out... like you did before.

T Right, how are we going to work it out? Now, we've got a statement. A hundred and twenty-five percent equals six hundred pence.

P3 .....(inaudible suggestion)

T Now, I'm afraid that won't work.
It's a good idea but it's one of those things that won't work. If I said to you, "a hundred and twenty-five pens cost six hundred pence, what is the cost of a hundred pens?" how do we work it out? A hundred and twenty-five cost six hundred pence, how much would a hundred pens cost? How would you do your sum?.....

P1 Find out what one cost.

T Right. You would find out what one pen cost. So can we find out the value of one percent? Yes; exactly the same way. What is the value of one percent? Yes?

P4 Six hundred divided by one hundred and twenty-five.

T Right, it would be six hundred divided by a hundred and twenty-five. If that's the cost of a hundred, or the value of a hundred and twenty-five percent, that six hundred divided by a hundred and twenty-five would be the value of one percent. How can I then find the value of a hundred pens, or a hundred and fifty....?

P5 ......(inaudible)

T Times it by?

P5 A hundred.......

T A hundred, right. So a hundred percent equals six hundred, over a hundred and twenty-five, times a hundred over one. Now what can we do?

P6 Cancel.

T Cancel: Fives into that goes twenty-five, fives into that goes twenty. Anything more we can cancel by?

P6 Yes.

T Twenty-five will go into six hundred, twenty-five goes into that once; twenty-fives into six hundred goes how many times?

P7 Twenty-four......

T Twenty-four; that's four for each hundred, so that will be twenty-four. What are we left with now? Nothing at the bottom, so we can multiply straight across. Twenty-four times twenty is? Four hundred and eight, or four pounds eight.

Now, Mark, because of the twenty-five and because he was thinking of a quarter, said you can think of a quarter and take it off. But I'm afraid it doesn't work there because it's a quarter of a hundred and twenty-five percent, isn't it? Not even that, it's twenty-five: well, I'm not quite certain what it is. Now, we are including that into your final amount in a percentage.

7. Age: <u>13-14 years</u> Ability Range: <u>C.S.E. Group</u>

P1 How do you find the answer to number 3?

T Ah... using Napier's rods..... Look at these (indicates rods).... Now to find 36 x 5 using the rods.
Take rod 3 and rod 6 with the index rod and look at row 5...

P1 Yes.

T This tells us what?

P1 It shows 1, 8, 0.

T Right. 1, 8, 0.... Can you see how it is obtained?

P1 Yes

T Right.... Use the rods to work out 36 x 2, 36 x 4 and 36 x 8.

8. Age: 13-14 years Ability Range: C.S.E. Group

T Even numbers are ones that we can divide by two. Odd numbers. ones that we can't divide by two.

PS Yes.

T Don't you think we ought to be a bit more careful about what we are saying? I can divide 3 by two.

PS Eh!!

PS Six.

T Divide.

P1 But you get a remainder.

T No, I don't get a remainder!

PS You do.

P2 You get minus one!

T Julie, what is it if I divide three by two?

P1 A fraction.

T Yes, what fraction do you get?

P1 $1\frac{1}{2}$

T $1\frac{1}{2}$, if you divide 3 by 2, you are splitting it up into 2 bits, and you'll get $1\frac{1}{2}$, so we need to be very careful about what we are saying, when say - we divide something by 2 we have got to divide it exactly by 2. Yes, Dawn.

P3 We say numbers that are divided by 2, but they only carry the whole numbers after.

T Yes, we must have whole numbers in the answer, mustn't we?

P3 Yes.

9. Age: 11-12 years Ability Range: C.S.E. Group

T Why do you think that house has a number 1A? Why on earth didn't they number it 1,3,5? See is anybody can tell us.

P1 'Cause they had one extra house on the end and they didn't know what number to give it.

T If they built it on the end, they'd just give it the next number.

P2 They built another house on the estate later.

T Samantha - Do you know what happened; were all the houses built at the same time?

P3 Don't know.

T Well, what probably happened is that that house was built after the others, I may be wrong, because I'm guessing now. If that was so, if the houses had been built and numbered 1,3,5 - which is what we'd expect, and then suppose they had a bit of spare ground on which another house was built, then they've got to fit another number in between 1 and 3 and we find them doing things like fitting in 1A. Right, see if you (to Samantha) can find if that is what happened; I may be wrong.

10. Age: <u>11-12 years</u> Ability Range: <u>C.S.E. Group</u>

T If I add 2 even numbers together, give me an even number.

P1 20.

T Another one.

P2 2.

T Right, let's add them together.

PS 22, an even number.

T I get an even number, now that happens every single time I add two even numbers together.... Does everyone agree?

PS Yes.

T You are quite sure?

PS Yes.

T Why are you sure?

P3 No, I'm not sure.

P4 If you add 2 even numbers together you are bound to get an even.

T All right, how many girls are sitting down that row.

PS Ten.

T And how many in that row?

PS Ten.

T And the third row.

PS Six.

T Two even rows, add them together, what do we get?

P2 20.

T Right, two even rows, add them together.

PS 16.

T Right, let's add the three together.

PS 26.

T An even number. How about if we had 2 odd numbers and added them together? 5 and 3 make?

PS Eight, even.

T 11 and 9.

P3 20.

T 15 and 7.

PS 22.

T 23 and 19.... come on quick.

PS 42.

T Stop there; what are we getting?

P4 Even numbers.

T Even numbers, yes. Why? If we add 2 odd numbers we are getting an even number. Yes, Kimberley?

P5 Well, if you had an odd row.

T Let's make it odd, come out of the way, Samantha, up you get, right, go out and stand by her, Debra, please. Do you agree that we have got 2 blocks where we have odd numbers?

P5 Yes.

P6 Nine and nine.

T Kimberley - if we put her to sit by her we would get an even number.

P7 No.

T Yes, come on, we can combine those two together to get a pair, because we've got an odd one there - I'm not saying you're odd! and we've got an odd there, and we put them together. Is that what happens, then? We've got an odd one from that pile and an odd one from this pile, that fit together to make a pair, to make an even number.

O.K. sit down. So that if we are putting even numbers together or odd numbers together what we are really doing is making up pairs of numbers, aren't we? And when I use the word 'pair' do you think of it in twos?

P1 A fruit.

T No!! When I say a pair of numbers (sigh!) you don't think of a fruit, do you?

P2 No - you think of two together.

11. Age: 14 years Ability range: C.S.E. Group

T I'm going to divide that rectangle into thirds, any suggestion as to how I can do it? Yes, Linda?

P1 Lines across.

T Lines going across, yes, on each one of the lines do you mean?

P1 Yes.

T Yes, that's it, right.

P2 Do we do the third?

T Yes, we'll do one third there, I'm going to do sixths on the second one, how do you think I could do sixths - Deborah?

P3 Put a line in the middle of each of those spaces.

T Or?

P3 Down.

T Go down, how many lines do I need to put down?

Ps Two, three, one.

T One, good, because I've already got it into three, haven't I, so that if I put one line down I've divided it up into two bits and one of those would be a sixth, good. Now I'll do twelfths.

P4 Oh, that's easy.

T It's easy, is it, Michelle. Right, come on then.

P4 All you have to do is have a square for each twelfth.

T Yes, so how many lines will I have going across in any rectangle?

P4 Five.

T Lines going across.

P5 Two.

T Then how many down?

P5 Three.

12. Age: 15-16 years Ability Range: Below Average C.S.E. Group

T Right, can we look at this problem for a minute; this is something that I haven't sort of mentioned so far - er - what?

P1 Can you do one going from the squares?

T Wait a minute, we can do all sorts of things but I want us to look at this aspect first. Don't draw this on yours. What's wrong with what I've done on the board? Theresa?

P2 They are not equal parts.

T Good. Right, you've got the right word there, equal, all the way along you see on those that we have drawn out so far, every time we've drawn a diagram we had to make sure that they were equal parts. We can't say one third unless we have divided it up into three equal parts. That is wrong what I have just done because we cannot just divide it up into any four parts and say that one of them is a quarter, each part must be equal. This fraction one over four means one whole one divided by, that line going across means divided, four equal parts, right, so that's what we have got to be careful about. Now, let's go back to this once again, we have fairly easily. Yes, Tracy?

P3 In division sums you sometimes have a line across.

T That's right, and it is regarded as division, isn't it? Yes, so think of that in the fractions. Yes, Michelle?

P4 Why did you put a line with the one-fourth because it wasn't divided properly?

T Exactly, That's what I'm saying, that is what is wrong. When we talk about a quarter it means that one whole is divided into four parts exactly, each part is equal.

Subject: PHYSICS

1. Age: 11-12 years Ability Range: Average C.S.E. Group

T Today we are going to try to understand more about air. First of all, what is air?

P1 It's a gas.

T Well, in fact it is a mixture of several gases, some of which are very important for living things. Do you know what some of the gases are?

P Oxygen.....

T Yes.

2. Age: 11-12 years Ability Range: 'O' Level Group

T Water vapour is one of the gases in the air. When water evaporates it changes into a gas called water vapour. You cannot see it or, indeed, any others because they are colourless and so invisible.

P2 What does evap.... evaporate mean?

T Well, you must have noticed that puddles don't stay wet. They dry up. The reason they dry up is that in the right conditions the water turns into water vapour - in other words, it becomes a gas and goes into the air. Have you noticed in what kind of conditions things dry most quickly?

P2 When it's hot and windy.

T Right. That's because the water turns into water-vapour more quickly when it's like that - both heat and wind increase the rate of evaporation.

3. Age: 15-16 years Ability Range: 'O' Level Group

T It has probably been noticed by most of you that a sounding body changes its apparent pitch when it passes the observer with considerable velocity. For example, a car horn or a locomotive 'whistle' appears to become lower in pitch as it passes the observer. This is what we call the Doppler effect...... But why does it happen...... pay attention! As the vehicle approaches the observer each compression or rarefaction leaving the sounding body is a little nearer to the compression in front than would be the case if the body were at rest. Thus, the frequency with which the compressions arrive at the observer will be greater than it would be if the sounding body is at rest. As the vehicle

moves away from the observer the frequency appears to be correspondingly lower.
Does anyone not follow that?
Right. If the sounding body is approaching the observer, what would we expect the pitch to be, relatively speaking?

P1 Raised.

T Right. The pitch is apparently raised and when the body recedes from the observer the pitch appears to be lowered.

4. Age: 13-14 years Ability Range: Mixed Ability Group ('O' Level & C.S.E.)

T Yes, Morris?

P1 Why pass electrical currents through liquids, sir?

T .....Well, Faraday had discovered that if electric currents were passed through electrolytes.....what are electrolytes... anyone... Baker?

P2 Liquid conductors of electricity.

T Well done. Yes...when electricity was passed through liquid conductors of electricity or electrolytes, chemical changes took place and he further showed that those chemical changes were related to the amount of current that had flown....
In other words, that the electricity was measurable. Electric current was measurable...... What does this seem to indicate about the atoms?

P1 They go from one place to another.

5. Age: 13-14 years Ability Range: Average C.S.E. Group

P1 Why does it need so much heat to melt a substance like a piece of metal?

T Heating causes the 'springs' between atoms to be over-stretched to an extent that causes the regular structure to collapse. At the point at which the collapse takes place the solid melts. To stretch the 'springs' in this way requires a supply of energy - What provides the energy, Sharon?

P2 The heat source, sir?

T Right. So it is not surprising that melting requires a good supply of heat. O.K., Harrison?

P1 Yes, sir.

6. Age: <u>11-12 years</u> Ability Range: <u>'O' Level Group</u>

T When a bar magnet is dipped in iron filings why do most of the filings cling near the ends?

P1 It must be more powerful there.

T What must be?

P1 The magnetism.

T Why do you think that is? Anyone? .... Well, these areas are known as the poles, one South seeking and one North seeking. They are of equal strength, are concentrated <u>near</u> the ends of the magnet and have the power to attract iron and steel.

7. Age: <u>13-14 years</u> Ability Range: <u>C.S.E. Group</u>

T Jeremy, bring your South pole towards my South pole (of bar magnets).

P1 It won't pick it up.

T Almost there. We say it won't attract. In fact, if you look, it is doing more than that. It appears to be.....

P Pushing the other one away.

T Good. Now, why do you think that is? .... Well, look at this (turns one bar magnet round so that N & S poles are facing).

P2 It picks that up.

T Right. Why does it do that, do you think? ...... Well, it's because the poles are what we call unlike. In other words, a North and South pole attract one another. Two south poles repel each other. Both poles can pick up pieces of iron and steel that are not magnetised.

P What about two North poles?

T The same as two South poles - so what will happen?

P(several) They will repel each other.

T Good.

8. Age: <u>13-14 years</u> Ability Range: <u>Average C.S.E. Group</u>

T Some boys and girls wear glasses because they can't see properly without them. Does anyone know why they cannot see properly?

P It's not clear what they see.

T True, but why is it not clear?....... Most of you can see clearly. ..... Well, the lens in the eye cannot focus correctly on the retina. This part here (indicates model) because the distance between the lens and the retina is too great or too small. All right?........

9. Age: 13-14 years Ability Range: Average C.S.E. Group

P1 Why are some lenses in glasses thicker than others?

T Anyone answer that for Paul?

P2 More powerful?

T More power if they are thick or thin?..... No one know?.... When the lens is thick it bends the rays more, see..... (puts different thicknesses in ray box)..... they converge more quickly.... Look there..... Everyone see that? Thicker lenses bend the rays more, so we say what, Pat?

P2 More powerful.

T O.K.

10. Age: 13-14 years Ability Range: Mixed Ability Group ('O' Level & C.S.E.)

T Most of you appeared to know that metals are good conductors of heat but very few explained why this is so..... So let's get it right. Metals possess a regular crystalline structure..... O.K.? ..... They also contain large numbers of free or very loosely held electrons..... Still with me?...... Rothwell?... If they are loosely held what can they do easily?

P1 Move about.

T Good. They can move easily through the regular structure.... It's a bit like musical chairs. For when an electron is moved from the end of something like a metal rod a positive charge is left there which attracts an electron leaving a positive charge further along and so on..... This is an over simplification, but it should give you the idea.

11. Age: 11-12 years Ability Range: Below Average C.S.E. Group

P Why is there a third wire in the plug?

T The third wire is a safety precaution. Can anyone suggest why it's necessary?......... No-one?

P Does it stop us getting a shock?

T Yes, that's its job. It's there in case a fault like a short circuit occurs in the appliance. The third connection goes to a ring of wire that is connected to.... to the earth..... see the dotted line on the diagram of the connection. ...... Look at it everyone.

12. Age: <u>15-16 years</u> Ability Range: <u>'O' Level Group</u>

T Some of you are making mistakes in the calculation..... You must be sure that.... that you take the correct distance moved..... If a man lifts a barrel of weight 200 N from the ground to a truck 1m high, the work is 200X1 = 200 joules..... But if he rolls it up a 3m long plank.... what distance do you take?

P1 200 x 3.

T No.... Now, that's the mistake many of you are making. ...... Although the barrel moves through 3m, the man does <u>not</u> exert a force as great as 200 N.... which is why he uses the plank, isn't it, Jones?

P1 Yes, sir.

T He's using the plank to save himself effort..... right?

P(several) Yes....

T How can you calculate the force he does apply? Remember you must do this for all cases like this (draws example on board). In (a) force 200 N and distance 1m, work done is 200 joules... because force is, Maynard?

P2 Applied upwards.

T Right... now in (b) what must you calculate before you finish off in the same way, Barbara?

P3 The - the force.

T Yes, the value of F.

Subject: CHEMISTRY

1. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Look at your write-up of last lesson's experiment. Your conclusions were in a few cases rather wide of the mark and in most rather limited and thin...... In other words, you only noticed some of the things that er - your results were giving you information about.

Now then..... many of you realised that the change that had come about for some of the nails was due to the process of rusting. But...... not all the nails had rusted so it should have been possible for you to realise why we can say that rust is a compound of iron, oxygen, water and carbon dioxide. You should also have been able to say why the nails have not rusted in certain of the test tubes. Let's have a look at the results again and see what they are telling us.

1. Iron does not rust in dry air because if the tube has been properly prepared there is no water and water is necessary in the process of rusting.

2. Iron will not rust under water if all the oxygen gas is dissolved because oxygen is necessary in the process of rusting.

3. Why did the nail in the salt water rust more quickly than the others?...... Because salt speeds up the process....

Is it essential for the process, Marie?....

P1 No.... because the nail rusts in tap water which is not salty ..... and in rain water.

T Good. It only speeds up the reaction.

2. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level

T What kind of a reaction is rusting, David?

P2 Chemical.

T Yes, a chemical action; that is why interfering with the reaction prevents rusting. How can the action be interfered with, Yvonne? Come on, the evidence is before your eyes.... Look at it.

P3 Grease.

T Yes, grease or paint helps to prevent rusting by interfering with the chemical reaction.

3. Age: <u>11-12 years</u> Ability Range: <u>Average C.S.E. Group</u>

P1 Sir. <u>How</u> does the balance work?

T Look at the scales..... Now some have got the beam on the top and some of them have got the beam on the bottom. We're concerned with the little divisions...... It starts at nought, one, two, and so on..... You can all see that these divisions are divided into ten small sections. Each is 1/10th of a gram. Now if 1.6 is wanted, how many little divisions must the rider be moved?

P2 Six.

T Right. ...... Six little divisions along the bar with the rider. ...... The thing that goes along the bar is called the rider and if the rider is a large square one it's the shaved off edge from which you take your reading..... the left hand edge. The other riders have a little pointer which points to the figure.

4. Age: <u>15-16 years</u> Ability Range: <u>Below Average C.S.E. Group</u>

T Start by dissolving your calcium nitrate in 25 cc's of distilled water. Why distilled water? .... Why not tap water?...... Well, it's got some other materials in it whereas distilled water has not, so if we want a <u>pure</u> solution, that is, one without any other substance in it, we must use distilled water. What sort of things could be in tap water?...... Anyone?

P1 Chalk,

T Possibly.

P2 Chlorine.

T Yes, things that have been put in the water to make it drinkable but which will contaminate our pure solution.

5. Age: <u>13-14 years</u> Ability Range: <u>Mixed Ability (C.S.E. & 'O' Level)</u>

T Suppose matter is made of particles, then what's a solid look like? If matter's made of particules, what's a solid?..... Should we say, ehm..... a block of ice. Now, in a block of ice, the particles can't move around. It's rather like you sitting in the classroom here. You're stuck there. You can't move around.... well, I hope not but, in a lesson, you're sitting there all in regular order and that's just what happens to particles in a block of ice. They're stuck there. They can't move around. However, when the ice turns to water,the particles can move around and, in fact, they do. They're just gently moving around banging into one another, so that's a liquid. Imagine a picture of a liquid. It's you moving around doing a practical, if you like. Not banging into one another too often, I hope, but doing a practical just gently moving around the room. Now what about a gas? Eh.... it's difficult to imagine a picture of a gas. Ehm, suppose the school catches fire. You probably all dash out into the middle of the school field and there you'd be scattered over the school field. Now, that's the picture of a gas. In a gas the particles are no longer close together. They've spread out over a wide area. They'll still bang into one another. They're much further apart..... so in a solid, the particles close together, not moving; a liquid, they're still close together but they're moving around banging into one and other. In a gas they're much further apart but they're still banging into one and other, all right. Now what happens when water.... well, let's consider this block of ice again. Take a block of ice. There the particles are.... all lined up.... just like you in (assembly in the hall?), if you like. Standing still, there they are all stuck there... Now, when ice melts, it's rather like..... breaking it. You're moving around gently in the hall, no running. You can go from group to group and talk to one another. That's a liquid. Now, as you heat a liquid up..... these particles start moving around, faster and faster. It's rather like.... a wet break and there's nobody in control in the hall. Somebody's gone out. To start off with you're all nice and orderly but gradually it gets rowdier and rowdier and you move around faster and faster. That's just what happens when water gets heated up. The particles move around faster and faster banging into one another more and more.... until..... in the end..... Well, if you were in the hall one or two people would probably get banged so hard they'd disappear out the doors..... In a beaker of water.... that's boiling, the particles move around so fast.... in the end, the particle near the surface is hit by another particle and is knocked right out of the water and that's just what happens when water boils...... Can you picture that happening?..... It's quite a simple picture really...... you can probably picture more easily somebody flying out of the doors in the hall.... ehm..... so you can see that.... it's quite easy when you start thinking about matter being particular to explain how things happen.... water boiling.... ehm, it all.... it can also be shown, it's been shown, I'm going to try and get a film to show you later on this year to show that particles are moving around.... What do you think would happen if, eh..... I mean you can't see a lot of water particles moving around, can you? No.... so you wouldn't, looking at that you wouldn't be able to say that the water particles were moving around but, if you were to put some very, very small particles in that water. (Blackboard)....................... and take a drop of that water with the very small particles in and put it under a microscope, hold the microscope and look at the little particles.... well, what do you think you'd see?..... You took these very tiny particles which you dissolved or placed in the water. They're suspended in the water... rather like, ehm... I can't think what I mean.... let's say soot particles but not really. Those tiny particles that you put in the water, now you're looking at the water with a microscope... magnifying up. Do you think you would see anything happening?....... If so, what do you think you would see?...... Nobody..... nobody courageous enough to say what they think they would see? All right, let's consider it (?). In the water, made of particles, the particles are moving around banging into one another. If you put very small particles of something else into there.... which you could see with a microscope.... what do you think you'd see on the microscope when, say, a water particle banged into one of these particles?..... Yes?

P	You mean it would shatter.

T	No, it wouldn't shatter, no. It, it, it's on the right lines. It wouldn't shatter, no.... I mean do you think if you looked with a microscope..... you'd just see lots of still particles? Or do you think you would see them moving?

Ps	Moving (very tentatively).

T	Come on, somebody. Do you think you'd see them moving or would they be still?

Ps	Moving.

T	Hands up! How many people think they'd be moving? Well, all right... most people think they'd be moving. Yes, they would be moving.... and they'd be moving around.... in a certain..... as each particle..... if you could look at this one particle....as it got bumped it would move and (slow up?) rather like you bumping into somebody in the hall.... and then it would be bumped by another particle and it would move about like that, then another one. There would be a sort of random motion, like that... and, in fact, if you do do this experiment, if I get this film, you'll see it happening under a microscope. You'll see that these particles do move around in a very..... They're sort of shaking like this as they move. So there's pretty good evidence then that matter is made of particles.

6. Age: 13-14 years		Ability Range: C.S.E. Group

P1	Why are sugars called carbohydrates?

T	It's a term that applies to all sugars and other compounds like starch that can be readily converted into sugars by hydrolysis.... The name comes from the fact that they contain only carbon, together with hydrogen and oxygen in the correct proportion to form water. However, they are in no way comparable to those compounds that we call hydrates, so don't let that part of the term confuse you..... Can you think of any other chemicals where... er.... where something like this term is used......
Yes, David?

P2	The hyd in hydroxide.....

T	Good.

7\. Age: 13-14 years Ability Range: 'O' Level Group

T Before the development of sulphide dyes, why was it necessary with most dye stuffs to use a different process when dying cotton than with silk or wool?

P1 Because they take up the dye easier.

T Nearly..... anything else anyone can add? .... Well, wool and silk are protein fibres and are not only more readily dyed when just heated with a solution of the dye stuffs.... they are dyed permanently. .... Cotton and linen, which are cellulose fibres will not retain the dye permanently even after boiling in a solution of the dye stuff.

8\. Age: 13-14 years Ability Range: 'O' Level Group

P2 What keeps the dye in then?

T The cotton is first impregnated with a solution of a metallic salt which is hydrolysed by the action of steam. Why do you think this is done?.... Clare?

P3 I'm not sure.

T After being hydrolised the material is impregnated with the hydroxide of the metal. It is then dyed and the dye attaches itself to the metallic compound in an insoluble form and is retained in the cotton.

9\. Age: 15-16 years Ability Range: 'O' Level Group

T Powdered antimony bursts into flame when dropped into chlorine ...... forming what? .... Anyone?

P1 A chloride?

T Good. Yes, a chloride..... Anyone know why we don't refer to this burning as true combustion? .... Well - true burning is generally defined as direct combination with oxygen.... The reaction we have is chemically a form of oxidation because the term oxidation is used when referring to any reactions in which electrons are lost whether oxygen is involved or not.... Antimony loses electrons in its reaction with chlorine so although not true combustion it is.......?

P2 Oxidation.

T Right

10. Age: 13-14 years   Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Everybody settled?..... We are starting new work today which will last through to half term.... the topic is Nitrogen..... Let's have a quick look at it. Anyone know anything about it..... What is it?

P1 It's a gas in the air.

T Good.... it's one of the gases in the air.... Anyone know anything else about it?..... What makes it rather an odd element?

P1 It doesn't seem to er.... do much. It's passive.

T Now, that's part of what makes it odd.... As Andrew says, it's passive.... or inert as it's often defined.... but this is only true when it is uncombined. If I said nitroglycerine, what would come to mind?.....

P (several) Explosives.....

T Right... That's what makes nitrogen odd. Its compounds are often powerful explosives, which when you think how unreactive it is as an element.... well, it's unexpected, isn't it?

11. Age: 11-12 years   Ability Range: 'O' Level Group

P1 Miss King, is it bicarbonate that causes hardness in the water?

T Yes.... Do you remember why and what kind of hardness?

P1 Er...... is it permanent?

T No. It's temporary hardness which is lost when water is boiled..... The reason it is lost is that any bicarbonate.... er.... decomposes to give insoluble carbonates when it is boiled....Does that happen with permanent hardness?

P1 No, Miss King.... it gets worse if you boil it.

T Right.

12. Age: 11-12 years   Ability Range: C.S.E. Group

P1 What's happening to the gas?

T Did you watch the demonstration with bromine?

P1 Yes, sir.

T Well, in exactly the same way you can explain what happens with the carbon dioxide. This goes into the upper gas jar for the same reason.

Although it's heavier than air.... sounds very unlikely, doesn't it, so why does it go up?..... Well, it's because of the way the particles are moving around, banging into one and another, colliding, they slowly get pushed up there.... What did you notice with the bromine?......

Did anyone take a note of what happened?.... Well, to start off with, I had a fairly uniform brown colour in the lower gas jar, immediately I was taking the cover slide away..... but slowly this brown colour went into the upper gas jet. Now, it didn't go straight up and give you a uniform brown throughout the whole of the two gas jars. It moved very slowly up.... the reason it was moving slowly up was because it was taking time for these particles to bang into one another and move up here..... Is that clear?

Subject: BIOLOGY

1. Age: 13-14 years Ability Range: Mixed Ability C.S.E. & 'O' Level)

T Today we are going to take a closer look at eggs. Does anyone know what the shell of an egg consists of?

P (Several) No.

T Well, it's mostly chalk or calcium carbonate with a little calcium phosphate. Looking at the opened egg can you see what is next to the shell?

P1 A sort of skin.....

T The shell membrane.... good. Well, this divides the broad end of the egg into two layers to form an air chamber which allows the embryo to breath air in a fertilised egg.... You realise that there is no other way the egg can get air?.... What stops air getting in?

P2 The shell.....

2. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T The yolk is roughly spherical and is surrounded by a thin elastic membrane. Underneath the yolk membrane is the living embryo. Attached to the yolk are two fibrous hoists. Does anyone know what they are for?..... No?...... Well, they are balancers. They keep the yolk in position with the embryo uppermost. Why is this important?

P2 The bird inside could be hurt when an egg is moved.

T Right. The egg gets moved around in the nest and this device makes sure that the embryo stays in place.

3. Age: 15-16 years Ability Range: C.S.E. Group

T Right! (noise) Listen, Mary! Your blood goes to all your organs, brain, liver, kidneys.

Ps Miss, Why does your blood go through your kidneys?

T Sh! Listen! Your blood goes through your kidneys and your kidneys take out the salt and a thing, a bit, a thing called urea, which is, which is waste bits in the blood, waste products, all the waste, the things that your body doesn't want, and lots and lots of water. It's mainly water and it takes that out, an', in fact, it takes out over a hundred litres (pause) a day. (children gasp). But, of course, you only get rid of one litre.

P I'm 'ungry now. (Laughter).

T Do you? All right, sh! Otherwise you'd just get bigger 'n bigger 'n full of water, wouldn't you, if you didn' get rid of it?

4. Age: 11-12 years Ability Range: 'O' Level Group

T Can anyone tell me why many living things need air?

P1 To live.

T Yes, but why do you need it to live?

P2 To breathe.

T Good. But why do living things have to breathe?..... No one?.... Well, living things need oxygen from the air. Breathing it in is only part of the process. It has to be taken to each cell in the body so that by a special process called respiration it can get the energy it needs to function. Have you learnt about chemical actions in chemistry some of you?

P (several) Yes..... Yes, Miss Powell.

T Well, respiration is a chemical action and oxygen is an essential part of the reaction which finished up releasing energy.

5. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

P1 There are sharp things on it. Why does it have those?

T Yes, that's right.... spines. These are for removing pollen from nine rows of combs on the inside of the .... er..... hind leg. These combs clean the middle leg...... The pollen falls into a hollow and... ehm.... by flexing the leg it is compressed and passed into the pollen basket. Can you see them?.... It's rather like combing your hair, isn't it?

P1 Oh... yes.

6. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Yes - Anne?

P2 Miss.... Don't the bees have trouble feeding themselves and all larv.... em.... eggs.

T They don't feel them all.... The drones are turned out to die over the winter.... (noise of pupil comment). Don't be silly... .... only the workers, queen and young larvae... er... go through the winter. Ehm.... Nurse workers feed the larvae on regurgitated honey and pollen.... (noise from class)... and honey.... I mean pollen.... one kind for the (future) workers and males, and 'royal jelly' for the future queens. Ehm.... the food is changed according to the age of the larvae.... Now, er, are there any other questions before Mr Herbert comes?.... How do you think we know how they go through the winter?

P Do they watch real bees through glass?

T Yes, ehm. They probably do... er....working on a comb.... between glass.... er. Mr Herbert is bringing a hive.... to show you how it works.

7. Age: 13-14 years Ability Range: C.S.E. Group

T Right... from your stomach, goes out of your stomach, where does it go to then? What's the next part from your stomach? (Laughter and calling out). Quiet, listen.... where does it go to next in the body? (P goes right down there!) Goes to this part here. But what's.... what's there, that's all coiled up?

Ps (Various attempts at answers). The catty.....bellybutton. Cattyfactor. (laughter).

T The capillaries? Yes, there are capillaries there.... No?.... You go on to your intestines, surely you know what your intestines are. You know that they're there, don't you?

P I don't.

T Did you know they measure up to about twenty-five feet long, your intestines?

P No, miss.

T Well then.... in fact.... all this puts something through your mouth right to your anus (laughter). That's thirty feet long, that whole tube!

P Miss! Miss, how do you know that it's thirty feet long when some of us are small and some of us are big?

T It's still thirty feet long.

P It comes out....

T It's much smaller when you're a baby 'n it grows as you grow older. It's still approximately thirty feet long... Why do you need it?

Ps (Start to discuss).... down to the bottom, don't it?

(The tape-recorder is switched off for a moment).

T Sh... Right. So, when food goes into your intestines, it's really in... it's in pulp, 'n it's.... it's just like water then. An'.... all round your intestines are all these blood capillaries that you mentioned, Sharon.

P Does your mouth get... (end of sentence lost in noise).

T Well, through the skin of the intestines goes all the food, all the important, you know, all the.... all your vitamins, and all your proteins.... and... erm.... the salts, the minerals, you've heard of carbohydrates, the fats.

8. Age: 11-12 years Ability Range: 'O' Level Group

T Well, you all seem to know that living things are made of cells. Can anyone say why we have cells - what sort of things cells can do..... What is their function?

P1 You can't see them, so you don't know what they do.

T Ah, but by looking at cells through the microscope you can find out all sorts of things about them. You cannot see them or move them yourself but each cell does certain things for itself. They can reproduce themselves, take in food nutrient, go through chemical processes, get rid of their own waste. Now, why should they be able to do all those things?

P2 They must help to keep us alive.

T Right. Each cell has a special job to do in your body. Some form linings, produce antibodies or become muscles. So, you see, they are busy all the time.

9. Age: 15-16 years Ability Range: 'O' Level Group

T Before we go on to look at leaf structure and transpiration, can we check the way in which the guard cells work. First of all, why does the plant need them?..... What are they controlling?

P1 The opening.

T Yes - the stoma. Right, they control the stoma which controls water loss. Now, what actually makes them work?

P2 They swell.

T Why do they swell?....... Does anyone know why they swell?..... What about the chloroplasts in the guard cells?

P3 Contain chlorophyll.

T Go on.... deathly silence!..... Exposure to light stimulates the chloroplasts in the guard cells to make sugars by photosynthesis, right? The increased sugar concentration in these cells causes water to enter from the cells around by.....?

P4 Osmosis.

T Good. Now the increase in the water content makes the guard cells swell and as the inner walls round the stoma are thicker than the outer walls, as the cell bulges they have to curve..... (Draws on blackboard)..... This enlarges the stoma. What would you expect to happen at night?

P They won't make sugar because it's dark and they can't photosynthesise.

T Right, so what will you expect the guard cells to be like?

P They won't bulge so the opening will be narrow.

T Good. Guard cells flaccid, stoma narrow.... So why does the plant need stoma?

P To control the loss of water from the cell.

10. Age: 13-14 years Ability Range: 'O' Level Group

T You can see that blood performs some very important services for the body so let's have a look at its make-up. What is the liquid part called?

P1 Plasma.

T Right. Plasma. This contains valuable proteins and is colourless.

P2 If it's colourless, why does blood look red?

T The red colour comes from the red blood cells which contain haemoglobin. These cells are produced in the marrow of the bones in the body. There are so many of them suspended in the plasma that it makes it look red. Do you understand, Anne?

P2 They must be very small because they don't look as though they are lots of little separate things.

T They are, but you will be able to see them later in the lesson when we look at a slide of a blood smear under the microscope.

11. Age: 15-16 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T (Completing diagram of a transect on board). There we are; that's the lot, now let's see if we can interpret the symbols and decide what it is telling us. Kevin. If you had not been to the place yourself, could you get some idea of it from the diagram?

P1 Well, you could, er.... well, you would know the land was rising because scale shows it at the side.

T Right. Anything else? .... Deidre?

P2 It's not all the same.

T Good. Can you say any more?.... Look at the diagram.

P2 Well, there's some places with a lot of plants and other bits with hardly any.

T Ah now, can we suggest any reasons why this is the case?.... Come on, anyone suggest why this is so?...... No?... Well, one of the things that is influencing the variety and density of the plant is the height. Look how many different plants grow down here (indicates). These bits here are almost bare.... What were they like, Sally?

P3 Rock.

T Right. Now plans need soil and in these parts where the rock is poking through only tough low growing, root spreading - gripping kinds can manage to survive. What's it like on top of hills, Garry?

P4 Windy.... and colder.

T Good. Both conditions that only hardy plants can survive. So now you see why, as Deidre said, 'it's not all the same.'

12. Age: 11-12 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Right. Can I have your attention now, please? (Pause) That diagram that you're .....looking at. You can see several things about it. Don't worry too much about the complicated words. The timescale down the side is important but the main things are these animal groups (pause) that you've drawn. And, as I explained last time.... the amphibia, the birds.... sorry, the amphibia, the reptiles and the fishes have all expanded terrifically in the number of species that they've had, and then they've retracted again. Some will have found to be less successful than others and so some of the species will have died out. Now, where did we say the birds and the mammals stood regarding that? What's the difference in the shape of the birds' and the mammals'... em graph, if you like to call it that, as opposed to the other three that I've already spoken about?

Pl (Colin?): They're still growing.

T They're still growing, or at least they haven't contracted again so you s- what does that mean in terms of number of species?

Pl More.... er ..... more to come, sir.

T There may be more to come, you've certainly got lots of them and they're still experimenting. Good. Now, going back down into history, as it were, going say when the fishes were quite young, three hundred and twenty-five million years ago, there were certain types of fishes in existence then. Two hundred and eight million years ago, coming up a little bit more recently, there were about the same number, but they may not necessarily have been all the same types. How.... is it possible that we can draw a chart like that?

P2 The fossils.

T The fossils in the earth, right. How do we know how long ago they lived, these fossils?

Pl By carbon dating.

T By... good. Yes, by carbon... yes carbon dating it's called.

Subject: ENGLISH

1. Age: 11-12 years   Ability Range: 'O' Level Group

P1 What - what makes a cluster into a message?

T We have already seen that Headings are often word-clusters which when added to can produce messages. The addition may be a word or a group of words but it does not merge with the Heading to form a cluster.... By and large most messages comprise at least two items to which we give the grammatical names of....? .... subject and........?

P2 Predicate.

T Yes.... so-called because, together, they make a prediction.... Messages unlike other sequences of words always - what, Janet?

P1 .... They - always predicate.....

2. Age: 13-14 years   Ability Range: 'O' Level Group

P1 Why is the passive form used at all?

T What normally tells us who has done an action in the sentence....?

P The subject.

T Good.... the subject..... However, we don't always know who has done the action and sometimes the most important thing in the... ..... er ..... message is not the subject but the action itself.... Now, the passive form lets you say both these things in a sentence ..... The terrorist murdered his victim.... can be said in the passive.... if we don't know who the murderer is.... as the victim was murdered. (Underlines on board)
They made the exam results known on Tuesday..... Vera?

P2 The exam results were... um.... made known.... on Tuesday.

T Fine.... Does everyone follow what I have been saying?...... Good.

3. Age: 13-14 years   Ability Range: C.S.E. Group

T I want to start off by discussing... the er.... the miracle play and to show in what ways it is a special kind.... of festival play. Does anyone know what is special about a miracle play?

P1 It's about something that.... that happens in the Bible.

T It is, but then so were all the festival plays. No, what marked out the miracle plays from other religious festival plays was their.... er their association with an annual religious procession

held in the towns..... The feast of Corpus Christi was a very popular one.... The play was always organised by the townsfolk themselves so miracle plays were essentially community plays. Each guild was responsible for one scene, usually one that... was.... er... something to do with its craft.
Anyone give me an example?

P2 Taylors could make costumes.....

T Right...and bakers and vintners might do the Last Supper scene...

4. Age: 15-16 years Ability Range: 'O' Level Group

T Why do you think it was possible for Abigail and the other children to persuade members of the community that witchcraft was rife among them?.... Were there any events that had prepared the ground?

P1 Some of the people seemed to want to believe it.

T How do you mean, Rosemary?

P1 Well, Mary Putnam... who... who lost all her babies could blame it on... on... witchcraft.

T Good...and she is not the only one who wanted to believe in something... some evil force. Reverend Hale sees himself as Miller tells us, as 'a young doctor on his first call' and in his zeal to identify and wipe out what he sees as an evil force he too is guilty of seeing only what he wants to see'...... Any other reasons?

5. Age: 15-16 years Ability Range: 'O' Level Group

T Starting off. Two points to make. Two terms I'm going to be using before you start. One of them is 'imagist' i-m-a-g-i-s-t (spelling) and when I talk on imagist technique... I'm talking about a technique of poetry..... Anyone know anything about this technique?.... anyone know what it is?

Ps (several) No.... No, Miss Threadgold.

T It's where you get a creation of a mental picture from the words, like a word picture. And this picture will be put alongside another, probably without comment, so you get juxtaposition of images without connecting comments so that the reader has to fill in the implications.... Understand? .... What's an image, Jenny?

P1 A mental image.

T O.K.

6. Age: 15-16 years   Ability Range: C.S.E. Group

P1 What does it mean when it says the 'curled up knees of Jesus choking in the air.'

T Anyone any ideas?

P2 Um... curled up could be just a description of a baby.... you know how a baby lies in his cot.

T But 'choking' is a disturbing word. It suggests death and must, I think, be looking forward in time to the crucifixion eventually - um - suffocates the victim. He has to push up with his legs to get enough air and as he grows weaker he cannot do this and suffocates. That's why the thieves on either side of Jeses asked the soldiers to do what.... Paul?

P3 Break their legs.

T Good. You see, they would not be able to push up then and would suffocate more quickly.... putting an end to their suffering.

7. Age: 11-12 years   Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T O.K.... settle down and have ready the questionnaires you used... Now, let's go through each question in turn, starting where we left off yesterday.... um.... it's number.... 5.... I think. 'Has television interfered with family life.... What came across from the interviews?..... Janet.

P1 The lady I was interviewing thought it had spoilt family life...

T Did she give her reasons?

P1 No... she just thought it had.

T Any person disagree?............... Not all at once.... Kevin?

P2 Mine said she thought it brought them together......

T The family?

P2 Yes, Miss.

T Why do you think we are likely to get quite different views on this one?

P3 There's no right answer.

T Good. Yes.... this is a matter for opinion.....but why such opposed opinions.... I wonder.... Anyone? ..... Well, I think it must be to do with the kind of life going on in the home. If before telly.... er the husband.... say.... went to the pub and the kids went out on the street, the wife could think it was better if after they had the telly, everyone stayed in and watched together. On the other hand, if they had been spending time following interests or perhaps all joining in a special hobby.... what might happen after the telly arrived?...... Debbie?

P4 They might drop their hobbies and just watch.

T Right.

8. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

P1 Sir, there's about twice as much 'violent' news in my paper than there is in Clem's and sometimes although.... er it's the same thing.... it's.... it doesn't seem to be the same..... They don't always agree about the facts.

T What did you expect, Jane?

P1 ......I don't know....I suppose I didn't think they'd be much different.

T There are several reasons why they are different.....

P2 One could have made a mistake.....

T That's right.... or both could be wrong.... It doesn't do to believe all you read not only bceause reporters make mistakes but - um..... each reporter has his own views and this may give him a bias...... Another reason is that people have to be er.... tempted to buy newspapers so they try to make them.... the way they.... er..... think their readers like them.... Jane's paper has a lot more detail about 'violent' happenings than Clem's. If this happens most days it is likely that the paper is aiming to attract people who want to read this kind of news... Yes, Don?

P3 My dad says the Telegraph has the best sports cover and that's one of the reasons he takes it.

T That's just the kind of reason that sells papers... though of course your dad may go for the political views.... most papers tend to be for one or other political party.

P4 What about The Times, Miss?

T Well, that does try to be neutral.... although this is a very difficult thing to be... I.... I think The Times does try to let you know when it is offering an opinion and... and when it's reporting fact. What else could a paper do to avoid... well, to avoid the things that Jane was mentioning.... How could they be more accurate?

P3 They could check all the items.

T Good. Careful checking would help, but of course it takes time and costs the paper more to check.

P2 They might be late getting the... um... the article in the paper.

T Right.... papers do like to get things out fast, otherwise it isn't news any more.

9. Age: 15-16 Ability Range: 'O' Level Group

T I want a word about your essays before we go on with our reading. On the whole they were quite a good set but no-one.... no-one took up the point that one of her readers made about 'Emma' being 'too natural to be interesting'..... You all concentrated on 'Emma's' character and forgot the character of the author. Now what do you know about Jane Austen's views of contemporary writings that would help..... Anyone?...... Did she know anything about it?.....

P1 She read a lot herself.

T Right... so she was in a position to criticise... well?

P2 She was critical of it... she didn't think much of a lot of it.

T Yes... but why didn't she like it?...... Surely you recall how she disliked pretension. This led her to have a distaste for the absurd artificiality of contemporary literature.... she was particularly galled by the unnatural and sterile conventions of the time.... which is why she would probably be pleased with a supposed criticism.... made er made on the grounds of her work being too natural.... Which of her early novels mocks novelistic habits?.... Pam?

P3 Northanger Abbey.

T Good.... a light hearted romance... but she is not laughing in her criticism... she is using it to attack what she despises.

10. Age: 13-14 years Ability Range: C.S.E. Group

P1 Why did he decide not to kill them after all?

T Can anyone suggest a reason?..... Yes.....

P2 He may have liked them and... er felt sorry for them.

T Well, stronger than that, I think.... If you remember he had killed a lot of others in cold blood and not only let them go free.... he.....

P3 Killed himself with the poisonous ice....

T Right. So he must have been feeling pretty bad, don't you think.... My view is that, like Sarah said, he found these people very different from the others who had come to the island but he might still have killed them if something hadn't happened to him, which the author just hints at..... Anyone notice?.... Doesn't the author suggest that he has fallen in love with Miss Belcher?....... Read that section again..... (several minutes while reading goes on).

T Now then.... anyone agree with me.... hands up... Oh, lots of you. I think it's possible that this, plus the fact that Miss Belcher won't return his affection is what makes him do what he does. Do you think that's possible?.....

P4 I think it is because he could have seen how bad and lonely he really is..... (murmurs of agreement from pupils).

T Good... that's just what might have caused him to take the poison.......

Subject: HISTORY

1. Age: 11-12 years Ability Range: 'O' Level Group

T When Britain was part of the Roman Empire, the Celts of the North-west did not learn Roman ways and so were never to be trusted to keep the peace. Also, across the frontier of Hadrian's Wall in the North lived the Picts, fierce barbarians who were always ready to attack, while across in Ireland lived the Scots who were eager to settle in Wales.... Yes - Windsor?

P1 I thought the Scots came from Scotland.

T You are not alone and not wrong as you will see when we trace the movements of each race. However, at this period they were living in Ireland and being kept at bay by the strength of the Roman-British fortifications. Does anyone know why in the end the barbarians were able to make successful attacks in many parts of Britain and to plunder the rich villas and farms?..... Well, the trouble was that barbarian tribes on the continent began to attack Gaul and even Italy - the home of....? Betty?

P2 The Romans.

T Right.... When this happened Roman troops were called back from Britain to fight on the continent. This left the forts under-manned and warrior bands were able to attack and overcome some of them.

2. Age: 13-14 years Ability Range: C.S.E. Group

T In the time of the early farmers every family had to grow or hunt its food... what happened to change this?.... Why did some of them stop doing this?....

P1 Er... people began to sell things.

T Yes, they began to trade. But what discovery really set up trading as an occupation?.......
It was the discovery of how to make bronze. Not only did this provide tools which could be traded for other goods but craftsmen began to shape ornaments, weapons.... plates.... out of bronze. The smith kept his methods secret..... do you see why?

P2 So the others in the tribe would look up to him.

T Good... He was a man of some importance.

3. Age: 11-12 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Is there anything you can see in the picture that's going on... what's happening?.... Yes?

P They're taking down the buildings.

T They're taking down the ruins of the buildings. You can see these men here. They're moving a large stone. These men here have got a rope round it and they're pulling. This man here's got a, ehm, piece of wood to act as a lever and these men here are lifting some pieces of carefully made stone and they're carrying them away. So these are Anglo-Saxons inside the ruins of a Roman town. Now, can anybody tell me what on earth the Anglo-Saxons would be doing inside the ruins of a Roman town? Yes?

P Taking the stones.

T But why should they take the stones?..................
Well you see, the Anglo Saxons weren't as we've said particularly civilised and so as somebody said they didn't know very much about architecture. They didn't know how to make buildings and so here when they came to a Roman town, here were stone buildings that still stood and here were some stones which still remained and so they took these, moved them away and they built their own places. In many cases, where the Anglo-Saxons first settled, there was just an ordinary Roman town that had been deserted...... Rather like the one in this picture.

4. Age: 11-12 years Ability Range: 'O' Level Group

T About half a million years ago a new arrival appeared on earth. He walked on his hind legs and was covered in hair. He is sometimes called an 'ape man'.... Yes, Sanderson?

P1 Why didn't they call him an ape? Why a man?

T That's a good question. Well, in addition to having arms and fingers with nails the most important difference is the size of his brain. This is larger than any other mammal and he used it to survive. He learnt to chip stones and with these to sharpen points on spears..... He hunted animals using the spears and made a shelter for himself from branches, or, in winter, used a cave. In other words, his development was more like that of a man which is another reason why he is called 'ape man'. ...... O.K.?

P Yes.

5\. Age: 13-14 years   Ability Range: Mixed Ability (C.S.E. & 'O' Level Group)

T First of all, I want to talk about Cromwell's recall from Ireland - where you will remember he dealt with the conquered Irish people with great savagery..... He took only six months to accomplish this being recalled in May 1650 to face a new danger ..... this time.... from Scotland. Now why do you think the Scots should pose a threat?..... What brought about this revolt?

P1 They wanted revenge for the King's death..... while Cromwell was out of the way.

T It's a good idea, but what they really wanted was the establishment of Presbyterianism.... something they expected after the execution of the king. They forced the late king's son.... also called Charles.... to sign a covenant agreeing to accept this religion and offered him their support in winning back the throne. Did it work?..... Janet?

P2 No, Miss. He was defeated at Worcester and had to escape to France.

T Right... leaving the burden of leadership to Cromwell.

6\. Age: 13-14 years   Ability Range: 'O' Level Group

T The homework wasn't particularly well done and some of you could not have read the chapter properly. What you seemed to forget is that, by and large, Elizabeth did not greatly care about people's religion. The important thing for her was their loyalty. If you remember she does not seem to want to execute her cousin. Do you remember?..... Karen?

P1 She wouldn't act when the first plots were discovered.

T Right... Things were getting worse, the Pope was training young Englishmen as Jesuit priests in colleges abroad and sending them over to win converts to Catholicism and Catholics in England were having a hard time.... Why was this?.... Was this because of their religion, Andrew?

P2 Er... yes, I think so.

T No. It was not, in fact! They were being accused of treachery.... It couldn't go on, and eventually letters between Mary and a conspirator named Babington (writes on board)... brought things to a head. The letters proved that a plot to invade England and remove Elizabeth was planned and Elizabeth decided she must remove Mary.

7. Age: 13-14 years Ability Range: C.S.E. Group

T Can anyone remember what factors encouraged the growth of a town?

P1 A castle.

T Good. Any others?..... It was often more than one thing and some were more important than others... Any more that you can think of?.....Well, there were others like castles that brought people to the town.... not for protection this time, but as pilgrims.... Yes, Dennis?

P2 A monastery.

T Yes. Monasteries and churches - but you still haven't given the chief factor...... No? .... Why did some villages grow into thriving towns?...
Well..
It was the possession of a market. In some places they had been there for a long time but, in others, the lord obtained a charter from the king and established one.... Having one brought traders and encouraged craftsmen to settle.... The lord allowed them to pay rent instead of labouring in his service, which left them free to do what, Beverley?

P3 To make things....

T Good.... They could work at their craft and were also free to trade and all this encouraged more and more people to the place ...... turning a fair number of villages into towns by 1377.... Have a look at the map on page 23 of your books.

8. Age: 15-16 years Ability Range: 'O' Level Group

T After the defeat of the central powers, why did the 'victors' find it very difficult to agree the new map of Europe?

P1 Most countries tried to get as much as they could from the agreement.

T What sort of actions and situations caused most trouble....?

P2 Secret treaties?

T Right.... Pledges had been made during the war in secret and the pressure was now on to honour them.... But these were not the only complications confronting the peace-makers. ..... The main problem was the amount of territory that had changed hands throughout the war... and it.... it was very difficult to dislodge claimants... Can you give me an example of a country that behaved in this way?....

P3 Australia tried to keep control of German New Guinea.

T That's right.... they tried to insist that 'what we have we hold.'

9. Age: 15-16 years Ability Range: C.S.E. Group

P1 This question says - why was Henry II sometimes called the 'lawyer king'?

P2 I think he read a lot.

P1 He must have brought in some law or something.... Do you know why, Tony?

P3 No.... shall I ask Miss Bird?

P1 She's coming round..... (noise...................)

P2 Miss..... we ...... we don't know the answer to number 4. Is it 'cos he read a lot?

T Well, he did read a great deal and was intelligent and educated but it was what he did to reform the law that.... that makes the words er.... right in his case. Haven't any of you read about his changes in the .... um.... the courts? What did he do about trials?

P3 Didn't the barons used to.... to..... they ran the courts -- and they weren't always fair.

T He certainly mastered the barons.... in .... law but he did more than that he really set up a proper legal system. When he came to the throne.... there were at least five.... five different systems of jurisdiction but by sending out his... his representatives he brought criminal offences of all kinds under the crown.... By choosing carefully.... and trying them out.... he formed a group of men trained to administer justice in the courts.... we call them.... Tony?

P3 Judges.

T Good. Now, that's only a start.... Read pages 193-199 in this book and you will see how much he did to set up the rule of law in this country.

10. Age: 14-15 years Ability Range: C.S.E. Group

T Yes, Linda?

P1 Why did they call the new colony Virginia..... when the queen was called Elizabeth?

T Well..... some places did have the name Elizabeth in them... But in this case you see they were remembering that the queen was... was not married.... not being married she would be a virgin.... she was often called the virgin queen. Do you see, now, where the name came from?

P1 Oh yes..... Does Virginia mean virgin?

T I'm sure it must, though.... I haven't looked it up in a dictionary of Christian names.

Subject: GEOGRAPHY

1. Age: 15-16 years Ability Range: Below Average C.S.E. Group

T What do you think will be the advantages for the Lake District of being marked out as a National Park?...... Jenny?

P1 They'll keep it looking nice.

T Yes, indeed, but it goes much further than that............ anything else?.......... well, in keeping its natural beauty they must, as Jenny says, look after it properly..... but, in fact, they have to take measures to improve its beauty...... they can remove dead trees, unsightly buildings, and so on. They must also improve its recreational facilities..... What might they do.... on ...... on this side, Norman?

P2 Provide camp sites, places where you can buy food.... or stay.

T Good.... anything else? ...... Anne?

P3 Places to sail or swim.

T Right... not to mention proper areas to park cars.

2. Age: 13-14 years Ability Range: 'O' Level Group

P1 Sir. Why are there farms under water at Haweswater?

T Well, the Corporation of Manchester in the process of converting the natural lake into an artificial reservoir made some very drastic changes which involved submerging everything below a certain level in the valley. The new village.... much higher up, is which one.... Geoff?

P2 Burnbanks.

T Right. This was created by - by Manchester Corporation to replace the old farmhouses that had been 'drowned'..... What other examples have you heard of?

P2 ...... inaudible.

T Good......

3. Age: 15-16 years Ability Range: 'O' Level Group

T Now, the homework you did last night was about steel making and I set you that homework because I said we were going to start on a part of the British Isles where the making of steel was one of the most important of its industries. Purvis, right, just attend to me. And what part of the British Isles did I say?

P1 Wales.

T What part of Wales, Cook, please?

P1 South West.

T Eh - South. South Wales - and you were drawing a map of Wales for me. Now - South Wales is one of our greatest....... Hall.... steel producing regions and as the film went on I think I stopped it and I told you that was one of the products of South Wales..... Scorer.... Now the next person I have to speak to, not attending, I'm a very good shot with chalk. Right, what did I show you on the film that I said this is what they do make in South Wales from the steel? Do you remember? It was something which was coming off at terrific speed off that rolling mill.... flaking off like a snake.

P2 Eh, wire.

T Not wire.

P3 Tape.

T Not tape.

P3 Er.... plate.

T Er... plate, yeah, steel strip or steel plate, correct, mm. Now what we've got to do is, we know the answer now, you see. I've rather put the cart before the horse this time. I've told you what South Wales produces, so instead of what we'd normally do, starting from South Wales and finding out what it's got and then what it uses these things for we can do it the other way round. We know what it produces... well, let's find out the working. Well, South Wales is an iron producing region, an iron and steel area, so there are certain things at once that we know that South Wales will have. It's got to have otherwise it couldn't be an iron and steel producing region. Right, what must it have?.... What must there be in South Wales? Eh? Chewing gum?.... Come on, what must there be for them to produce iron and steel? Why has it been able to develop a steel industry? What do you need to make iron and steel?

P4 Limestone.

T Limestone.... yes..... I wouldn't call that the most important one but there is limestone (interruption - teacher says "Thank you very much indeed")..... yes, there is limestone but what's the most important thing(?) (pupil's name)

P5 Iron ore.

T Iron ore.... yes, iron ore and.....?

P5 Coal.... coke.

T Coal and coke is made from.....?

Ps(Chorus) Coal.

T Coal. Right, so let's say coal (....?) and (cough interrupts) there's got to be air to produce the hot blast of, I think we can say.....

P6 Gas.

T Well, the gas comes from the coke but I was thinking about the air. I don't think we need worry too much about that, need we, Brown, because there's air.....

P6 All over.

T All over, yeah, there's air everywhere. That's a one that everybody can have. All right now, let's just go and look at this list and let's find out whether South Wales does, in fact, have this, these things. Well now, you drew a map of Wales for me, didn't you?.... and what did you put down in the south of Wales by shading?

P7 Coal area.
P8 Coalfield.

T Robson -- a coalfield, yeah. There is a very large coalfield in South Wales and it's called, strangely enough, you'd never guess what it's called - it's called the South Wales coalfield. The South Wales coalfield. It's a very big coalfield and we shall find out that it has just the right kind of coal which is needed because not all the coal is suitable for making coke. Right, there's the South Wales coalfield. Now, in the northern part of that coalfield there used to be discovered iron ore and this was mined along with the coal. Sometimes the two were mined together. Well, that was very useful, wasn't it? They could mine the coal and they were mining the iron ore as well (interruption by Mrs R) so in South Wales then we have the South Wales coalfield and we have the iron ore. Now this limestone..... well, coal is a mineral, you know, and it's only found with certain other kinds of rocks. I don't know if you know this but if you go into our Pennines or Cheviots here or if you walk along our coastline you can see these coal seams coming up, can't you? Right, and one of the rocks that the coal is found with is lime-stone. It's usually found below the coal. Now, if we look in our books, the British Isles books, this one, have a look on page... 68. You should have your books out, shouldn't you, Cook - eh? I know you were helping Mrs Richards. Page 68.... hurry up! Oh dear.... all right, now it says a section across the South Wales coalfield from North to South. Well, this is as though you made a cut clean through the rocks, a section. Those of you who do metal work or woodwork.... you may be used to using sections. And it's as though they had set off one of these atomic bombs and made a great big earthquake and caused the wo... earth to split open so that you could look down and see what sort of rocks you've got. Well now, if you look at South Wales here, what have you got? Well, we've got upper coal, it says, then we've got sandstone, then we've got lower coal. So we've got two lots of coal.... that's very useful, isn't it? Upper coal and lower coal. Then we've got what it calls, well ...... underneath, it says, old red sandstone but if you look you can see in the dotted area millstone grit and carboniferous limestone. Right.... carboniferous limestone. Can you see it printed down there on the left? So there we've got the coal and not very far below it we've got the limestone. And you notice that the limestone comes to the surface, doesn't it? If you follow that bed, the limestone is the faint red, right, ... the pink. It comes along and it comes to the gr...surface in the South and up in the North by what are called the Brecon Beacons, right. So South Wales then has iron ore, coal, limestone. So it has the three most important things you need for making iron.

4. Age: 11-12 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Look at the map in front of you..... Now... what do you notice about the distribution of crops and farm animals in England and Wales and Scotland?

P1 It seems to be... er.... some things are grouped together.

T Like what?

P1 Like wheat and barley....

T Yes... any reason for that?.....

P2 Rotation of crops.

T Well.... yes.... that would happen but as a result of what... you have to look at the distribution over the whole country to get the answer..................... can no one see a pattern? ...... Well, you are dozy today....Let's take sheep. The position of a lot of the sheep are on places like..... The Pennines. The Welsh mountains, the Chilterns.... all .....

P3 Hills or mountains.

T Right. Now we cannot jump to the conclusion that sheep like hills because we know they are also happy eating grass on lowland, so we can only assume that they are there because.... why, Michael?

P4 Nothing else will live there.

T Right. Cattle are not able to get enough grass on places like the Pennines and the soil is not rich enough to grow crops.

5. Age: 11-12 years Ability Range: 'O' Level Group

P1 Why are the lines different distances apart?

T They are called contour lines. If you look you will see they have heights marked.... Now if you imagine a hill - if there is a big space between that line and the next height it means the slope of the hill is rising slowly. If they are very close together it means... it's very steep. What are those there showing? (indicates on atlas).

P1 A fairly steep slope.

T Good. You've got it.....

6. Age: 14-16 years Ability Range: E.S.N. Group

T A lot of you have seen this book (P. I ain't).... er... it's got a lot of babies in it from all over the world. You'll see that some of them look very different from you. Look at this Eskimo lady and her baby.... what do you think about her?..... Put your hand up..... Julie?

P She's darker.

T She's darker skinned, yes (several voices) sh.... I must say put your hands up otherwise two people talk at once and we don't get the benefit of what you're saying. Yes, Cheryl?

P Her baby looks like his... like what his Mum is... or her Mum.

T Doesn't he? He looks very like his Mum. What about the clothes they're wearing? Cheryl?

P --------------- from sheep an' things like that.

T What's the word for it?

P Wool.

T Yes. er...

P Or.. er

T Fur

P Or fur.

T Yes, and why do you think they're wearing fur things?

P To keep 'em nice and warm.

T Yes.... so what do you think the weather must be like there?

P Freezing cold.

T Freezing cold weather, so they wear....

P Not like this.

T Not like this, that's right. Eskimos, they look very cosy in their nice warm clothes.

P Miss Knowles, can we have a look at that, please?

T Sh.... Yes, certainly. What about this little boy?

P ...... Indian.

T What do you think?.... Yes, but hands up. Andrew, what do you think?

P Indian.

T Why do you say Indian?.... He's not, doesn't look anything like an Indian..... You said it 'cos Kevin said it, didn't you? Now tell me something that you think about it.

7. Age: <u>11-12 years</u> Ability Range: Mixed Ability <u>(C.S.E. & 'O' Level)</u>

T Milford Haven used to be a small town in which sailing and some fishing went on.... Now, the tankers from all over the world bring oil to the refineries there. Why do you think they chose it?....... Schofield?

P1 It would give the people work.

T Well, that is true, but I don't think it is the most important one...

P2 It's a port.

T Right, but there are lots of ports they could have chosen..... What's its position for getting the oil from the refinery to the petrol pumps?...... Dyson?

P3 Bad, sir - there are no main roads until you get near Port Talbot.

T Good... so why choose it?..... Well, the reason is that it has one of the largest... and more important, <u>deepest</u> natural harbours in Europe, which means the tankers can come right up to the refineries instead of what..... Sarah?

P4 Having to have long pipes to pipe it ashore.

T Good.

8. Age: 13-14 years   Ability Range: C.S.E. Group

T   Right.... This morning we are going to look at our traffic survey and try to see if we can use the information to answer certain questions.... Have you all got your sheets ready? ....(noise)................................. Right... First let's see if we can identify the really congested spots..... the places where traffic gets held up for a long time or is always very slow... Gary?

P1   Near the bridge......

P2 (calling out) Both sides of the bridge.

T   Yes.... both sides.... any others?

P3   First part of the High Street.

T   O.K. .... anywhere else?

P4   Past the hospital going up Castle Street.

T   Are you sure... I have never been held up there, myself... How long were you observing this point and did the traffic really have to stop for long?

P4   It was stuck for ages... 'Bennie' was with me.

P5   It was, sir...

T   O.K. I believe you. Now what time was this?...

P5   Between 4.00 p.m. and 4.45 p.m.

T   Which day?

P5   Thursday.

T   That is odd because Thursday is early closing and usually quiet. .... What could have caused it?.... Wait a minute. I think I know why - It was probably a race meeting and that would explain it. Check that out, Graham.....

P4   I think there was one... though we couldn't see the entrance, it's round the corner from where we were watching.

9. Age: 15-16 years   Ability Range: C.S.E. Group

T   I noticed when marking your work that you were not clear about the reasons for making the Local Authorities in African countries collect the local tax which goes to the County Council. What happens to the major tax?... Yes?

P1 Goes to Central Government.

T Right. So why is there any advantage in having a local tax for the County Council to use?

P2 The Central Government might not know what - what the people want.

T Well, they will have some idea of the problems, but the people on the County Councils come from every part of their country and can let them know of local difficulties and possible improvements much better and quicker.... What's more the Councils have money from the local tax to try to do the things that... that need to be done.

10. Age: 13-14 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Now in the film you saw something of the different methods of fishing and you know... well, what did you learn about the importance the industry is to a number of countries like... Yes?

P1 In Iceland it's - it's most important.

T Right... and this country, of course. Can you think why the Governments of many countries involved in fishing exert certain controls?.... Anyone?.... Yes?

P2 You mean like saying where their fishing limits are?

T Well, that's the kind of thing - It stops other countries from fishing in what is considered to be a country's waters without permission..... I was thinking of a restriction on nets which makes sure that little fish can get through and only fish of a certain size get caught..... Can you see why this is done?... Joan?

P3 So little ones can get bigger.

T Yes.... and have a chance to multiply.

Subject: FOREIGN LANGUAGES

1. Age: 11-12 years Ability Range: 'O' Level Group

T Can you give us a plural form, Pam?

P1 Habitamus..... They live.

T No, that becomes habitant.... If you take any of those verbs, habitat, ridet, ambulat, whatever they may be, and put an 'n' in, it makes them into they do something instead of he or she, but there's one of them where it doesn't work.

P2 Est.

T Est..... because est becomes?

P2 Sunt.

T Sunt.... nothing like it. Est becomes sunt. Now, I wonder if you can tell me, eh, how you describe a word in a language which doesn't obey the rules.... it particularly applies to verbs. You call it a certain kind of verb and this is a good example of one.

P3 Irregular.

T Right. This is an irregular verb and if you have a word which is irregular.... disobeys the rules and so eh.... you don't try to make any others fit in, in a word like that. Est is different from the rest. For all the others, if they end in a 't' in the singular, for he or she does something, you simply put in an 'n' and that makes it they do something......

2. Age: 11-12 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T O.K. and the last one.... aller..... Je vais.... How does it go?

Ps Je vais, tu vas, il.... il va, nous allons, vous allez, ils vont, elles vont.

T Now what you have to remember is that.... er.... these four verbs, in fact the only four in Fr.... in the French language which in their final form, in the ils plural form, or elles, if you like, have o.n.t. S.o.n.t., f.o.n.t. and v.o.n.t. (blackboard). Look, each one. Ont, sont, vont, font. In addition, a lot of you are confusing this verb, especially in this form. Eh, sorry, I (confused) myself then, vous avez and this one, vous allez and, of course, the nous forms, allons and, eh, avons. Now, be careful

and keep those separate in your minds, would you...........
Now then, I shall leave the rest of that to you as far as the present tense goes, ehm, except to bring again to your attention the need for knowing thoroughly avoir for the perfect, the passé composé, O.K.

3. Age: 11-12 years   Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T   Several of you made the same mistake in your translation of No. 3 yesterday. Look at it now.... How do we say.... I like flowers. Those who got it wrong put... J'aime fleurs. Now in French the definite article 'the' is used whether or not there is a 'the' in the English, if the meaning is general. So what should No. 3 be, Dan?

P1   J'aime les fleurs.

T   Good. Now all of you do Nos. 10 and 15 for practice.

4. Age: 13-14 years   Ability Range: Mixed Ability (C.S.E. & 'O' Level)

P1   Why is there a de before pain?

T   There is a special rule about the use of de - Listen everyone so that you know on what occasions to use de or d'.... on what two occasions instead of the usual du or de la. These are, first after a negation to mean any...... He is not taking bread .... Il ne prend de pain. He hasn't any money - Terry?

P2   Il n'a pas d'argent.

T   Good. - Now, the other occasion is after an expression of quantity. - How many boys. Combien de garçon - a lot of boys. ..... Beaucoup de garçons. O.K. .... Brenda, does that make it clear?

P1   Yes.

5. Age: 13-14 years   Ability Range: 'O' Level Group

T   I want to start off this morning by explaining the agreement of past participles. What tense uses past participles, Dawn?

P1   Compound past.

T   Right.... Now there are two rules for the agreement of the past participle. One concerns those verbs that follow être and the other avoir. Let's make those following être first...... Can someone give me a verb that takes être, and I'll show you how it works......

P2 Aller.

T Right, aller - Now the rule is that the past participle agrees with the subject in gender and number. So - Il est allé (writes on board) but Elle est allée. Can someone write up "The men have arrived".... John?

P3 (writes on board)

T Good. Les messieurs sont arrivés. What would we add if it were the women who had arrived. Neil -

P4 Another e (writes arrivées).

T Good.

6. Age: 15-16 years Ability Range: Mixed Ability (C.S.E. & 'O' Level)

T Let's see how to make agreements when using avoir....
Now the past participle after avoir and the past participle of a reflexive verb agrees in gender and in number with the preceding direct object. This is the one that often gives the problems. Hands up those who are not too sure about what a preceding direct object is?.........
Hm.... most of you. ...... The direct object can often be located by asking yourself either what or whom. For example, sent what? or sent whom? If the answer precedes the past participle then the past participle agrees with the answer. For example.....
J'ai mangé la pomme..... Ate what, Philip?

P1 The apple.

T Does it precede the past participle?

P1 No.

T So - no agreement necessary. But if I write I ate it....
Je l'ai mangée..... Ate what, Annette?.....

P2 'It'.

T Where does 'it' come?

P2 Before the past participle.

T Good. So there is an agreement necessary.... Make the agreement for these examples when necessary (writes on board)........

7. Age: 13-14 years Ability Range: 'O' Level Group

T What is Karola asking for.... Fur heute abend.

P1 Something for the evening.

T She is asking for a room for this evening, meaning for tonight (fur haute nacht). Note two things, she will be asked to do... sign the register - tragen sie sich bitte ein - and what sort of room she would like if it's available....
What sort of room were you thinking of - was fur ein zimmer sole das sein? Right - now you know how to ask for a room.

8. Age: 15-16 years Ability Range: C.S.E. Group

T What would you expect the people in this part of the Loire to drink?.... Yes?

P1 Wine.

T Well, yes it would be wine but wine is not all the same, is it? Can you say what kind of wine by looking at the chart?..... Anyone?.............. Well, vineyards in that area are in the Muscadet region. So the wine will be dry and white.....
Has anyone tried Muscadet? .... No .... well, you will take my word for it, I hope, and perhaps we will have some next lesson.

Ps .....(excited agreement).

9. Age: 13-14 years Ability Range: C.S.E. Group

T Que fait Denise avec la boule de neige?

P1 Elle souffle.

T Qui--mais que fait Denise avec la boule de neige après elle souffle?.....................
.... No one... I think you must have failed to understand that part of the story. ...... Look at the sentence c'est n'est plus une boule de neige. C'est une belle pomme rouge.... Comprenez?

P2 An apple.

T Right. It's no longer a snowball, she has turned it into an apple.

10. Age: 15-16 years Ability Range: 'O' Level Group

T I noticed going over your work that you had very little trouble using the l'interrogatif-affirmatif 'simple' method but that you were less clear about other methods using est - ce-que and n'est-ce-pas. Can anyone explain how we deal with pronoun subjects and noun subjects? .... No one?........ Debbie?

P1 No, sir...

T Well, it's as well I brought it up.... A rule that helps is est-ce-que goes before je with a pronoun subject.... Est ce-que je donne? All other pronoun subjects are placed after the verb or auxiliary...... Did you give?...... Powell?

P2 Donnez-vous....

T Now for noun subjects you repeat the subject in the form of a pronoun after the verb or auxiliary. Is the boy singing.... Mark... What do we say?

P3 Don't know, sir.

T Oh come on. Turn it round to - The boy is he singing.

Ps Le garçon.... is is chanter to sing -

T Yes... carry on.

P3 Le garçon chante-t-il.

T Good... Let's try a past... Yvonne... Did my sisters come?

P4 Vene...

T Hold on.. turn it round in English first....

P4 Oh - er - Mes soeurs... er ven.... (teacher interrupts)

T Passé compose, Yvonne... No... can anyone help her?.... What should it be - Pete?

P5 Sont - elles venues?

T Good. So the whole thing is, Yvonne?

P4 Mes soeurs .... er .... sont-elles venues?

T Right.... I think we had better try some more with everyone working on their own.

A2.2 Nature and Distribution of Question Types Within Explanations

Subject: MATHEMATICS (Primary)

Explanation	What-Questions			Why-Questions			
No.	Sci.	Inf.	How	Ded	Pro	Gen	Te/f
1		4	2				
2		1	1				
3		1	2				

Subject: HUMANITIES (Primary)

Explanation	What-Questions			Why-Questions			
No.	Sci.	Inf.	How	Ded	Pro	Gen	Te/f
1		1	1				
2		1					
3		1				1	
4		1	1				

Subject: NATURE STUDY (Primary)

Explanation	What-Questions			Why-Questions			
No.	Sci.	Inf.	How	Ded	Pro	Gen	Te/f
1	1	1	1				
2		1	1				
3	1	1					1
4		1				1	1

Subject: ENVIRONMENTAL STUDIES (Primary)

Explanation	What-Questions			Why-Questions			
No.	Sci.	Inf.	How	Ded	Pro	Gen	Te/f
1		1					
2		1				1	
3		1					1
4		1	1				

Subject: RELIGIOUS EDUCATION (Primary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1		1					
2		2	1				
3		2					

Subject: MATHEMATICS (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1	1	1	2				
2			1	1			
3	2	1	1				
4		2	1				
5		1	2				
6		1	1				
7			2				
8	1		1				
9		1			1		
10	1	1	1				
11			1				
12	1	2					

Subject: PHYSICS (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1	1						
2	3						
3	1			1			
4	2			1			
5				1			
6	1			1			
7	1			1			
8							
9				1			
10	1			1			
11				1			
12	1		1	1			

Subject: CHEMISTRY (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1				3			
2	1		1	1			
3			1				
4	1			1			
5	3	2	1			1	
7				1			
8	1			1			
9	2					1	
10	3						
11	1			1			
12	2			1			

Subject: BIOLOGY (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1	1	1					1
2	1						1
3							1
4				1			1
5							1
6			2				
7		1	1				1
8	1						2
9	1		1			1	2
10	1					1	
11		2				1	
12			1			1	

Subject: ENGLISH (Secondary)

Explanation No.	What-Questions Sci. Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1	1	1				
2		1				1
3	1	1				
4	1				1	
5	1					
6	2			1		
7	1			1		
8	2	1		1		
9	1			1	1	1
10				1		

Subject: HISTORY (Secondary)

Explanation No.	What-Questions Sci. Inf.	How	Why-Questions Ded	Pro	Gen.	Te/f
1					1	
2	1	1			2	
3	2				1	
4					1	
5	1				1	
6	1				1	
7	1	1			1	
8	1				1	
9	2				1	
10	1				1	

Subject: GEOGRAPHY (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1		1	1				
2		1				1	
3		5	2			1	
4	1	2				1	
5	1						1
6		2			1		
7		1				1	
8		1			1		
9		1					1
10		1					1

Subject: FOREIGN LANGUAGES (Secondary)

Explanation No.	What-Questions Sci.	Inf.	How	Why-Questions Ded	Pro	Gen	Te/f
1		1	2				
2		1	1				
3		1	1				
4		1					1
5		2	1				
6		2	1				
7		1	1				
8		2					
9		1					
10		2	1				

A2.3 Nature and Distribution of Concept Types

A2.3.1 Primary Explanations:

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
MATHEMATICS	1	side number name look	group regular four-sided shapes figures	triangle square rectangle hexagon parallelogram trapezium
	2	line top	base	vertex triangle
	3	cost	divide multiply times	
HUMANITIES	1	year country battle cathedral leader	Queen power nominal rule govern vote represent major run (rule) law elect decision	Parliament party (political) Conservative Liberal Labour General Election
	2	debt quarrel obedient argument war	king advice rule unfair vote criticise demands countrymen believe	Charles 1st Parliament Government Roman Catholic Protestant Civil War
	3	favourite harvest soil	fails (harvest) lack	
	4	courage train reliable	Red Indian N. America tribe period braves prove	

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
NATURE STUDY	1	glued	hatch	pupa
		eggshell	caterpillar	cocoon
		nibble	butterfly	
		hungry	egg	
		built	skin	
		body	change	
	2	crafty	match	camouflage
		slimy	surroundings	
		trick	master of disguise	
		pretend	caterpillar	
	3	pounce	leopard	suited (adapted)
		fix	big cat	
		animal	cheetah	
		different	prey	
		desert	sense	
			African	
			power	
	4	striking	elephant	
		ear	solve	
		fan	earflaps	
		country	hearing	
		jungle	coding device	
		shade	African	
		creature	Asiatic	
ENVIRONMENTAL STUDIES	1	armour	coat of arms	
		weapon	arms	
		protect	knight	
	2	factory	machine	
		building	assembly line	
	3	wool	substance	
		greasy	lanolin	
		sheep	incidentally	
	4	collect	skein	
			vat	
			substance	
			dye	

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
RELIGIOUS EDUCATION	1	comfort promise alive	raised disciple appeared	Good Friday Jesus God
	2	peaceful	earth body spirit	heaven
	3		member charged executed suffer admit Christian	early church Roman occupation faith saint martyr

A2.3.2 Secondary Explanations:

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
MATHEMATICS	1	side	length add equal	right-angle hypotenuse square diagonal
	2	side short	length add	square hypotenuse area centimetres
	3	join numbers	ridiculous statement balance multiply add unknown	substitute solution value
	4	number nothing row right left underneath	double figure nought space compile	Pascalls-triangle triangle hexagon calend
	5		divide basic technique sequence	fraction terminating fraction recurring fraction decimal
	6	pounds sold	selling price cost price amount	fraction percentage cancel
	7	row	multiply	Napiers rods Index rod
	8	whole number	even divide remainder odd minus	fraction
	9	built spare guessing	numbering fit	
	10	number together	odd pair even combine	

Subject	No.	Spontaneous	Intermediate	Non-Spontaneous or Scientific
MATHEMATICS (continued)	11	line middle across		rectangle thirds sixths square twelfth
	12	whole parts four	divide quarter equal	traction

Subject	No.	Spontaneous	Intermediate	Non-Spontaneous or Scientific
PHYSICS	1		air mixture gas	oxygen
	2	puddle hot windy dry up quickly	water colourless invisible increase condition living things gas heat	water vapour evaporate rate
	3	car horn whistle	relatively apparent observer lower vehicle at rest recedes	pitch sounding body velocity locomotive compression frequency rarefaction Doppler effect
	4	discovered one place - to another	related measurable indicate passed through liquid Faraday flown	electric currents electrolytes chemical atoms liquid conductors
	5	springs good	heating collapse supply melting solid	atoms energy
	6	dipped	iron filings powerful magnet attract steel concentrated	magnetism south seeking equal
	7	pick up	attract unlike like repel	South Pole
	8	glasses see clear	eye distance correctly	lens retina focus
	9	glasses thicker bends	powerful	lenses rays converge

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
PHYSICS (continued)	10	move musical chairs	metals heat regular structure possess loosely held free over simplification metal rod	conductors crystalline free electrons positive charge electron
	11		plug safety precaution shock fault connection ring of wire	earth appliance
	12	plank	calculation distance weight moves through effort	work joule force value applied upwards apply (a force)
CHEMISTRY	1	nails	test tube rusting process essential reaction	salt oxygen carbon-dioxide chemical dissolved gas
	2	paint grease	interfered prevent rusting evidence	chemical action
	3	scales	bears division nought sections bar rider reading figure balance	
	4	tap drinkable	water chalk substance pure contaminate	dissolving calcium nitrate cubic centimetres distilled chlorine solution

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
CHEMISTRY (continued)	5	moving stuck banging faster shaking apart shatter	solid heat liquid boiling evidence water particles	matter surface microscope suspended magnifying random motion
	6	apples	sugar term proportion comparable	carbohydrates starch compounds hydrolysis carbon hydrogen oxygen hydrates
	7	cotton silk wool	process readily heated permanently boiling	sulphide dyes dye stuffs protein fibres solution cellulose fibres
	8	keeps	dye steam attaches retained impregnated action of	solution metallic salt hydrolised hydroxide metallic compound insoluble form
	9		bursts into flame	powdered antimony chlorine chloride combustion oxygen chemical reaction oxidation electrons
	10	odd	air gas explosive powerful	nitrogen element passive inert uncombined compounds unreactive
	11		hardness water permanent temporary boiled	bicarbonates decomposes soluble carbonates

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
CHEMISTRY	12	upper	gas	bromine
(continued)		heavy	gas jar	carbon-dioxide
		collide	air	uniform
		brown	particles	(distribution)
		bangs	cover slide	
		collide		
BIOLOGY	1	egg shell	egg	calcium carbonate
			skin	calcium phosphate
			chalk	shell membrane
			layers	embryo
			divides	air chamber
				fertilised
	2	nest	egg	embryo
		elastic	yolk	membrane
			balancers	fibrous hoists
			in position	
			uppermost	
			device	
	3		brain	organs
			salt	urea
			liver	litres
			kidney	
			blood	
			waste products	
			water	
	4		living things	oxygen
			air	function
			break	respiration
			releasing	energy
			essential	chemical action
			process	
	5	remove	spine	pollen
			comb	
			flexing	
	6	winter	drone	
		food	worker	
			queen	
			royal jelly	pollen
			live	
	7	mouth	stomach	mineral salts
		food	intestine	capilliaries
			feet	vitamins
			fats	protein
			skin	carbohydrates

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
BIOLOGY (continued)	8	waste food	living things linings muscle	cells function microscope reproduce nutrient chemical process anti-bodies
	9	leaf narrow curve swell inner outer	structure plant control opening walls sugar water loss	transpiration guard cells chlroplasts photosynthesis stoma flaccid
	10	body	blood performs services liquid colourless	plasma protein haemoglobin bone marrow blood smear
	11	low rising rock windy cold hard bare	valuable symbol diagram plants height variety survive	density
	12	million chart attention	fish bird type expanded retracted	amphibia reptile species mammals carbon-dating fossils
ENGLISH	1		heading messages word group items sequences	cluster subject predication grammatical terms
	2	action	sentence	passive form
	3	play town clothes baker tailor vitner festival annual	miracle scene feast (of Corpus Christi) Last Supper	
	4	children babies evil zeal	community witchcraft believe force identity	

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
ENGLISH (continued)	5	picture	technique creation mental juxtaposition	imagist poetry
	6	knees curled choking baby cot death soldiers break push suffocate victim air	Crucifixion suffering	
	7	television family hobby disagree	questionnaire interview interfered view opinion	
	8	news paper buys sells sports mistake reporter violent attract	facts cover neutral accurate check article	political party
	9	writing read mock despise absurd interesting	author character natural view contemporary pretension artificiality	sterile convention novelistic habits
	10	kill like sorry for poison love island lonely affection	cold blood author	

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
HISTORY	1	fight live home peace strength	Britain Celts Picts frontier Ireland period tribes warrior settle fortifications	Roman Empire barbarian
	2	family plates grow hunt weapon goods ornaments secret method discover	trading craftsmen bronze tribe occupation	
	3	houses picture rope town stone ruin building	deserted	Anglo Saxons Romans
	4	cave animal hair arms fingers nails spear shelter million	hind legs ape man survival development	mammal
	5	people danger savagery	Ireland revolt revenge king execution throne Worcester France burden or leadership	establishment convenant religion Presbyterian
	6	people cousin discover	loyalty execute plot England treachery convert	Catholicism religion Pope Jesuit conspirator

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
HISTORY (continued)	7	town castle people church village market	factor encourage monastery possession trader rent craftsmen growth	pilgrim
	8	map war secret country victor peace defeat	map territory claimant control agreement	central powers treaty
	9	educate lawyer	king law judge representations trials courts baron	reform jurisdiction legal system rule of law
	10	new name married virgin dictionary	colony queen Virginia Christian	
GEOGRAPHY	1	park trees car swim sail	National Park recreational facilities unsightly buildings advantageous Lake District	
	2	farm houses lake village natural level	Haweswater	Corporation of Manchester artificial reservoir
	3	iron river	coalfield coke industry map products regions steel limestone seams earthquake iron ore	rolling mill blast furnace section

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
GEOGRAPHY (continued)	4	farm animal wheat barley country sheep cattle grass hills	distribution crop Pennines soil fertile (rich) Chilterns	rotation of crops
	5	lines hill close steep	heights space slope	contours
	6	baby lady dark skin clothes cold warm fur wool weather hair	Eskimo Indian	
	7	town sailing fishing walk petrol pump roads pipe	Milford Haven oil refineries port main road natural harbour ashore tanker deepest	
	8	traffic places hospital race meeting	traffic survey information identify congested observing	
	9	money	improvements African coun- try	Local Authorities County Council Central Government local tax
	10	fishing country bigger fish nets	industry Iceland governments controls fishing limits restrict multiply	

Subject	No.	Spontaneous	Intermediate	Non-spontaneous or Scientific
FOREIGN LANGUAGE	1	word confuse example kind tell work fit	obey disobey language rule	plural singular irregular present tense perfect passe compose verb
	2	go careful confuse separate	final form French language	noun form verb
	3	general	translation meaning	definite article
	4	after	special rule occasion expression of quantity	negation
	5	works	agreement takes (etne) number	subject past participle tense gender
	6	make come	agreement example necessary	past participle reflexive verb gender preceding direct object
	7	room asking sign register		
	8	drink wine vineyards white	Loire chart muscadel dry	
	9	words make snowball apple sniff	French	
	10	simple method	rule	l'interrogatif affirmatif noun subjects pronoun subjects auxiliary verb passe compose

A2.4 Meanings Communicated Within Explanations

A2.4.1 Primary Explanations

Subject	Question	Sub.Ass	Sub-Log	Inst.Ass	Inst-Log
Mathematics	1	1	1		1
	2	1		1	1
	3	1	1		1
Humanities	1	1		1	1
	2	2			1
	3	1			1
	4	1			1
Nature Study	1	1			1
	2	1			1
	3	1			1
	4	1	1		1
Environmental Studies	1	1	1		1
	2	1			1
	3	1			1
	4	1	1		1
Religious Education	1	1			1
	2	1			1
	3	1			1

A2.4.2 Secondary Explanations

Subject	Question	Sub.Ass	Sub-Log	Inst.Ass	Inst-Log
Mathematics	1	1	1		
	2	1	1		
	3	1	1		
	4	1	1		
	5	1	1		
	6	1	1		
	7	1	1		1
	8	1	1		1
	9	1			1
	10	1	1		1
	11	1	1		1
	12	1		1	1

Subject	Question	Sub.Ass	Sub-Log	Inst.Ass	Inst-Log
Physics	1	1			1
	2	1			1
	3	1			1
	4	1			1
	5	1			1
	6	1			1
	7	1		1	1
	8	1			1
	9	1		1	1
	10	1			1
	11			1	1
	12	1	1		1
Chemistry	1	1		1	1
	2	1	1		1
	3				1
	4	1			1
	5	1	1	1	1
	6	1	1		1
	7	1			1
	8	1			1
	9	1			1
	10	1			1
	11	1			1
	12	1	1		1
Biology	1	1			1
	2	1			1
	3	1		1	1
	4	1			1
	5	1			1
	6	1	1		1
	7	1		1	1
	8	1			1
	9	1			1
	10	1			1
	11	1	1		1
	12	1			1

Subject	Question	Sub-Ass	Sub-Log	Inst-Ass	Inst-Log
English	1	1			1
	2	1			1
	3	1			1
	4	1			1
	5	1	1		1
	6	1			1
	7	1	1		1
	8	1	1		1
	9	1	1		1
	10	1	1	1	1
History	1	1			1
	2	1			1
	3	1			1
	4	1			1
	5	1			1
	6	1		1	1
	7	1		1	1
	8	1	1		1
	9	1		1	1
	10	1			1
Geography	1	1			1
	2	1			1
	3	1			1
	4	1	1	1	1
	5	1	1	1	1
	6	1	1	1	1
	7	1			
	8	1	1	1	1
	9	1			1
	10	1			1
Foreign Languages	1	1	1		1
	2	1	1		1
	3	1			1
	4	1			1
	5	1			1
	6	1	1	1	1
	7	1			1
	8	1		1	1
	9	1		1	1
	10	1	1		1

APPENDIX A3

TEACHERS' EFFECTIVENESS IN EXPLAINING SOMETHING TO SOMEONE

A3.1 Predictions and Actual Proportions of Pupils in Each Category given as Percentages of the Whole Class (Hypothesis H6)

Teacher No.	Cat.1 A	Cat.1 B	Cat.2 A	Cat.2 B	Cat.3 A	Cat.3 B	Teacher No.	Cat.1 A	Cat.1 B	Cat.2 A	Cat.2 B	Cat.3 A	Cat.3 B
1	70	72	20	26	5	2	19	45	41	50	54	5	5
2	56	60	34	30	10	10	20	30	60	65	35	5	5
3	60	58	25	30	15	12	21	50	42	45	50	5	8
4	65	59	30	31	5	10	22	66	63	24	32	10	5
5	72	60	24	30	4	10	23	55	60	40	40	5	0
6	66	32	30	53	4	15	24	60	50	35	40	5	10
7	48	55	40	40	12	5	25	80	69	20	21	0	10
8	60	52	40	43	0	5	26	60	50	30	40	10	10
9	66	69	36	26	4	5	27	70	60	25	30	5	5
10	55	60	40	33	5	7	28	48	55	50	33	2	12
11	75	69	20	29	5	2	29	75	65	20	30	5	5
12	65	57	25	28	10	15	30	55	55	40	35	5	10
13	70	52	30	40	0	8	31	70	58	25	32	5	10
14	70	50	20	42	10	8	32	68	70	30	25	2	5
15	65	45	20	39	5	16	33	70	56	25	29	5	15
16	66	50	30	40	4	10	34	45	48	50	42	5	10
17	70	62	25	37	5	2	35	70	71	20	17	10	2
18	50	58	40	32	10	10	36	70	48	25	32	5	20

Categories:

Cat. 1 - Pupils understand all or most of the explanation

Cat. 2 - Pupils understand some of the explanation

Cat. 3 - Pupils understand little or nothing of the explanation

Column A - Predicted percentage

Column B - Actual percentage

A3.2 EXPLANATIONS AND CHECKS USED IN ASSESSING PUPIL UNDERSTANDING (H7)

A3.2.1 Mathematics Explanations

Age: 12 years Ability Range: C.S.E. Group

T On Saturday I was in a bookshop in the town and I bought a book from a pile marked reduced for 25p..... Now they must have been selling at a loss..... How can I say they must have been selling at a loss..... Yes?

P1 It's much too cheap.

T The price was down too far. Do you think anybody could produce a book, indeed a paperback book, but bigger than an exercise book, for 25 pence? No, the cost of the paper would be more than that. So they have sold at a loss.

Now we have to work out whether they dropped the selling prices or the cost prices. So one thing we've got to know is the cost price itself, and then we've got to work out the percentage in profit or loss. Now, firstly, we have an item costing £1, which is going to be sold at 25% profit. Now, there are two ways of working it out, but I want you to get used to the second way that I'm going to show you.

There is our cost price. Our selling price is going to be that, plus, this is the 25%. I could work out 25%, and remember what 25% means; it means 25 over 100 of my £1. I'm not going to write my £1 as £1: I'm going to write is as a 100 pence, because obviously it's going to be difficult to work with 1.0. Two 100s cancel out and I'm left with 25p. What is my selling price going to be?

P2 .... Is that a 5?

T No... That's supposed to be a nought. Sorry, that's my bad figures. Right.

P2 .... £1.25.

T That's £1.25. Now you can work that out very easily because I've chosen very simple numbers. Now, let's see if there's another way. Our cost price was £1, which represents all the cost, and therefore must be 100%. If that's what it costs you it has to be a 100%. Our selling price is that 100% plus our profit, which is - well, what did I just say the profit was going to be, as a percentage?

P3 Er.... 25%.

T 25%. So as a percentage, my selling price is 125%. So I've got to work out 125%; that's 125 over a hundred, if we multiply a hundred pence. Again, the hundreds cancel out: 100 into 100 goes once, a 100 into a 100 goes once, and so we are left with 125 pence, which is £1.25.

Now I say this is a better way to do it because I think it will make you understand a great deal better. Another thing is you will only need the one sum....

Now, an item costs £5. First of all, if it costs £5, what is it as a percentage? 100%. I sell it at a loss of 15%. What is my selling price as a percent? Right?

P4 85%.

T Right. 85% As an amount of money my selling price will be 85% of £5. When you think if you're going to need to spread it out so you got (rid) of that 5.... (working on board).

So my selling price is going to be 85% of the 500 pence. Two noughts will cancel, so we're left with the cost which is: 5 times 5, that's 25, 5 times 8 is 40. So 42 pence. So that becomes £4.25. Now think of your cost price always as a hundred percent. Now, the selling price is going to be that original, plus the profit, minus the loss. So you're going to think of your cost price first of all as an amount of money, and as a percentage; your selling price as a percentage, and then you will work out an amount of money.

No, supposing I said to you, "I have just sold an article for £6." So the selling price is £6 or 600 pence. That represents a 25% profit. You've got to work out how much the thing costs. Now we don't know the cost price, but we do know what as a percentage? Right, yes?

P5 It's 100%.

T A hundred percent, good boy. We do know the selling price.

P5 It's 125%.

T Good.... So the C.P. = $\frac{600}{125} \times \frac{100}{1}$ O.K.

You know what to do next.......

P6 Cancel.

T Right, work it out yourselves.

CHECK II Mathematics Explanation

A worksheet containing 5 questions involving finding cost price, selling price, profit and loss.

CHECK III Mathematics Explanation

1. What is another way of writing 8 out of 100? ____________________

2. What is an improper fraction? ____________________

____

3. Which is usually larger, the cost price or the selling price?

____

4. What do we call money a shopkeeper makes on the goods he sells in his shop? ____________________

5. If a shopkeeper wants to make 20 per cent on each item that he paid £1 for to the manufacturer, what must he sell each one for? ____________________

6. In deciding what percentage to set the selling price, what is always considered to be 100%. ____________________

7. What do we call a fraction which consists of a whole number and a part of that number? ____________________

8. Put down the sum as you would if you were finding 75% of £15. (Do not work it out).

9. What do you know about the selling price of an article when a shopkeeper sells at a loss?

A3.2.2 Physics Explanation Age 13 years 'O' Level Group

(Pupils have been working in groups of 5 and 6 on apparatus)

T Quiet please.... everyone... settle down on your stools.... you too, Parker... Now... is there any group that did not get a chance to try out all the different conditions on the apparatus?..... Including checking if the frictional force remains constant?..... The last question... Right.... good ... er...we'll work through the results together but before we do... what can you tell me about the nature of friction .... Jane?

P1 It makes it more... difficult to move things.... I mean... it still does when things are moving.

T Yes... that's why we view it as a force that has to be overcome .... What do you think causes it?....... Only Turner with any ideas? ...... O.K. Turner -

P3 Is it because things are rough?

T What do the rest of you think.... Claire?

P3 Sir... the... the rollers weren't rough.

T Apparently not rough is more like it, Claire... Turner is right when he says things are rough... Even the flattest and most highly polished surface is not really flat... An atomic scale would show that there are peaks and troughs differing in height by... er... around one hundred atoms or more... If we could see surfaces under a microscope, this is what they would look like (draws on board)..... When one solid rests on another, the peaks flatten until the upper solid can be supported. At the places er.... of contact there are strong attractive forces between molecules... and before one surface can be moved these tiny.... er... er 'joints' have to be broken.... O.K. ......? Once motion starts the flattened peaks appear to skim over one another... but this does not prevent there... being... no force to overcome... it's just that this force is not as much as the frictional force just before movement.... What did you find was the reading on the spring balance when you were doing operation 3?.... Check if you can't remember.... yes, Andrews?

P4 The reading isn't the same at the... er... beginning as it is when it is moving.

T Is it greater at the beginning or later on?

P4 More, sir.

T Why will it be greater, Green?

P5 Don't know, sir.

T You will if you listen..... it's greater because more force is needed at the beginning.

CHECK II Physics Explanation

Write a conclusion to the experiment that uses all the information in your results.

CHECK III Physics Explanation

1. In Physics, friction is considered to be a ____________________

2. What do polished surfaces look like under a microscope?

   ____

3. When one solid rests on another what has to happen in order that the upper one can be supported? ______________________________

   ____

   What is there at the places of contact? ____________________

   ____

   What must happen before one surface can move over another?

   ____

4. When you start something moving on the apparatus used in the experiment when is the reading on the spring balance greatest?

   ____

   What does this tell us about friction at that point?

   ____

5. Does friction remain constant? ______________________________

6. Is it possible to get rid of friction completely? ____________

7. If the difference between the peaks and troughs of a surface are measured - what sort of scale is used? ____________________

   ____

A3.2.3 Chemistry Explanation Age 12 years 'O' Level and C.S.E. Group

T We are starting new work today on acids and alkalis..... Er.... As you know we've been considering the properties of liquids.... and... er.... one of the things we know about liquids is that they're acid or alkali or neutral. .... It's important to know which category because.... anyone? .... Well, their.... many of their chemical properties and... er ... uses... depend on this.... Right... let's start with acids..... Anyone know anything about an acid.... Yes, Thomas?

P1 Turns litmus red, sir.

T Yes... that is a test for an acid... anyone else think they know something about an acid... King?

P2 They burn and... er... wear things away.

T Right, but isn't that also true of a strong alkali..... like sodium hydroxide?

P2 ... Er... yes.

T Can anyone be more specific.... Atkins?

P3 They wear away metals.

T Good... they corrode metals and the fizzing that takes place when a metal dissolves in acid is caused by the evolution of a gas.... Anyone know which gas.... Annette?

P4 Is it hydrogen?

T It is.... and this gives us our definition of an acid.... .... It is a substance which generates hydrogen ions (writes on board). H^+ .... An alkali on the other hand generates hydroxyl ions (writes on board).... OH^- .... To understand just what these definitions mean is our work for the next weeks... Now, let's re-cap the information we have about acids.... Gillian, one thing you know about acids...

P5 They dissolve metals, sir.

T Right... they dissolve metals to form salts.... Another one.... Wilkinson.

P6 They contain hydrogen.....

T Good.... they generate hydrogen.

CHEMISTRY EXPLANATION CHECK II

1. Using the apparatus provided describe how you could set up an experiment to produce hydrogen.

2. Form the list of substances given overleaf, select the ones you could use for the experiment by ticking them.

Hydrochloric acid	Copper
Sodium hydroxide	Marble Chips
Calcium hydroxide	Zinc
Sulphuric acid	Sodium chloride

CHECK III   Chemistry Explanation

1. Some liquids are acids, as what other categories are the remaining liquids classified? ______________________________

2. Why is it important to know in which category a liquid belongs? ______________________________

3. State a test for an acid ______________________________

4. What substances do acids corrode? ____________________
   What is happening during the fizzing that takes place when the process of corrosion is going on? ____________________
   What is left when the fizzing stops? ____________________

5. Complete the definition - An acid is a substance which generates ______________________________

6. What do liquids that are of the opposite sort to acids generate? ______________________________

7. If you dropped some acid on your skin, what would be the best thing to do to prevent a burn? ____________________

A3.2.4 Biology Explanation Age 14 years C.S.E. Group

T O.K. Stop looking at your tests and let's recap on what we've done so far. (The tests are referred to later in the explanation.......

Last week we studied the work of the teeth and... if you remember .... er... we came to the conclusion that teeth start off what we call the process of digestion.... Why is that, Brenda?

P1 They break down food into bits.

T Good.... it's easier for food to be digested later on if it is broken down.... Does anything else happen in the mouth?

P2 Miss.. it's made soft by sp... er.. saliva.

T Yes, Don, it is saliva that moistens it.... Why do you think it needs to be soft?

P3 It would hurt yer throat.

T Right... and I think you would find it very hard to swallow... Saliva is a useful product - it has another purpose in the mouth.... Does anyone know what? We mentioned it last week... Anne?

P4 It changes starch.... into sugar.

T Good.... Into a simple sugar called glucose actually..... Remember the experiment you set up.... half of you have starch solution in your parchment diffusion shell.... the rest have a solution of glucose.... Have you all tested the water in the beaker?..... go quickly and do it.... (to those pupils involved in testing) Iodine if you've got starch, fehlings if its glucose. Right... now what question are we hoping to answer from your results.... Clive?

P5 Why is starch in your food... er... changed during digestion?

T Good.... Has anyone got a bright idea?........

Well, look at the evidence in front of you.... Any change in your iodine, Carol?.....

P6 No, miss.

T Has anyone got a change in the iodine... no.... O.K. What about the glucose?..... Anyone?

Ps (speaking together).... Yes, it's turned... etc.

T O.K.... sh.... quiet... now ..... what does the colour change indicate.... Derek?

P7 There's glucose in the water.....

T Right.... it must have come... through where? ......

P7 Through the er.... parchment.

T Right. It has come through the parchment.... How about the starch?

Ps (Together) No.... no, miss.

T Now does this give you a clue to the answer of our question? ..... Come on.... you're asleep today.... anyone? ...... Well, later on in the process of digestion the products have to be absorbed through the wall of the small intestine..... If starch were left in original state it couldn't pass through the walls of the small intestine.... but as glucose it can... .... What does this tell you about the relative size of the molecules in starch and glucose..... Andy?

P8 Glucose.... is... er .... has smaller ones.

T Right. Glucose has smaller molecules. Now make sure you put in your own group's result and those of the other group.

CHECK II Biology Explanation

Without talking to anyone else, write your own conclusion to this experiment.

What in the digestive system is represented by the parchment diffusion shell?

CHECK III Biology Explanation

1. How do teeth help the process of digestion?

____

2. What is produced in the mouth when we chew? ________________

Give two ways in which it helps us in the digestion of food.

i ____

____

ii ____

____

3. What happens to starch in the mouth? ____________________

____

4. Which of the solutions in the parchment diffusion shells entered the water in the beaker? ____________________

What did you use to test for it? ____________________

How did you know it was present? ____________________

____

5. Why can one solution go through the parchment shells and not the other? ______________________________

Where in the process of digestion is it necessary for this process to happen? ______________________________

A3.2.5 History Explanation Age 12 years 'O' Level & C.S.E. Group

T Next lesson.... and for the whole of the morning we are going into Worcester.... to look round at some of the historic places..... like King Charles's House.... We shall be finding out about the battle of Worcester .... so today I want to tell you.... er.... a little bit about... er... what led up to the battle.... First... who can say how the country is ruled today.... Jane?

P1 By the Queen.

T Well.... the Queen is the... er.... nominal head, but the ruling is really done by..... Stephen?

P2 The Government.

T Right. We have a parliament to run the country......
Now the Queen has to agree to any change in law or any decision that the Government makes. She is still, in a way, the leader of the country, but there is no way that she can really sign a new act. She has no actual power..... But it wasn't always like this; for many hundreds of years the King or Queen of this country had a lot more power... He really did rule... He could call together the men in parliament... or dismiss them. He had a lot more to do with the making and passing of laws.

Now just prior to 1640 Charles 1, then King of England, began to ignore the advice of his parliament and to exert his right to rule without them by claiming for himself the 'divine right of kings'. He voted himself extra money when he ran into debt and threatened to disband parliament whenever they opposed him...... Things were made worse by his marriage to a Roman Catholic French princess.... although he was a Protestant. His wife Henrietta encouraged him to stand against Parliament... so quarrels grew worse.... Eventually men began to take sides and a terrible Civil War broke out in the country..... At first Charles and his army were successful for they had good cavalry..... What's cavalry.... Mitchell?

P4 Ehm.... they're men who fight on horses....

T Good... The King's army became known as Royalists.... his cavalry as cavaliers...... After a time the king began to lose more battles and eventually he surrendered..... Then something most unusual happened. He was tried and beheaded. The only king of this country ever to be executed by Parliament... Anyone know what happened next?.......

P5 Cromwell ruled.... Miss, I saw the film of Cromwell.

T Did you?.... Well, as you say, Cromwell ruled for some years with the help of the army.... Then another Charles, the son of the Charles who had been beheaded, raised an army and the two sides met.... The battle took place at Worcester where Charles was defeated.... Any questions... Yes, Phillip?

P6 Did Charles.... I mean the son of Charles, come back again?

T Yes, he did and we will be talking about that after the visit next lesson....

CHECK II History Explanation

Starting from the King's quarrel with Parliament:

Make a list in the order that things happened, of the events that led up to the battle of Worcester.

CHECK III History Explanation

1. How is our country governed today? ______
2. How is our government chosen? ______
3. Can you give some reasons why King Charles was so unpopular? ______
4. What is a civil war and why is it worse than other wars? ______
5. What was another name for the Cavaliers? ______
6. Why were they called this? ______
7. Who were the Roundheads? ______
8. Who was their leader? ______
9. What happened to Charles the First? ______
10. What happened later that led to the battle of Worcester? ______

A3.2.6 Geography Explanation Age 15 years C.S.E. Group

T In the lesson today we will try to see what alternative forms of energy are available to replace fossil fuels.... First of all... what's the problem with fossil fuels?

P1 .... They are running out...

T Right. We are using them up at a very fast rate and they're not replaceable..... Can anyone suggest other sources of energy that are not oil, gas or coal.....? Yes....

P2 Sir... wind... it drives sailing boats and windmills.

T Good.... any others?.... Well, what about the sun? ...... You may be surprised to know that the sun is our largest alternative source of energy..... We receive the equivalent of 100 million, million tonnes of oil from the sun each year... if you think of a supertanker carrying 200,000 tonnes of oil then it would need... er.... so many tankers that they could girdle the earth.... and more..... Yes, Peter?

P3 Where does it all go, sir?

T It radiates from the sun at a rate of around 225,000,000 million tonnes per year..... The earth doesn't get it all..... You see, some of it is not directed at the earth.... and a quarter of the sun's energy is reflected back into space by the upper atmosphere.... What does come through.... er.... creates winds and ocean currents and produces clouds rain and waves... Jenny?

P4 .... Is the energy used in any other way?....

T Yes, it is.... it's used to harness the wind.... You see, indirectly the sun causes winds.... when our atmosphere absorbs solar energy it changes the air temperature and this causes winds.... Water power too is indirectly energy from the sun, because rainfall comes from clouds and clouds are formed by the evaporation of water and evaporation of water is caused by the sun's heat..... Anyone want to ask anything?..... Yes, Donald?

P5 Isn't there energy in plants.....?

T Good. There is... and it comes from the sun.... but it's only a small amount of what the sun gives off..... We release it... when Sybil?

P6 When we eat food... like cereals.

T Yes... and other foods, too.... and when we burn wood.

CHECK II Geography Explanation

Work Sheet:-

Draw a diagram that shows pictorially what happens to the energy radiating from the sun. Start with the sun and use arrows ⟶ to symbolise radiation and boxes to put the names of what the radiation causes $\boxed{\text{waves.}}$

CHECK III Geography Explanation

1. Give 2 examples of fossil fuels ______________________

2. What is the largest alternative source of energy to fossil fuels? ______________________

3. About how much energy is released from the sun?

____

4. What happens to the energy that does not reach the earth?

____

5. Put down 2 things that are created by solar energy.

____

6. What happens when our atmosphere absorbs solar energy?

____

What does this cause? ______________________

7. How are clouds formed? ______________________

____

APPENDIX A4

FACTORS INFLUENCING PUPIL UNDERSTANDING

A4.1 Unfamiliar Word List (Gardner - Hypothesis H8

Word	School Form 1	2	3	4	Word	School Form 1	2	3	4
ability	71	79	88	90	capture	89	92	96	93
abnormal	85	87	93	95	caution	86	92	92	95
absence	74	78	80	85	cave	81	89	95	94
abundant	72	82	93	94	characteristic	73	79	88	91
accumulate	61	70	87	92	chew	88	90	96	95
accurate	75	79	88	92	chip	82	88	89	93
*action	46	57	64	76	clamp	80	90	95	96
adjacent	73	83	95	96	climate	80	89	89	93
adjust	64	75	77	73	coarse	76	84	92	92
adopt	88	82	93	92	coil	89	91	97	96
advantage	85	89	95	92	*coincide	60	77	90	93
affect	87	93	88	91	collapse	88	94	95	96
agent	72	80	87	93	column	63	63	73	79
agriculture	75	82	93	96	combination	86	91	94	97
airtight	82	87	96	94	commence	86	91	96	95
*algebra	48	58	71	81	compare	89	91	94	98
alternate	64	82	91	92	*complex	52	64	77	82
analysis	68	78	81	92	*component	49	63	76	87
ancestor	84	87	91	92	*composition	49	61	81	91
angle	80	85	93	95	compress	83	88	93	95
annual	70	78	90	90	**concept	32	45	61	74
aperture	67	73	83	87	**conception	31	44	63	74
apply	83	88	93	94	conclusion	76	86	88	91
appropriate	70	79	91	83	conical	62	72	79	83
approximate	81	79	86	89	consecutive	68	78	81	88
*arid	53	72	86	92	consist	88	93	97	91
ascend	83	88	92	92	consistent	68	79	87	92
ash	84	90	93	94	constant	71	79	92	96
assignment	80	87	95	94	*constituent	44	51	63	81
associate	70	78	78	84	construct	86	93	95	95
assume	76	85	91	87	*consume	47	62	76	85
attract	87	90	95	96	contact	87	92	97	96
*audible	45	60	69	75	container	80	84	88	92
automatic	78	85	88	92	contents	87	92	95	96
*average	35	54	60	61	*continent	54	64	71	79
avoid	89	93	90	94	continual	89	91	96	94
aware	88	92	93	94	**contract	39	59	70	80
basic	87	93	96	97	*contrast	51	53	60	68
bind	86	95	97	98	*contribute	58	72	86	89
bounce	79	87	87	89	convenient	83	91	97	97
boundary	76	84	91	91	convention	61	72	82	85
breed	82	86	93	95	*converge	58	74	81	87
breeze	89	93	94	94	**converse	38	39	38	41
brittle	75	86	92	94	convert	72	84	88	91
bud	89	91	94	94	co-ordination	81	89	92	94
bulb	84	92	95	91	cord	87	93	94	93
bump	88	86	92	93	core	85	93	92	90
calculate	68	83	92	96	**correspond	35	44	58	61
camouflage	85	88	95	95	creation	88	93	95	98
canal	83	93	97	95	*crest	50	66	72	74
cancel	83	91	88	95	criticise	66	72	79	83
capable	76	84	92	85	*crude	42	62	71	87
capacity	82	88	96	97	crust	87	92	95	97

*see last page

cultivate	76	84	92	92
cure	82	85	88	90
decay	72	79	83	90
decimal	89	93	93	95
decrease	80	82	96	97
define	74	78	90	97
deflect	64	75	80	83
degree	66	78	84	85
dependent	85	92	95	99
depth	82	90	90	95
derive	74	73	84	91
descend	69	85	92	93
**descendant	32	47	52	62
description	84	93	95	92
detect	61	71	79	83
device	67	81	87	88
*devise	53	65	69	84
diagnose	69	79	90	95
diagonal	69	75	85	86
dial	88	91	92	93
*diameter	48	67	81	86
dimension	77	86	93	95
disc	83	85	92	88
discuss	84	92	95	97
**disintegrate	18	22	27	38
disperse	62	74	85	90
displace	67	72	73	82
distinct	71	85	90	93
distribute	79	85	91	96
disturb	89	89	87	88
*diversity	49	58	66	78
*dominant	51	67	81	88
doubt	82	91	94	95
drain	87	90	93	94
drought	85	88	95	93
duplicate	89	93	98	96
edible	77	85	91	93
*effect	45	46	62	70
*efficient	48	56	68	72
elastic	74	86	86	86
*emit	46	58	65	79
enable	62	76	83	83
equipment	89	93	95	96
equivalent	88	92	93	97
erect	75	85	91	93
essential	63	71	82	86
estimate	76	76	82	89
evacuate	78	85	94	93
exact	70	85	88	85
exception	79	87	93	96
excess	70	79	90	94
excite	69	77	80	89
exclude	68	79	91	95
exert	64	68	88	87
expand	89	91	93	96
expel	77	82	87	93
experience	88	93	92	97
explode	86	88	93	94
expose	70	76	89	90
*external	53	68	82	90
extra	87	88	93	91

extreme	79	88	92	93
**factor	35	62	67	76
film	64	72	75	84
fin	82	79	81	75
fog	66	79	75	81
formation	88	93	96	96
function	88	94	96	95
*fundamental	53	66	73	75
generate	67	81	86	87
globe	88	91	91	95
**grain	31	35	39	48
grind	79	85	89	90
hatch	82	86	84	87
horizon	85	91	92	95
hygiene	88	92	97	98
identical	85	87	84	84
identify	82	90	93	95
*illuminate	49	71	84	89
*illustrate	56	59	70	76
imagination	78	82	88	91
*immerse	52	62	80	85
impact	66	77	85	87
*incident	42	54	54	62
*incline	47	47	61	63
index	78	84	81	89
indicate	85	91	94	96
industry	87	93	97	96
inflate	77	83	85	83
influence	63	73	79	90
inhabit	84	84	91	95
inhale	88	94	96	96
**initial	35	45	47	64
inquiry	86	92	93	97
insert	88	90	95	93
instantaneous	77	84	92	96
instrument	88	88	94	94
intake	71	82	85	92
intelligence	89	89	91	94
interfere	84	87	90	94
internal	79	86	93	94
*interpret	56	67	77	83
intersect	89	94	98	95
interval	88	96	96	97
invent	89	88	95	91
*invert	45	54	68	79
involuntary	67	80	89	92
irritate	69	77	89	86
isolate	63	77	90	97
junction	74	78	87	92
**latitude	35	45	47	52
**law	39	51	72	78
layer	77	83	95	95
leaf	86	88	87	91
leak	87	86	94	95
level	79	84	91	87
liberate	54	71	86	90
limit	69	81	86	91
*linear	52	59	77	80
logic	61	69	70	78
**lubricate	37	45	70	84
*magnitude	50	74	85	80

majority	86	88	96	95
manufacture	74	82	91	91
margin	87	92	94	96
mate	84	90	92	95
mature	74	82	92	92
maximum	63	74	84	90
measure	87	86	88	89
medium	87	90	90	94
method	82	87	95	95
mild	75	85	90	89
*minimum	52	67	82	81
mobile	87	90	96	97
modify	57	61	76	87
moisture	89	89	94	94
molten	64	75	86	92
multiple	70	72	85	90
multiply	86	88	94	97
naked	65	68	75	80
*negative	39	61	73	77
neglect	78	86	95	92
*negligible	52	68	62	73
*neutral	53	67	78	82
observation	74	77	92	88
obvious	67	73	83	84
occasional	89	93	98	92
occur	84	83	90	93
*omit	42	59	74	81
operate	88	92	95	90
opinion	83	87	93	92
oppose	68	71	84	82
origin	64	78	87	87
*outline	56	70	80	80
overcome	85	92	95	90
overhead	88	91	90	88
*partial	39	51	59	68
particle	82	84	94	86
penetrate	76	84	91	94
per	88	86	88	91
*percentage	41	51	49	55
permanent	76	84	89	90
*perpendicular	47	67	84	81
*phenomenon	56	59	73	81
pierce	87	90	95	91
pivot	82	87	91	92
*plot	51	81	90	95
positive(test)	64	72	78	81
*positive (number)	42	86	92	92
practise	87	91	98	93
predict	71	85	93	94
preparation	74	78	85	82
presence	74	84	92	92
previous	64	72	84	89
primary	63	71	76	83
primitive	67	65	86	86
*probability	52	58	68	76
procedure	81	88	94	94
process	66	76	84	91
profile	67	81	88	90
proof	77	87	87	90
propagate	67	69	70	71
propel	84	90	90	93
proportion	65	67	74	81
pump	69	81	88	84
purify	81	92	92	93
**random	12	18	36	35
**rate	25	39	47	58
*recoil	52	63	71	75
reference	67	77	85	93
refine	76	84	88	90
reflect	62	62	79	80
regular	69	76	76	85
*regulate	50	61	75	82
reject	89	93	96	97
relationship	79	89	92	94
*relative	41	58	63	74
relevant	66	75	84	88
reliable	88	91	94	95
*repel	58	71	83	88
replace	88	94	94	95
*represent	59	74	83	86
research	86	94	96	96
*residue	57	65	79	81
*resist	55	72	79	90
resource	64	76	86	86
respond	72	80	87	90
retard	62	80	87	90
**revise	33	40	50	58
rigid	60	68	82	85
rim	81	86	94	92
rotate	83	91	95	93
*row	53	49	55	57
rule	78	84	83	88
scale	76	85	95	94
scratch	88	88	95	93
screen	87	89	90	92
seaweed	88	92	93	94
section	61	65	76	86
*sense	47	53	65	68
sensitive (to light)	64	68	83	82
sensitive (instrument)	75	79	86	88
*sequence	57	63	63	80
sign	79	87	90	92
significant	83	86	93	94
simplify	78	86	91	91
*simultaneous	54	66	71	77
sink	86	91	91	88
smear	74	80	89	93
source	79	89	94	94
spark	88	91	95	94
spiral	76	82	89	89
splint	87	90	92	92
**spontaneous	15	26	39	45
stable	85	93	95	94
stagnant	63	69	79	87
stain	64	81	86	90
*standard	41	50	72	76
stationary	85	93	95	95
steady	87	93	91	94
*stimulate	43	48	57	71
structure	88	92	97	96
submerge	70	76	82	85
substance	87	96	94	94
substitute	64	76	87	88
successive	79	88	93	96

suckle	63	69	81	78
summary	85	89	95	98
suspend	62	72	84	87
*symbol	54	73	84	91
**symmetrical	23	35	48	60
system	70	77	85	84
systematic	78	93	94	93
table	80	88	95	95
tabulate	75	78	89	93
*tank	43	56	56	65
temporary	66	73	80	90
tend	82	87	94	94
tension	75	78	87	93
*textbook	55	63	66	80
theory	67	78	78	74
thrust	69	77	83	88
tide	77	82	92	90
topic	48	59	61	66
trace	85	90	91	92
transform	78	85	91	88
transmit	85	84	95	96
treatment	67	75	79	86
trough	85	86	91	95
tube	77	83	91	90
tweezers	81	81	92	93
typical	77	87	93	97
uniform	73	87	87	96
upset	85	94	94	96
**valid	30	50	65	79
variable	80	90	93	96
variety	87	93	96	97
vertical	64	72	84	87
*vessel	56	70	78	90
vigorous	82	84	92	93
violent	84	89	96	96
vital	61	75	85	91
vocal	71	83	91	94
weed	80	86	91	90
wilt	78	82	90	90

School forms 1,2,3 and 4 equate approximately with ages 12,13,14 and 15 respectively.

* Students at first form level scored 40-60% correct on the item testing the word.

** Students at first form level scored less than 40% on the item testing the word.

A4.2 Special Vocabulary in Subject Explanations

Occurrences of Technical and Special Non-Technical Words:

Mathematics	Selling price	Profit	Represents
	Cost price	Loss	Plus
	Percentage	Dropped	Cancel
	Multiply	Marked	
	Hundred per cent	Reduced	
Physics	Frictional force	Conditions	Reading
	Atomic Scale	Apparatus	Joints
	Microscope	Constant	Attraction
	Solid	Nature	Appear
	Force	Overcome	Rests
	Molecules	Peaks	Causes
	Spring Balance	Troughs	Apparently
	Atoms	Surfaces	Prevent
	Operation	Supported	
	Motion	Contact	
Chemistry	Acids	Salts	Evolution
	Alkalis	Liquids	Substance
	Chemical	Properties	Generates
	Litmus	Neutral	Definitions
	Sodium Hydroxide	Category	Form
	Metal	Depend	Information
	Hydroxil	Test	Dissolve
	Hydrogen	Burn	Gas
	Ions	Corrode	
Biology	Digestion	Small intestine	Relative
	Saliva	Results	Evidence
	Starch	Tested	Indicate
	Sugar	Teeth	Absorbed
	Solution	Process	Wall
	Parchment diffusion shell	Broken down	State
	Molecules	Product	Mouth
	Iodine	Moistens	
	Fehlings	Purpose	

Occurrences of Technical and Special Non-Technical Words

Geography	Energy	Radiates	Produces
	Fossil	Creates	Reflected
	Tonnes	Clouds	Sources
	Upper atmosphere	Winds	Space
	Temperature	Ocean Currents	Million
	Forms	Waves	Indirectly
	Alternative	Harners	Absorbs
	Fuel	Evaporation	Power
	Release	Directed	Equivalent