The development of science and technology reporting in The Times and The Guardian

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The Development of Science and Technology

Reporting in the Times and the Guardian.

by

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ABSTRACT

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The reporting of science and technology in newspapers is an area of mass media research which has been well covered. The development of such reporting over an extended time period is not something which has been sufficiently researched, as yet. This survey of the Times and the Guardian in 1974 and 1975 and 1989 and 1990, is the beginning of such a study.

The major part of the project was to survey all the science and technology articles in a chosen time period. Data was collected on article location, subject matter, heading status, length and graphical component. A content analysis of medical and space/astronomy articles was performed, which examined the differences in article attitude, use of quotes and technical terms and acronyms.

The survey data was used to make comparisons over time, both for science and technology reporting as a whole, and the various subjects which make up that field. It was found that certain aspects of the reporting of science and technology were not static over the time period studied, but changed with time. These changes were not the same for all subjects or both papers, and can only be said to apply to the years examined in the survey. Also, some aspects of reporting, (namely mean article and graphic lengths, and status of article headings), remained largely unchanged.

Some possible reasons for the results obtained are suggested. These include the aims of the newspapers, the nature of the newspaper audience and the changing popularity of the subjects which comprise science and technology.

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LIST OF GRAPHS

LIST OF ABBREVIATIONS

CA	content analysis
nt	no test
ns	not significant
*	significant at the 5% confidence limit
**	significant at the 1% confidence limit
env. sciences	environmental sciences
computing/IT	computing and information technnology
space/astro	space and astronomy
misc	miscellaneous
S & T	science and technology

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The nature of cultural experience in modern societies has been profoundly affected by the development of mass communication. Newspapers occupy a central role in our lives along with other media such as books, magazines, television, radio and so on. Together they provide us with a continuous flow of information and entertainment, with newspapers, radio and television the major sources of information, ideas and images concerning events which take place beyond our immediate social milieu. In spite of the centrality of mass communication in modern culture, its study has often been regarded as peripheral to the core concerns of sociology and social theory (1).

The development of mass media institutions- newspapers, book publishers, broadcasting organisations and the like, marked the emergence of new forms of information diffusion and cultural transmission. Systems of writing have existed since the 3rd millennium BC but the practice of reading and writing has, for most of the 5,000 years since then, been restricted to a small minority of the population. With the development of the printing industry in Europe in the 15th and 16th centuries, the capacity to produce multiple copies of texts and documents was rapidly increased. It is estimated that in 1850 as many as 150 book titles were published in England, compared to only 13 titles in 1510. The development of the newspaper industry in the 18th and 19th centuries significantly extended the availability of the written word. The first daily newspaper in England, the Courant, appeared in 1702. The first Sunday paper was the Sunday Monitor and appeared in 1779. The growth of the mass circulation newspapers continued into the 20th century, although it has tailed off in recent years. This decline coincided with the growth of television as a medium of mass communication (2).

The mass media are therefore, one of the major forces that mould and shape social movements and keep the majority of the populace informed about change and progress in, amongst other things, science and technology. They have the ability to change and direct thinking and attitudes, and to misinform as well as inform. However, the basic path of science is not usually significantly altered by the attitudes of the press because scientific journals and meetings are an effective internal method of communication formed by and for the scientific community (3). Many potentially interested groups however, are unable to use specialised sources of scientific communication such as journals and conference proceedings., either because the nomenclature is unfamiliar or because they cannot physically access such information sources. Consequently, these groups and the general public frequently gain their primary image of science (and scientists) from the mass media (4).

Cultural forms in modern societies are increasingly mediated by the mechanisms and institutions of mass communication. In a period of less than 200 years the conditions under which individuals acquire information about their world, derive entertainment and participate in public life have changed dramatically. For many people in industrial societies today, the products and institutions of the mass communication media are a principle source of information and entertainment (5).

Unquestionably, the twentieth century era of science and technology has made an impact on all areas of the mass media, including newspaper editors and newspaper reporting as well as the magazine field. In turn, one can say that there has been a feedback from the output of the newspapers and magazines into the scientific arena. This takes place via the public who read scientific articles and publications. That feedback has been in several areas, such as money, men and even ideas (6).

It is clear then that the public presentation of science has been well studied already with most work being carried out on the oldest media that of newspapers, and then expanding into radio and television. Most studies have tended to concentrate on the reporting of specific events. These events were often discrete occurrences, for example Krieghbaum's discussion of two Gemini space flights. As a result the development of science and technology reporting over an extended time period has not been extensively studied. Students and commentators on journalistic affairs have only infrequently looked into the news flow to test its contents and so there is no continuing, consistent measurement of what science developments have appeared in print or on the air, and which have been omitted (7).

The quality press has, in some studies, (8) come out favourably in its informativeness, in that it provided a reasonable amount of information about health issues even when articles were based on events. They, along with the popular press, relied upon the traditional practice of reporting events rather than issues. The popular press focused more on symptoms (in health reports) and the subjective experience of health and illness occurred because these topics are appropriate to their human-interest, sensationalised approach to reporting.

A recent study by Entwistle & Hancock-Beaulieu (9) looked specifically at health coverage in the quality and popular press. This gave some very interesting results especially with regard to the place of the health section in overall reporting. However, again this type of study only affords us a glimpse of one moment in time- a snapshot.

Logan's study (10) revealed discrepancies between recent qualitative literature and his study in terms of the overall balance between human-interest and educational reporting. The former seem to reveal that studies which reflect the performance of a science and biomedical news staff over time may be different than research about their performance within one or two story cycles. Logan's study suggests the value of looking at a newspaper's reporting for an extended period before assuming that short term work is indicative of overall performance.

1.2 WHAT DO WE CALL SCIENCE AND TECHNOLOGY AND WHY IS IT REPORTED

To most medieval scholars, the pursuit of science was not a journey into the unknown but a search in the library for something which was already known and written down in the past (11). The real art of making progress in science is to ask the right questions about nature which can be answered by observation, experiment and mathematical analysis (12). Science is another word for knowledge and technology is concerned with the practical application of knowledge. This differentiation is rarely made in public discussions and it really is of little use because it is so hard to apply in practice. In its popular image science is inextricably confused with technology (13). Science is not just a collection of data but a cooperative search for truth which generates its own values. Practising science should encourage people to be intellectually honest, internationally minded, critical of others and yet capable of accepting criticism themselves and to be ready to publish and discuss their results. These ideals could only hold in an ideal world though. Today's scientific community is larger and more 'industrial', more collective and governed by politics. They work in teams, but are often surrounded by secrecy due to the nature of their work (military or acquiring patents) and the competitive pressures of acquiring and distributing funds for research. Compromises with the older ideals of science are inevitable (14).

For our purposes, science and technology include the pure sciences and some of the applied disciplines. English-speaking countries differ from the non-English-speaking countries in their treatment of the social sciences. We would not include sociology or political science in a "science" definition, whereas French or German surveys may well do so. For this reason I have not extended my survey to cover such areas, but studies from other European countries may well extend the definition of science and technology into the social sciences and areas of applied technology. This difference in basic assumptions should be borne in mind when comparing studies from more than one country. American writers too may have a different perspective on what constitutes science. Logan (15) defined science, for operational purposes, into reporting about environment, computers, biology, ethics, geology, space, social science, chemical sciences, physics, nuclear energy and miscellaneous. Biomedical news was also included and further subdivided for specific study. It is definitely a problem with communication studies that there are such marked anomalies in what should be a standard term- that of "science and technology".

Today's scientists are not working in isolation either financially or intellectually. Consequently they report their findings more freely to their colleagues and co-workers initially, then to their sponsors and finally to the non-scientific community at large. Of course the financial burden which researchers feel now more than ever, when funds are scare and results obligatory, may instil them with a degree of trepidation when announcing progress in their work. No-one wants to give their ideas away and have someone else make all the profits- but in general, the dissemination of primary information is seen as necessary now, perhaps even an obligation to sponsors, and is accepted as such (16). The "right to know" ethos of modern society puts the media in the centre of the distribution network for scientific and technical findings. Moreover, society has developed a thirst for information per se, so again the media, including daily newspapers are a critical part of the chain of information movement. Where one must look at the contents themselves in more detail, is at the point of "knowledge". What is the audience told? Does it learn anything? Should they be educated about science or informed about the news? The debate about whether science and the mass media ought to work together for the betterment of mankind, or that- like it or not- science and the mass media are intrinsic to the process by which non-scientists come to understand science, goes on (17).

The mass media can arouse public awareness in science in a relatively short period, but to develop deep abstract concepts within such a limited time through the use of conventional spot news coverage and features: long term diffusion may be something else again. They can create awareness and perhaps stimulate the desire to learn, but it is more likely and fitting that they should provide background, or put the meat on the bones of the events of the day, thus contributing to education whilst ostensibly informing the public (18).

Newspapers are the oldest mass media channel for reporting scientific advances although their primary aim is still to report what is news. Science, like any other area, is picked over to find the stories with some element of shock, amusement or general human interest (19). What all science reports have in common is that something in the field must have changed, or a new element come to light before it is worth reporting. They would not report something which was known about already. Thus the educational element of the reports takes a back seat.

Scientists are frequently flattered by and benefit from coverage of their research and views in the media. What they do not like is exposure to negative publicity or the revelation of results or work which has little popular support. The media are not the scientists so they do not shy away from difficult issues (20). Recent negative aspects of science and technology have led to a more critical stance on the part of some media correspondents. Scientists tend to resent this, believing it leads to a destructive, rather than constructive criticism. The reporters involved see this attitude as healthy, arguing that informed criticism is a fundamental requirement of good media presentation. Agreement between the two camps is unlikely to be reached (21). Scientists also criticise the way their work has been trivialised or sensationalised by the media (22). It is worthy of note that the press rarely influences behaviour directly, but sets the agenda for public debate and awareness (23).

Findings have indicated (24) that the public press cannot within a short period of time, ie. one year, hope to impart detailed scientific information on any subject. Instead, the amount of general information held by an audience was shown to increase greatly in a short time span, and they developed an increased awareness of science and technology. The conclusions drawn from this were that newspapers do not develop deep abstract scientific concepts in the public within a short period of time. They can do so in certain subject areas where there is an intimate concern, for example in medicine.

1.3 INFORMATION GATHERING AND THE REPORTING PROCESS

For journalists, objectivity should be the most important professional norm, and from it flows the more specific aspects of news professionalism such as news judgment, the selection of sources and the structure of news beats. It resides in the behaviour of journalists, but objectivity does not mean that they are impartial observers of events, but that they seek out the facts and report them as fairly and in as balanced a way as possible (25). Their information comes from a variety of sources including government and educational institution reports, scientific articles and press releases, much of which they do not use. Only about 2.5% of all the items coming into an international press agency ever reach the average newspaper reader (26).

The accuracy with which these sources are transferred into the paper by the reporters, varies with the source, its length and the length of the piece being written. The main errors appear to be misquotes, mainly through lack of respect for the sanctity of the original quotations (in this case press releases) and the error of over-emphasis. There are many factors affecting the way a journalist puts together a story, and so, necessarily, how accurate he/she is. Journalistic needs have bent science writing goals, often inhibiting what scientists and some science writers would like to see in articles, such as more explanations, depth of coverage, or attention to detail (27).

Science writers see relevance or application for the readers as being more important then the drama and human interest prevalent in most other areas of popular journalism. Writers must look at their audience, the time constraints and the space constraints on a story and balance all three satisfactorily. It is immensely difficult to explain adequately, accurately and interestingly a complex technical subject in 1000 words. The who, what, where, when, why and how of the story must be in their first, so details often get edited out of the bottom of an item. Additionally, for a piece to have high profile it must contain hard news, something current which makes the story immediate; a news peg. Scientists therefore often find the stories lacking in detail and giving the wrong impression of what science is like:- immediate and consisting solely of breakthroughs, rather than a time-consuming, cumulative process. Some scientists will create news pegs by holding a press conference for example to induce reports on the stories they consider to be important. Reporters call these events pseudo-events because of their contrived origins (28).

Since the public gets all or most of its information on science from the public press, the science writers in newspapers or magazines become the principle agent of transmission. How well a science reporter performs his/her duty determines to a significant extent how much information the public gets from the press and the quality of such information (29). The American Society of Newspaper Editors (ASNE) have put forward seven "canons of journalism" (30), which they see as codifying the aspirations of American journalism. These are:-

a) the responsibility of each journalist to be true to his audience
b) the freedom of the press
c) freedom from all obligations except fidelity to the public interest
d) sincerity, truthfulness and accuracy
e) impartiality
f) fair play
g) decency

Science and medical writing specifically serves a powerful alerting function, making it possible for long-term "educational" processes to take hold in the community. Science writers now know that the public and more specifically their audience has an interest in science, but, at the same time, has a lack of knowledge concerning some of science and technology's basic concepts. Thus there are significant technical problems in the transmission of scientific information to the public. For example, the reporter and editor have to decide whether it is better to make definitions organic to the story, or to give them as a dictionary at the end? The latter option involves greater risk because the ends of articles are frequently edited out. Generally speaking, editors and also publishers attempt to provide satisfaction for the desires and tastes of what they conceive to be their proper audience (31).

One long-held dogma among scientists is that "sensationalised" science news in newspapers and magazines did, indeed, bring in readers who might not normally have read such articles, but at the same time they repulsed knowledgeable individuals seeking information and did more harm than good (32). So scientific journalists should be aware of the balance between attracting new readers and maintaining a standard which their regular audience expects. The increasing use of journalists with a scientific background to write science articles should reduce unnecessary sensationalism. The vast majority of science articles are now written by professional science writers, but a century ago they were written either by scientists or journalists with no training. The situation is far more satisfactory today (33).

The scientific journalist has the constant problem of interpreting technical and complicated material for the comprehension of laymen (34). This is not a new problem as science reporting is certainly not a new field. In fact, the first example of such a report can be found in the first edition of the newspaper Publick Occurances, dated 25 September 1690. Some of the basic concepts of science reporting have prevailed throughout its history. For example, the majority of articles emphasise "progress" in a field and attempt some analysis of the facts. They may also give some background to each item (35). Science moves so fast and the average reader is aware of so little that the reporter may be forced to educate to some degree with definitions, explanations and background, whether he wants to or not. Innovating concepts have to be explained so that the audience can make sense of the latest developments. There is no point reporting an event or an issue if your target audience cannot comprehend the details.

Scientists for their part see their responsibility as to "determine the truth" and publish their results and theories for other scientists to verify and/or apply. Media people see their responsibility as "telling the truth" or "entertaining" and seldom do the two go together. Presumably, the compromise is to have trained reporters with a scientific or technical background coordinating science reporting. In this way, information is gathered effectively and reported efficiently. In the 19th century, there was a great push for popularising science. It is only lately that people in both science and politics have been saying there is responsibility for scientists to make an effort to inform the public of the reasons for and the results of their work (36). Consequently, scientists have been drawn into the science communication process, although the popularisation of science still seems low on their personal agendas. Many of the scientific societies, however, do place public understanding high on their list of priorities (37).

A closer association with the mass media could only be beneficial for the long-term popularisation of science. Indeed, the plethora of science articles which have appeared in the mass media since the boom of reporting in the 1970s indicate that frequent contact is being made between scientists and journalists. Their relationship has been termed as symbiotic, a condition in which diverse entities coexist for mutual benefit, rather than anything as consenting as a partnership. This contact was stimulated by the world wars and prompted the American Chemical Society to establish the first news service in 1919. In 1921 E. W. Scripps, a newspaperman, established the "Science Service" selling science news to newspapers (38).

1.4 THE NEWSPAPER AUDIENCE AND ITS ATTITUDE TO SCIENCE

Would it be true to say that the newspaper audience of any one publication consists of the general public as a whole? No, probably not, because different sections of society choose to read different publications. Britain's quality press caters to the higher socioeconomic classes. Lower socioeconomic classes are more likely to read the popular press or magazine publications (39). This is going to have an effect on the type of material that one finds in each publication because, to some extent, they are tailored to the specific audience (40). Even if all audiences acted in the same way, the general public itself is too vague a term to use with any conviction. It includes, for example, the M.P.s and civil servants who are involved in the funding of science; technologists who are trying to keep up with scientific developments; the scientists themselves, when they wish to find out what is happening in other branches of science; amateur scientists who want to hear what professionals are doing; as well as various groups of the lay public (41).

Despite the diversity of audiences, most people today know something about science and recognise that it is an important force in modern life. Even though they may have little formal training in science, many of them have a keen interest in all kinds of science. They recognise what constitutes science but often their understanding remains at the definition level rather than having any detailed knowledge of concepts or theories. There is an element of magic and mystique about what happens behind closed doors in labs and academic ivory towers, and this creates a barrier between those specialists and scientists who not only know, but also understand, and those members of the audience whose understanding is minimal (42).

Even though awareness and understanding on the part of the mass media audience are increasing, they are not keeping up with the advances in scientific knowledge among scientists, so this gap is not decreasing significantly. The information explosion which we have witnessed in recent years has occurred in science and technology as much, if not more, than in other fields of study, so the audiences have a wealth of information to sift and digest. It is hardly surprising that they find the subject matter ever more applicable to everyday life as their sphere of information grows. It is to be hoped that popular science such as we see in newspapers and magazines will reduce rather than add to their confusion, as this is where they turn for scientific information (43).

When questioned about the value of science and technology in our society today, people are less positive than they would have been say, 100 years ago. Surveys have shown that, the public still hold science in high regard and believe it to be essential to progress and for its practical benefits, but they regard it as a mixed blessing. We have benefited from the wide range of new goods and services, but some of these industries have polluted our world and depleted our finite resources. On the social side, automation has made working easier, but has also been the cause of unemployment. In most people's minds the worst effect of applied science is the enormous increase in the elaboration and destructive power of modern armaments. The balance of spending in this area seems ludicrous, so it is no wonder the general public sometimes has a dim view of science and technology (44).

Despite this the public are still interested in science, and the emphasis on science and health in mass media publications seems to reflect this interest. Nunn (45) found that newspaper audiences had a high level of interest in science news with, particularly strong interest among the 18-29 year olds. Other studies (46) have shown that 40% of American adults were interested in science and science policy. They have been divided into groups according to interest and knowledge. The "attentive public" are individuals with a functional knowledge of science and technology, a high interest and a pattern of relevant information gathering. The remaining individuals were labelled the "interested public". They lacked the functional knowledge of science, but maintained an active interest in science and science policy. Generally, they were slightly older than the attentive public and less well educated. They form the pool from which additional attentives might emerge (47).

As to what the audience wants from scientific reporters, opinions vary. Isolated bits and chunks of science news might satisfy some in the science audience, but, some say, the bulk of the group would prefer science-in-context; science news that has meaning because it helps make sense of the world (48). It has also been suggested that what science news consumers want from the mass media is the essence of the experiment, but not its detailed nuts and bolts (49). This is obviously an area which requires investigation and, indeed, it is important for mass media publishers to discover how and what their audience thinks and expects of their newspapers. A fast moving world necessarily gives rise to a changing audience. This needs monitoring if the media are to achieve a satisfactory balance between giving their clients what they they want and what the publishers and producers think they ought to have.

1.5 A BRIEF HISTORY OF THE NEWSPAPERS

The development of the British Press has been punctuated by technical and political events which alternately slowed and accelerated the evolution of newspapers to the status they occupy today. The arrival of letterpress printing techniques in 1476 facilitated the start of the press. Prior to this the only comparable items were letters sent out by correspondents to wealthy merchants and a small number of printed pamphlets or newsbooks carrying items of interest. As discussed in section 1.1, regular daily papers first made their appearance in London in 1702 in the form of the Daily Courant. This was not a healthy time for the free press which had suffered the imposition of the Licensing Act of 1662 for 33 years. Other regional papers did take off though, and by the beginning of the nineteenth century the newspaper press had become firmly established as a national middle-class institution, with considerable political influence.

Many of the important technical advances came to be developed by the newspaper which dominated all others in the first half of the nineteenth century; the Times. It began life as the uninspiring Daily Universal Register and after four years, in 1788, became the Times. They consistently applied new techniques, such as the rotary press, and thus increased their circulation. Success was also achieved via the capacity of their professional journalists to inform, entertain and persuade the readership. Circulation rose from 3,000 per day in 1801 to nearly 60,000 in 1855, and the Times incisive commentary and editorials earned the paper the nick-name of "The Thunderer". The first half of the nineteenth century also saw great advances in the provincial press, with the highest circulation in 1854 going to the Manchester Guardian. This was one of the most successful provincial papers, founded as a weekly in 1821 by a group of Manchester radicals. By 1842 it had a circulation of around 8,000 copies. It became a daily in 1855, but its heyday really began with the appointment of C.P. Scott as editor in 1872. He forged the paper into a leading vehicle of Liberal opinion (50).

The quality dailies such as these have always had more science in them than other newspapers such as the News of the World which was also establishing a market for itself at this time, and the Times is generally considered to be the leader in its field. It was not always the most innovative paper though. It was the Manchester Guardian which appointed the first specialist science reporter in the UK (51). These two titles are certainly interesting to look at then in terms of science and technology reporting.

Today newspapers are having to compete with radio, television and a whole range of specialist and general magazines for the attention of the attentive and interested audience. The peak of newspaper buying was between 1930 and 1947 when sales doubled to more than 15.5 million issues per day. By the end of the sixties sales had peaked and were on their way down again. Partly as a result of this decline, which coincided with the rise of television, the press became wary of upsetting their readership and far fewer innovations or changes of any kind were seen (52). Today the press industry has a streamlined physique and has regained some of its innovative style, as seen by the introduction of special sections and the recent change in format of the Guardian. The circulation of the Times is 424,051 and 423,155 for the Guardian for the period June to November 1990 (53).

1.6 WHY THE GUARDIAN AND TIMES WERE SELECTED AND THE ROLE OF SPECIAL SECTIONS.

The science presented in the more popular newspapers is, in comparison to the quality papers, narrow in its orientation and limited in its amount. As the popular press have a much larger circulation than the quality titles, only a minority of the total newspaper audience receive a reasonably diverse and extended commentary on scientific developments, and this is almost exclusively from the quality papers such as the Guardian and the Times. They tend to present a wider range of sciences to their audience and treat the subjects with more depth (54). Therefore, previous studies indicated that the selection of quality papers would be more beneficial for this study, although there is definitely a need for a study of a broader range of titles.

These two publications in particular were chosen because they may have a slightly different orientation towards the news items they report. It was hypothesised at the outset that the difference would be revealed by an analysis of the contents of selected articles. Consequently, these two titles are of significance in the mass communication of science and technology to the general and lay public, but they are also different enough to provide good subject matter for a comparison of styles and journalistic approaches to the professional reporting of science and technology. Both publications are respected, and the Times, especially, has long been renowned for its scientific coverage. Even though both are quality publications, it would be unwise to assume that the traits and habits of journalists are similar in the two. Therefore both are studied to see if this is true, or if one can extrapolate from one quality paper to another.

Newspaper editors have traditionally underestimated the public's interest in science, but this seems to be changing. Recently there has been a movement in news coverage to include science and health related information as part of regular newspaper coverage. Science makes local and national headlines. Newspaper reports provide the public with most of its science news. A growing number of papers feature weekly science sections. Some may not go this far, but do have a full-time science writer on the journalistic staff. Virtually all newspapers feature some reporting on environmental and medical/health issues. They can influence the public's knowledge of science and their attitudes toward science. In 1986 in the United States, there were 66 newspapers with weekly science sections and 81 newspapers had weekly science pages. This compares with only 19 such sections in 1984 (55). Both the Times and the Guardian introduced various special sections with a science or technology theme between 1975 and 1989. Part of this study looks at how this type of change in the compilation of a newspaper affects what is reported, and therefore contributes to an assessment of the importance of such sections. The size of a news organisation plays a large role in determining whether there are speciality reporters at work. As the organisation gets larger, the journalists' duties become more specialised, including assignment to full-time news sections. A larger organisation, such as a national paper, is also more likely to engage in in-depth reporting and have feature sections where there is more room to develop the why and the how of articles and provide more perspective. So the reporting will be more specialised in the Times and the Guardian but because their readership is smaller than that of the popular papers, their level of reporting will also be maintained (56).

1.7 OTHER MASS MEDIA FORUMS

The closest form of publication to newspapers is magazines. They range from the general publication which covers science and technology as well as a vast number of other subjects, to specialist science magazines that only cover science, but are for the lay reader. These should not be confused with scientific journals, which also only cover science and are probably much narrower in only covering one small branch of a discipline, but are directed toward the professional scientific community. To complete the picture there are also more general publications for the scientists (57).

Magazines as a group have been more flexible in their attitude to adopting special sections and supplements. They have made extensive use of specialised population segments in their editorial, circulation and advertising sales strategy, whereas newspapers still base their strategies more or less on simple circulation counts with little regard for how their readership breaks down or changes over time (58). The aim of scientific publications is to maintain scientific and technical accuracy, so that experiments can be repeated and scientific judgments made. The newspapers' aim is journalistic accuracy; giving the correct impression or overall picture of what the scientific findings mean to a non-scientist. Therefore the two are not in serious competition, their audience, coverage and detail vary too much (59).

The main threat to the popularity of the newspaper is the whole field of broadcast media:- radio, but more importantly television. The same differences in size, structure and autonomy have to be considered as they do in the print media, and the same differentiations in frequency of publication, depth and breadth of coverage, locality and credibility apply (60). The constraints on national news air time are even more demanding than those on space in a national daily newspaper. It has been estimated that if the script of a thirty minute evening newscast was set into type it would not even fill the front page of a broadsheet. Television editors must, therefore, be extremely selective in what they choose and the amount of detail they can allow for each story. Detail, or the lack of it, is a problem area for scientific writers and reporters (61).

Television does have several advantages over traditional print media. It has visual immediacy lending even more weight to stunning events and subject areas like space travel or astronomy. They tend to be lightweight on the technical side because of the lack of air time and the much higher diversity of audience experienced than newspapers. Their forte is presenting what happened, but they can make little impression on background or explanation. In this respect, both radio and television are seen by some commentators as being a generation behind newspapers (62). The newspaper remains the workhorse for conveying most scientific information to most people, despite television's advantage during spectacular events. Part of the reason for this heavy audience reliance on the print media is that a daily newspaper can present a whole range of news, whereas broadcasters must concentrate only on those items that will appeal to a mass audience (63).

REFERENCES

1. THOMPSON, J.B. Mass communication and the modern culture: contribution to a critical theory of ideology. *Sociology*, 1988, **22**(3), 359.

2. *Ibid.*, 362-363.

3. VAN DRIEL, B. & J.T. RICHARDSON. Print media coverage of new religious movements: a longitudinal study. *Journal of Communication*, 1988, **38**(3), 37.

4. JONES, G., I. CONNELL, & A.J. MEADOWS. *The presentation of science by the media*, 1978, p. 1.

5. THOMPSON, ref. 1, 363.

6. UBELL, E. Science in the press: newspapers vs magazines. *Journal of Communication*, 1963, **40**, 299.

7. KRIEGHBAUM, H. *Science and the mass media*, 1986, p. 66.

8. KRISTIANSEN, C.M. & C.M. HARDING. A comparison of the coverage of health issues by Britain's quality and popular press. *Social Behaviour*, 1988, **3**, 29.

9. ENTWISTLE, V. & M.M. HANCOCK-BEAULIEU. Health coverage in the quality and popular press in the UK. *Proceedings of the International Conference on Public Communication of Science and Technology*, 1991.

10. LOGAN, R.A. Events, contexts and conflicts: a content analysis of the Los Angeles Times and the New York Times' reporting of science and biomedicine. *Proceedings of the International Conference on Public Communication of Science and Technology*, 1991, 11.

11. BROWN, H. *The wisdom of science, its relevance to culture and religion*, 1986, p. 1.

12. *Ibid.*, p. 4.

13. *Ibid.*, p. 106.

14. *Ibid.*, pp. 133-134.

15. LOGAN, ref. 10, p. 6.

16. KRIEGHBAUM, ref. 7, p. 50.

17. FRIEDMAN, S., S. DUNWOODY & C. ROGERS, eds. *Scientists and journalists. Reporting science as news*, 1986, p. xii.

18. KRIEGHBAUM, ref. 7, p. 55.

19. *Ibid.*, p. 21.

20. POCKLEY, P. Communicating science to the skeptics. *Impact of Science on Society*, 1988, **38**(3), 224.

21. JONES *et al.*, ref. 4, pp. ii-iii.

22. *Ibid.*, p. 59.

23. ENTWISTLE & HANCOCK-BEAULIEU, ref. 9, 1.

24. UBELL, ref. 6, 296.

25. SOLOSKI, J. News reporting and professionalism: some constraints on the reporting of news. *Media, Culture and Society*, 1989, **11**(2), 213.

26. MEADOWS, A.J. & M.M. HANCOCK-BEAULIEU. The selection of scientific information by the mass media. In press, 1.

27. KING, J. An input-output study of science news in the press. *Australian Journalism Review*, 1986, 8(1/2), 56.

28. FRIEDMAN, S. The journalist's world. In: Friedman *et al.*, ref. 17, pp. 18-26.

29. UBELL, ref. 6, 294.

30. AMERICAN SOCIETY OF NEWSPAPER EDITORS. Canons of journalism. In: Schramm, W. *Mass communications*, 1969, pp. 623-625.

31. MOTT, F.L. Trends in newspaper content. In: *Ibid.*, p. 371.

32. UBELL, ref. 6, 297.

33. MEADOWS & HANCOCK-BEAULIEU, ref. 26, 18.

34. KRIEGHBAUM, ref. 7, p. 52.

35. *Ibid.*, pp. 18-20.

36. POCKLEY, ref. 20, 22.

37. FRIEDMAN *et al.*, ref. 17, p. xiv.

38. *Ibid.*, pp. xii-xiii.

39. KRISTIANSEN & HARDING, ref. 8, 27.

40. CARTER, M.D. *An introduction to mass communications. Problems in press*

and broadcasting, 1971, pp. 67-68.

41. JONES *et al.*, ref. 4, p. ii.

42. KRIEGHBAUM, ref. 7, p. 56.

43. FRIEDMAN *et al.*, ref. 17, p. xii.

44. BROWN, ref. 11, pp. 102-103.

45. NUNN, C.Z. Readership and coverage of science and technology in newspapers. *Journal of Communication*, 1979, **56**, 28.

46. MILLER, J. Reaching the attentive and interested publics for science. In: Friedman *et al.*, ref. 17, p. 56.

47. *Ibid.*, p. 57.

48. KRIEGHBAUM, ref. 7, p. 61.

49. *Ibid.*, p. 39.

50. CARTER, ref. 40, pp. 27-34.

51. MEADOWS & HANCOCK-BEAULIEU, ref. 26, 14.

52. CARTER, ref. 40, pp. 70-74.

53. *Willings Press Guide 1991*, 117th ed., 1991, pp. 609-1329.

54. JONES *et al.*, ref. 4, p. 3.

55. HINKEL, G. & W.R. ELLIOTT, Science coverage in three newspapers and

three supermarket tabloids. *Journalism Quarterly*, 1989, **66**(2), 353.

56. FRIEDMAN, In: Friedman *et al.*, ref. 17, pp. 19-23.

57. FRIEDMAN, In: Friedman *et al.*, ref. 17, pp. 18-19.

58. MILLER, In: Friedman *et al.*, ref. 17, p. 56.

59. KRIEGHBAUM, ref. 7, pp. 29-42.

60. FRIEDMAN, In: Friedman *et al.*, ref. 17, p. 18.

61. *Ibid.*, p. 22.

62. KRIEGHBAUM, ref. 7, pp. 29-30.

63. *Ibid.*, pp. 63-64.

CHAPTER 2

METHODS

2.1 PURPOSE OF THE STUDY

This study evolved from work undertaken by Meadows & Hancock-Beaulieu (1) on the selection of scientific information by the mass media. This recognised that very little work had been done on how science reporting has changed over time. The reporting of specific events has been examined, for example Darwin's theories of the evolution of mankind, and several studies have looked at the presentation of science by newspapers (2, 3, 4, 5, 6, 7) and have compared the amount and makeup of science reporting in a range of newspapers. However, investigations of changes in reporting over time are less common. Very general studies of content analysis trends have been conducted, for example Mott's study of the amount of space given over to areas such as foreign news, business or sport in 1910, 1920, 1930, and 1940 (8). It is interesting to note though that science was not even considered as a category for this piece of work.

A lack of continuity in research is compounded by the fact that each study uses a different method of data collection and analysis and asks different questions. This is, of course, the nature of research; to ask a variety of questions and enlarge the paradigms of study. However, it is difficult to view such independent studies at a glance in an attempt to see how the attitude of newspaper publishing has altered with regard to science and technology. No two pieces of work cover the same subject matter and often use different working definitions of science and technology. For example, Jones, Connell & Meadows (9) had ten categories for science articles; medicine (including human biology), behavioral science, engineering/technology, biology (natural history), space, earth sciences, physics, chemistry, general (science policy) and unclassified (science fiction etc.). Hinkle & Elliott (10) only had three categories; medicine/health, technology and hard science. The definitions vary with the direction of the research and the authors' desired emphasis.

Logan 1991 (11) makes a distinction between science and biomedicine. Science divides into environment, computers, biology, ethics, geology, space, social science, chemical sciences, physics, nuclear energy and miscellaneous. Here we can see how definitions are bound to change with time as new areas emerge (computers and nuclear energy) and how broad the definition of science can become with the inclusion of social sciences or science fiction. Consequently, this study is an attempt to begin the analysis of the evolution of science and technology reporting in one area of the mass media. It is anticipated that the findings should prove to be a useful basis for further research in the future.

2.2 AIMS AND HYPOTHESES

Broadly, the aim of this project was to look at the development of science and technology reporting in two British newspapers, the Times and the Guardian, over a fifteen year time period (1974-1990), in order to obtain an idea of how reporting is evolving. A series of hypotheses have been proposed and data was collected in order to test these hypotheses. The results of an analysis of the data supports or refutes the hypotheses. In order to do this, the survey of the two papers looked at the location of articles, total amounts reported, the subject matter of articles, and how it was portrayed in terms of pictorial additions and headings. Headings were ranked according to point size rather than length. This information was then broken down by various factors, to look at proportions of space devoted to certain subjects and printed in certain parts of the paper.

This was followed by an analysis of how, if at all, the introduction and composition of special sections differed from and affected the main body of the newspaper- the general news sections. Special sections are defined as those parts of the paper which may not appear daily, but weekly and which focus on one specific subject area. Subjects covered vary from sport to women's issues, but, for the purposes of this study sections were chosen which were devoted to science and technology, either as a whole or in part. Finally a content analysis of selected articles in the medical and space/astronomy subject areas was undertaken to look at the qualitative aspects of science and technology reporting, rather than the quantitative side which was examined in the first part of the project. The specific hypotheses tested were as follows:-

1. That there is a relationship between articles and their location in terms of

a) page of publication
b) day of publication
c) section of publication

The relationship is expected to be in the number of articles present on certain days, certain pages or in certain sections. Some, specific pages, days and sections will contain more articles than others.

b) and c) will be less apparent in 1974 and 1975 than in 1989 and 1990.

2. There will be no difference between the papers with regard to what is reported; that is to say the general composition of science and technology reporting when broken down by subject will be the same.

2.1 There will be no difference in the total amount of reporting found in the Times and the Guardian in both time zones.

3. Over time there will be an increase in

a) the overall amount of science and technology reported
b) the mean length of articles

4. Over time, in both papers, there will be a change in the

a) composition of science and technology
ai) the mean length of articles in each subject
b) status of articles (the size of the headings given to articles)
c) number of graphics used
ci) mean length of graphics used
d) distribution of graphics between subjects
di) the mean length of graphics in each subject

5. Over time, more articles will appear in special sections, less in general news.

6. Articles in special sections will tend to be

a) longer than those in the main body of the newspaper
b) have larger headings (bigger type size)
c) utilise more graphics
ci) utilise longer graphics

The subsequent content analysis was designed to identify any differences in the way medicine and space/astronomy were reported and the way the two papers dealt with them, as well as looking at changes within subjects over time. Three specific aspects of the articles were examined.

a) the use and frequency of positive and negative attitudes to science
b) the use of personal names in quote attributation as opposed to generic terms
c) the use and frequency of acronyms and technical terms

2.3 SCOPE OF THE STUDY

The study focused on newspapers as the mass medium to be examined and did not expand into any other written media such as magazines, or audio or visual media such as radio and television. These latter areas require independent study using techniques modified to suit the medium. They were not excluded because they do not warrant study, quite the contrary, but a comparison across media as well as between time zones would require a more in-depth research project than time allows. Science and technology was chosen as the subject area for investigation because it has not as yet been studied in this way. Also, there have been many changes in science and technology over the last twenty years, perhaps more so than in other areas covered by newspapers, and these changes naturally lend themselves to investigation. It was also felt that some background knowledge of the subject matter would be beneficial for the accuracy of the project. Also, science and technology is a large field and to expand the subject coverage of the study would probably have resulted in a reduction in the depth of analysis.

The study was primarily carried out to discover any patterns in the reporting of science and technology over time and so aimed to cover a time span which would be long enough to illustrate such changes, but not so long that the two time periods would be too different to compare with any degree of success. It is to be expected that newspaper reporting of all areas; current affairs, sport, disasters as well as science and technology, has changed and is probably in a state of constant evolution. It is affected by the society which it serves and, in turn, affects changes in the attitudes and opinions of its readership. By looking in detail at one specialised area of reporting, it was expected that a clearer, more informed picture of the evolution of science and technology reporting over the past fifteen years could be drawn.

The Guardian and the Times were the newspapers chosen for this study because they represent different facets of the same area of the mass media; the "quality newspaper" market. They have both had reputations at some point in their histories for outspoken copy and innovative style, but with different political orientations. Consequently, they both ensure a quality product, but with different emphases on the news, resulting from writing from different starting points. As with the restriction to subject matter, a comparison of "quality" and "tabloid" titles requires another study to deal with time comparisons and style comparisons effectively at the same time. The philosophy and approach of the various types of publication are quite different, so it is probably only wise to extrapolate the results given in this study to other similar publications, ie. other quality newspaper titles. Further studies on other newspapers and, indeed, other media are also required before a comprehensive picture of science reporting in the mass media can be seen.

2.4 METHOD CHOSEN-THE SURVEY

The main part of this study is a quantitative analysis of the reporting of science and technology in two newspapers over a fifteen year time span. Collecting data to elucidate the evolution of reporting involves looking at, and sampling from, the actual articles which appear in print. This is a discrete stage in the process of bringing scientific discoveries and events to the attention of the mass media audience. The study is not concerned with how stories come to the attention of the journalists nor how they select their items for publication. Nor is it concerned with the other end of the scale: the attitudes of the consumers to what they read and the wider effects of the articles on society. Since these questions flank the concerns addressed here it is necessary to be aware of them. Many studies are being done on these areas to form a complete picture of the information transmission and transformation process which occurs within and around the mass media. King (12) and Meadows & Hancock-Beaulieu (13) look respectively at the use of press releases in scientific reporting and the selection procedure for scientific articles. Weiss & Singer (14) examine the process of reporting in its entirety, whilst Bostian (15) studied journalistic writing styles and their effect on readability and reader interest. Friedman, Dunwoody & Rogers (16) engaged several writers to survey the entire communication process in several mass media settings.

A survey instrument was used to collect data (Appendix 1), details of which are given in section 2.8. A systematic study of each of the issues chosen for analysis was made and the details recorded on the survey sheet. Many studies use surveys to collect this type of data, as it is a quite efficient method and ensures that data are collected uniformly over the collecting period. It is often necessary for experimenters to use more than one coder, that is, more than one person to collect the data and assign data to categories or rank it, as appropriate. In this case only one coder was involved, and this eliminates the problem of inter-coder variability. Obviously, there are some details which are not ambiguous to record; for example dates, pages and lengths of articles. Ranking the heading given to an article and determining its subject categorisation involves the use of some discretion. Using only one coder reduces the risk of this type of evaluation changing from day to day or between coders.

2.4.1 METHOD CHOSEN- CONTENT ANALYSIS

An additional part of the project was to look at the content of selected articles to gain some idea of how the qualitative approach to certain aspects of science and technology may vary. Content is that body of meanings through symbols which makes up the communication itself. No single system of substantive categories can be devised to describe it, but a systematic *method* has been developed for describing various facets of communication in summary fashion (17). This technique of "content analysis" operates directly on transcripts or texts of human communications thus yielding unobtrusive measures in which neither the sender nor the receiver of the message is aware that it is being analysed. This minimises the danger that the act of measurement itself will alter the message at some point (18). It is an attempt to produce an objective and measurable description of a text by identifying and counting particular units (usually words) that it contains (19). As a result, valid inferences can be made from the text, about the sender of the message, the message itself or the audience of the message. The best studies have both a quantitative and a qualitative element (20) and should be both objective and systematic (21). A relatively small sample was used in this study (see section 2.5), so no analysis of syntactical arrangements or styles was possible. Similarly, studying the balance in papers between event-based and issue-orientated stories; that is, those articles which are based on a specific event as opposed to those which form part of a long-running discussion of an issue, was not feasible. Neither was a study of the balance between educational style and sensational style articles.

The descriptions rendered in content analysis are of two kinds. Qualitative content analysis is the assignment of codes to content and depends on the coder's subjective impressions of the latent contextual meaning of words. If sufficient inter-coder reliability cannot be demonstrated, then, as with similar sections of the survey, the replicability of the findings may be called into question. Again for this study only one person was involved with coding so the risk of unreliability is minimised. Using computers to analyse articles would give perfect inter-coder agreement on the manifest content of texts, but computers are not able to pick out the subtle meanings inherent in language. The analysis would thus lose some of its depth, as there would be too much reliance on objective data and not enough on impressionistic content (22). The use of only one coder ensures that content analysis techniques were applied consistently. By stipulating what elements were to be studied before any of the articles were looked at, it is likely that a balance was obtained between identifying the manifest and the latent aspects of the content. Content analysis assumes that i) inferences about the relationships between intent and content, or between content and effect, can validly be made, ii) study of the manifest content is meaningful, iii) the quantitative description of communication content is meaningful and the frequency of occurrence is itself an important factor (23).

2.5 ISSUES USED IN THE SURVEY

The data used in this study are taken from two newspapers (the Times and the Guardian) which are published daily from Monday to Saturday. The Times also has an associated paper and magazine on Sundays and several educational supplements published during the week. These were not included in this study because Sunday and specialist publications generally have a different style and direction and therefore require separate study. Two discrete time zones were chosen so that the data collected could be used to indicate the validity of the hypotheses about the reporting of science and technology over time. These time zones were firstly 1974 and 1975 and subsequently 1989 and 1990. 1989 and 1990 were chosen to ensure that the study was as current as possible. 1974 and 1975 were chosen because it was a time when attitudes towards science were changing. People were starting to question the role of science in their lives whereas before they were much more accepting. This change is seen in the newspapers in the form of a change in the way science is reported. It became more questioning too. It was not felt necessary to select issues randomly from over the whole of each year because it was decided to sample one quarter of all the issues in a year. This is a relatively large sample size given a population of all the issues in one year, and so January, February and March were selected as being sufficiently representative of a year. Every issue from these three months, except for those exclusions already discussed, was examined.

The two titles were chosen because it was known from previous studies (24) that the so-called "quality" papers reported a significant amount of science and technology that can be analysed statistically. Tabloid or low circulation publications, such as local papers, were not felt to be suitable for study because too many editions would have to have been examined to gather enough data for analysis. Also, tabloids have a much narrower range of science subject coverage, and so even if enough issues were examined to make a large data set, many subjects would still not be covered at all. It is not, however, expected that the two papers will be identical either in the results of the survey, or when a content analysis is performed on certain selected news items.

The limiting of the sample to nationally known and respected newspapers may, of course, have consequences for the analysis. A majority of the population does not regularly read a newspaper of the quality of those selected. However, this choice of sources has been used before, and is justified because this reporting has the most significant impact on the public's opinion of science (25).

2.5.1 ISSUES USED FOR CONTENT ANALYSIS

This part of the project was restricted to two subject areas, namely medicine and space/astronomy articles, which were chosen because they are well represented in all the years examined, and because there is an interesting contrast between the way the two subjects are reported and the nature of reader interest. Medical and biological subjects are reported differently to technological subjects, and people read medical articles for different reasons to why they read articles about space exploration. Furthermore, for the analysis between papers to be feasible, it was necessary to find reports in both publications which covered the same issues or events. This is almost impossible to do with subjects such as chemistry or physics where the volume of reporting is very low. All parallel articles in any subject were identified, but only those in the above two categories were retained for analysis.

When the first part of this project was undertaken, details of the title of each article were recorded, as well as all the locational and structural aspects. From these data it was possible to identify and extract articles suitable for qualitative study. Forty-four such articles were finally selected in total, twenty three being medical and twenty one space/astronomy. Articles were paired by story subject matter, but the lengths were also taken into account. This is why there are uneven numbers of articles in each subject, to account for slight length differences in articles. One long article in the Times may be balanced by two shorter ones in the Guardian. Runs of articles covering basically the same event/issue were avoided because it was likely that they would have virtually the same content. To use a run would be like comparing several articles which were all the same. No importance was placed on the issues from which the articles originated, as long as there was a balance between the years and the papers. Selection criteria were instead all content-based using the article titles as a guide to content.

2.6 ACCESSING INFORMATION

As part of the pilot study, the Index to the Times was used to select articles. However, when the articles chosen in this way were compared to those chosen by going through each issue systematically page by page, it was found that many articles considered relevant had been missed using the former method. Using the latter method it was evident that keywords did not appear in the headings of certain types of article (eg on computing) and so they were being missed in a sweep of the Index. Primarily for this reason it was decided that it would be better (ie. faster and more thorough) to forego the use of indexes. Also, no index was available for the Guardian, so it was better from the point of view of standardisation of methodological procedure not to use the Index for the Times. Using an index also added an extra, unnecessary stage to the project which did not improve the method of data collection.

The next stage was to locate the editions chosen for study. All were available on microfilm either at Loughborough University Library, Manchester University Library or Manchester City Council Central Reference Library. It was necessary to use all three locations as no one library stocked all the issues needed. Various different microfilm readers were used, so a careful record was kept of where data was gathered and on which reader, as the magnification of the readers varied as did the print size of the papers. Once the survey was completed, articles were selected for content analysis as described in section 2.5.1. These articles were then photocopied from microfilm so that a more detailed study of the content could be carried out.

2.7 AIMS AND DESIGN- THE SURVEY

The survey was designed primarily to collect information which would enable the hypotheses suggested to be tested, but a separate survey was implemented for the qualitative content analysis part of the project. It was necessary for the first part of the project to collect actual measurements of article length, and also to rank articles for status, record their location and so on. Space was made for information which would make article identification easier, but which did not actually contribute to the testing of hypotheses.

Once relevant questions had been identified and the improvements needed as a result of the pilot study had been made, the main criterion for layout was ease of use. The various data questions were arranged in a logical order so that it was possible to scan the articles fairly quickly and record the date, page, subject area and so on. The section for quantitative data (article and graphics length and number of columns covered) came last because it was only used for the first fifteen of any one subject area. This number was chosen because it represented between fifteen and twenty percent of the largest (in terms of number of articles) month surveyed. This was felt to be a reasonable proportion of the sample to study in detail. In fact, in 1974 and 1975 there were often months when all the data were recorded for all the articles, because the fifteen percent limit was marked from the month which contained the most science and technology articles.

An equally important consideration when collecting data is the method and tools one is going to use for analysis. In this case the data was entered onto the spreadsheet (SuperCalc 5) for the purposes of data collation and manipulation. It was then transferred to the statistical package (Minitab) for analysis. All spreadsheets are basically the same, and SuperCalc was chosen because it was readily available, had a larger memory and accommodated the large data sets more readily than products such as As-Easy-As, rather than because it possessed any specific functions which made it preferable to any others on the market. Minitab was felt to be a suitable alternative to SPSS (Statistical

Packages for Social Sciences) because it is much less complex, but still performs most of the statistical tasks necessary for the analysis of these data.

2.7.1 AIMS AND DESIGN- CONTENT ANALYSIS

In this case, content analysis was used to identify a few characteristics about the communicators (the papers), discover any trends in communication content (26) over time and between subject areas. The results provide an insight into the presentation of scientific topics by the Guardian and Times newspapers (27).

A central idea in content analysis is that the many words of the text are classified into much fewer content categories. Each category may consist of one, several or many words. Words, phrases, selected key terms or other units of text classified in the same category are presumed to have similar meanings. Such sub-divisions are the units of content analysis and may, as in this case, be as small as a single word. "Words" also include compounds, such as phrases, where applicable (28). For the purposes of part a) (see below) of this content analysis, this similarity was based on the precise meaning of words and so relevant synonyms were grouped together. This is a simple technique and can be both reliable and valid if the coding is done consistently and the variables used do actually measure what the coder wants them to measure.

Standard codings are infrequently established although a number of dictionaries, or listings, of categories and words which fit into them, are available. A specific, personalised coding was used for this study. Opinions vary as to whether it is better for all content analyses to use the same categories regardless of the study. Berelson (29) argues that analysis should employ the categories most meaningful for the particular problem at hand. As has been stated before, using only one coder increases reliability, but because standard codes are rare, researchers rarely use accuracy as a measure of reliability. Using human rather than machine coding avoids problems of misclassification due to the ambiguity of word meanings, category definitions or other coding rules (30), and so relatively specific and concrete categories are often the most meaningful.

Three features of the texts were examined:-

a) the positive or negative skew of the articles

b) the use of personal names

c) the use of acronyms and technical terms

Large portions of text were not always available for study so the analysis was limited to features of single words or equivalent compounds. This removes the problems which arise when large amounts of text are analysed, such as the increased likelihood of being presented with conflicting cues (31).

Parts b) and c) of this analysis are self-explanatory. The words are identified and their frequency recorded. A coding scheme is used for part a), and this is created and tested via several steps (32).

i) define the recording units. In this case individual words and their meanings where ambiguous.

ii) define the categories:- negative or positive words. These categories are mutually exclusive, but quite broad. The category of personal names versus one of non-personal references will be narrower, as will the acronyms and technical terms categories.

iii) test on a sample of text. See section 2.8.1

iv) revise the coding rules. See section 2.8.1

v) code all the text. This was done one article at a time, looking at each feature (a-c) in turn

The coding scheme is used to determine the direction of the communication, an area where subjectivity is difficult to control and impossible to eliminate entirely. Showing direction, however, can be very productive. It is the attitude expressed toward any symbol by its user (33) and is usually categorised as favourable or unfavourable, or, as in this case, positive-negative. Many textual passages are not clearly pro or con, so the third category of 'neutral' is generally included. It is a matter for the analyst to formulate complete and logical definitions of positive and negative material and apply them with due regard for the concept of the language of the material (34).

2.8 PILOT STUDY AND FINAL DESIGN- THE SURVEY

As previously mentioned (section 2.6) the method of determining which articles were to be analysed underwent some changes in the preliminary stages of the project. Similarly, the design and layout of the survey sheet was changed as a result of a pilot study of one month. On the one hand, some information was being collected which was not strictly necessary, and, on the other, it was not proving possible to record certain important facts in as much detail as was desirable. Therefore, some of the data questions were changed and their position on the survey instrument altered.

New subject categories were created because some articles were clearly science or technology, but did not fit into any of the existing categories and some existing categories were proving to be too broad. 'Computing' became 'computing & information technology' and 'space/astronomy' were separated from 'physics'. 'Agriculture' was removed as a separate section and articles were classified either in 'biology', 'environmental sciences' or 'science policy'.

The question regarding sections of the paper was expanded and new categories were introduced. Initially there had only been one code for articles appearing in a special science and technology section so this was expanded to four, more detailed divisions; 'science & technology', 'computing', 'health' and 'environmental'. 'Science and technology' was retained as a specific section because it is used as such in the Times every Thursday. Recording of advertisements was stopped because it was decided that a different study technique was necessary to adequately examine the evolution of advertisements.

The final design of the survey instrument collected data for each article on the following areas; (see Appendix 1 for layout)

1) the title of the paper of origin.

2) identification number.

3) the title of the article.

4) day of publication- Monday to Saturday coded 1 to 6

5) date of publication (day:month:year)

6) page on which article appeared.

7) column on which article started.

8) subject of article- coded as follows

medicine = 1
engineering = 2
computing/information technology = 3
earth sciences = 4
science policy = 5
miscellaneous = 6
biology = 7

environmental sciences = 8

chemistry = 9

physics = 10

space/astronomy = 11

9) status of article- coded as follows

headline = 1

intermediate heading = 2

minor = 3

10) section location of article- coded as follows

general news = 1

foreign = 2

financial = 3

science and technology = 4

editorial = 5

letters = 6

political = 7

miscellaneous = 8

health = 9

sport = 10

computing = 11

motoring = 12

environmental = 13

11) presence or absence of graphics/tables (hereafter termed graphics). This includes photographs, tables, line drawings and plans. Code '1' = presence, '0' = absence.

12) length of article (cm). This is the length of one column, not the total length of the article. It includes any graphics, so the article is defined as being the whole piece in the paper, both text and graphics where appropriate. If a piece covered more than one column, but was not the same length in each column,

then the mean column length was used. For example, if an article covered two columns and was 15 cm long in the first, and 20 cm long in the second, then the length of the article would be recorded as 17.5 cm.

13) number of columns covered by article.

14) number of columns on page.

15) length of graphic (cm). Again this is the length of one column not the total length of the graphic, measured in the same way as the articles.

16) number of columns covered by graphic.

The initials CA (for content analysis) were printed on the top of each sheet so that those articles which were going to be considered for content analysis could be so marked.

2.8.1 PILOT STUDY AND FINAL METHOD- CONTENT ANALYSIS

Two articles were chosen for a pilot study to assess the suitability of the twenty negative words and the twenty positive words chosen to assess the direction of the articles. Categories can be represented by a universe of items. The indicators are a selection or a sample of such units. Working with the material under study allows the discovering, defining and subsequent redefining of the indicators (35).

The original list was compiled from a thesaurus, starting from the words 'success' and 'problem' and is as follows:-

POSITIVE

success, triumph, prosper, thrive, top, pride, achieve, accomplish, coup, feat, sensation, celebrate, fortunate, progress, foremost, lead, honour, elite, breakthrough, advance.

NEGATIVE

problem, complication, dilemma, dispute, trouble, dubious, uncertain, objection, opposition, confusion, drawback, challenge, friction, controversy, doubt, argument, discord, skeptical, unclear, detriment.

As a result of the pilot study four positive and five negative words were removed from the lists. They were;

top, coup, sensation, honour
dilemma, dubious, friction, discord, detriment

Added instead were;

valuable, excellent, effective, improve
impossible, contradictions, difficulties, ineffective

As a result of looking at the medical articles five positive and seven negative words were introduced to the list. They were;

promising, insight, encouraging, powerful, positive
strike, attack, abuse, fail, suffer, hazard, adverse

As a result of looking at the space/astronomy articles three positive and six negative words were added. They were;

surpass, acclaim, perfect
malfunction, crisis, setback, damage, suspend, delay

The final lists are as follows;

POSITIVE

success, triumph, achieve, progress, lead, effective, improved, promising, insight, encouraging, powerful, positive, surpass, acclaim, perfect

NEGATIVE

problem, trouble, drawback, difficulty, strike, attack, abuse, fail, suffer, hazard, adverse, malfunction, crisis, setback, damage, suspend, delay

It is neither unethical nor unscientific to expand definitions of direction as new developments occur and after the study is underway. When words appear which clearly should be categorised but do not appear in the indicator list, the list can be refined so that the word can be classified. The only proviso is that the word has not been previously classified in some other manner, that is to say the word cannot be both positive and negative at the same time (36).

Once the pilot study was complete articles were scored for the criteria under examination and the results recorded on a score sheet. For each article the following data were collected;

1) positive terms. Each different term was recorded along with the number of times it appeared.

2) negative terms. As above, but following and adapting the negative term list.

3) the overall direction of the article. The sums of positive and negative terms were calculated and whichever was the larger determined the overall direction of the article. Some articles reflected neither favourable nor unfavourable condition, either through a balance of content, or a lack of controversial material, and so were termed 'neutral' (37).

4) the number of occurrences of quotes personally attributed to specialists. Specialists included medical doctors, academic doctors, academic professors, scientists and civil servants.

5) the number of occurrences of quotes personally attributed to non-specialists.

6) the number of occurrences of quotes not personally attributed. "A spokesman said... " or "A researcher said...".

7) acronyms. Each different term was recorded along with its frequency.

8) technical terms. Again each different term was recorded along with its frequency. Terms were selected as technical by the experimenter, and a preliminary list was drawn up. This list was sent to a random group of 20 people who were asked to identify which words they considered to be technical (see Appendix 2). As a result of this survey, words/phrases which the majority considered to be non-technical were removed, and a revised list was formulated (see Appendix 2a). Exceptions were made for words which, out of context, seem common, but in fact, have another, more technical meaning.

2.9 DATA MANIPULATION

In order to analyse 1748 data sets in the limited time available for this project, following data entry onto a spreadsheet (SuperCalc 5) from the survey sheets and subsequent transfer to the Minitab data analysis system for analysis, another statistical package (Mega-Stats+) was used to perform routine t-tests, G-tests and u-tests where appropriate. Not all the information gathered via the survey instrument was entered onto the spreadsheet, as it was not considered necessary for the analysis to succeed. The title of each article was recorded, but not entered, and information was excluded on whether the article was suitable or not for qualitative content analysis. All the survey sheets were scanned by hand after all the data had been collected to select articles for content analysis. This was felt to be more efficient and effective than trying to pick out suitable articles at the time of data collection. Large pieces of text, such as article titles, cannot easily be entered onto a spreadsheet, and so these were used initially for article identification and later were considered for the content analysis phase.

The date (1-31) on which the article appeared was not felt to be as important as the day (Monday - Saturday) of publication. Newspapers tend, if they do have any cycles, to work on weekly, rather than monthly rotations, and this would be picked out by noting the day, but not enhanced any further by noting the date. Therefore date information was recorded essentially to allow easy identification of the articles at the secondary stage of data collection. At this point, data were checked for accuracy and some articles subsequently relocated for alterations to be made. Similarly, the column on which each article began was recorded to make it easier to relocate the article, rather than as a potentially important variable in the reporting of science and technology. The number of column centimetres found in total on each page was not noted every time data on an article was collected. Instead, a separate record of the physical size and dimensions of the papers was kept.

The remaining data fields were entered onto the spreadsheet, necessarily in a constant format (see Appendix 3). At the onset of data collection several hundred articles were being identified per month and it became increasingly obvious that it was not going to be possible to note down all the detailed quantitative features on every article in the time allotted. These details were number of column centimetres of article, number of columns covered by article, number of columns on the page, number of column centimetres of graphic, if any, and number of columns covered by graphics if any. Consequently, a situation arose whereby only the first fifteen of any one subject were measured in detail; the information gathering stopped once the location and general features had been recorded. Quite often in one month less than fifteen articles on any one subject were present anyway, but in areas such as medicine, computing, biology, environmental science and space/astronomy, there were often more than fifteen articles and so gaps in the spreadsheet resulted. These were filled by '-1' to indicate that they were not missed data, but missing data. Minitab does not recognise -1 as the code for missing data though, so each file (of which there were 24, representing three months x four years x two papers) was edited using PC-Write and the '-1's replaced by '*'s which is the official Minitab code for missing data.

Once all the data were gathered into 24 separate files, some necessary manipulation was performed before any analysis could begin. Firstly an extra column was added to distinguish between data collected from 1989 and 1990 and that collected from 1974 and 1975. All the files have a column for year, but for certain analyses they needed to be connected to their "sister" year by a common code. Thus all 1989 and 1990 data were coded 1, and all 1975 and 1975 data coded 2. Also at this point the measurements taken off microfilm of length of articles and graphics (in centimetres) and the amount of the page they covered, were converted to real sizes. A careful record was kept of which microfilm reader was used to view which papers, as the magnification of both the films and the readers can alter. A scaling factor was thereby calculated for each data file (ie each month). Two new columns were created on the spreadsheet, the first to record the actual length of the articles and the second to record the actual length of the graphics. For each article this was calculated by multiplying the number of column centimetres of the article by the number of columns covered, by the scale factor. One then needs to compensate for the variation in the number of columns on any one page. This is usually eight, but it can be as low as four. Multiplying the above calculation by eight over however many columns there were on the page on which the article appeared removes any anomalies caused by column number variations. The same process was repeated for the graphics present, but obviously using the number of column centimetres and number of columns covered for the graphic rather than the article. The scale factor and column moderator would be the same for articles and graphics appearing on the same page.

The next stage in data manipulation is to merge all the separate files into one, again using PC-Write, so that it can be analysed using Minitab. The first merge was of months, January, February and March, within the four years for each paper. Then the "sister" years, 1989 & 1990 and 1974 & 1975 were amalgamated, then the four pairs of years into two sets of four, and then the data for the Guardian were joined onto the data for the Times. Each time a merge was completed, the new stage was saved on a fresh disc, so that if at any time it was found necessary to look at data in a more dissected form, this would be possible.

For the purposes of analysis, certain columns were removed because they were redundant. This is as a result of the creation of "real length" columns for article and photo length. The columns which were no longer useful were those containing article length, number of columns covered by the articles, number of columns on the page, length of graphic and number of columns covered by graphic. These are effectively replaced by actual length of article and actual length of graphic. In addition, an extra column was created to make it easier to analyse the role of special sections. In this case, out of thirteen sections where articles could appear, four are dedicated to science and technology in one form or another.

4 = general science and technology section
9 = health
11 = computing
13 = environmental

The other sections have been amalgamated, so that comparisons can be made between the four types of section listed above and the rest of the paper, which is mainly general news.

It was originally intended that one file would be used on Minitab which contained all the data. However, a discussion of how the analysis should be broken down into manageable sections, revealed that it would probably be more effective if the data for the two papers were analysed separately and the results of the analysis compared in a separate stage. The first stage of the analysis was to look at the various amounts of reporting which took place and its presentation:- firstly in terms of science and technology as a whole and then with subject breakdowns. Total article and graphics numbers and mean lengths were used. Lastly came a consideration of the role and relevance of special sections. All of these areas were looked at firstly for the Guardian, giving an indication of what changes have occurred between the mid-1970s and the late 1980s- early 1990s. The exercise was then repeated for the Times. From the analysis it is possible to see what changes have occurred, their direction and significance and whether both papers have undergone similar changes or not. In total a series of thirty-three individual tests were performed on the data for each paper, which facilitated the testing of twenty individual hypotheses.

2.10 STATISTICAL ANALYSIS

This survey collected three types of data, some of which were used in descriptive statistical analysis and some in inferential analysis. Some of the data collected were nominal, that is data where the units of scale are categories, and objects are measured by determining the category to which they belong. There is no magnitude relationship between the categories so it can only be determined whether something is, or is not, in one category or another. Presence or absence of a graphic as part of an article would be an example of nominal data:- '0' = no, '1' = yes. The next type of data collected was ordinal scale data and this was used to rank the status of the headings given to articles. They were ranked 1-3 according to whether they were allocated more, less or the same degree of importance. It is not possible to determine how much greater, or less, 1 is than 3, only that there is a difference between them.

The actual length of articles and graphics is classed as continuous ratio data. It possesses the properties of magnitude and equal intervals between adjacent units, which in this case are centimetres. The numbers are ordered and the intervals between each step, at all points along the scale, are of equal size. In addition there is an absolute zero point, which is what distinguishes ratio from interval data.

Nominal and ordinal data are the weakest types of data and, consequently, only descriptive statistics or non-parametric tests can be applied. These are relatively weak tests which make very few assumptions about the nature of the data collected, only taking account of the rank order of the scores. As a result of this, they are less able to detect a significant difference between two sets of scores (38). Wherever possible (i.e. where ratio data has been collected), parametric tests were applied. These are much more powerful, but can only be applied to interval or ratio data because they assume that the data are normally distributed and that all populations from which samples are taken have the same variance (39).

These are quite severe restrictions on experimental data. All the parametric tests conducted on these data are t-tests, which test the difference between the means of two independent samples. The test was chosen because all the data were of a suitable type and the samples being compared were small ($n<30$). It has been found that this test is very robust and so results obtained from it are not seriously distorted even when marked departures from normality and homogeneity occur (40). Also, by using a computer program to perform the tests, rather than doing them by hand, a complete t-test is performed, whereby variations in sample sizes and variances are accounted and adjusted for. It should be noted that in order to take into account such variations, the degrees of freedom are calculated differently, and therefore they may not always be as expected. Consequently one can be confident that the results of the tests are accurate. Some of the tests were one-tailed because the original hypothesis predicted the direction in which a change would go, but most of them are two-tailed. They result from hypotheses which predicted that the variable would have an effect, but not the direction of the change. The probability obtained from the t-tests has been halved if the test is one-tailed.

G-tests of independence were used in preference to chi-squared tests because some of the comparisons were performed on data which was comprised of 20% or more values less than five. The G-test is more robust in these situations, and so was preferred. Where zeros were recorded in the data, it was not possible to perform either a chi-square or a G-test (41).

An analysis of variance for non-parametric data was performed on some of the results of the content analysis. The test was based on a Mann-Whitney-u test but was taken from the slightly more complex Meddis program, which is an amalgamation of several tests.

Many tests were performed in total, and it is important to realise that performing this number of tests increases the likelihood of getting type I errors. These are significant results by chance at the 5% confidence level. Selecting at this level means that up to 1 in 20 tests could be significant by chance. Selection at the 1% level would overcome this but would increase the number of type II errors. That is, getting non-significant results at the 5% confidence level which in reality are significant. At the 5% level far more than 5% of the results were significant. This and awareness of the possibility of erroneous results negates the need to change the confidence limit to 1% (42).

Data which could not be analysed using inferential statistics have been displayed using descriptive statistics, via various graphs and charts of totals, percentages and means. These present the data in an easily digestible form but offer no quantitative interpretation.

REFERENCES

1. MEADOWS, A.J. & M.M. HANCOCK-BEAULIEU. The selection of scientific information by the mass media, In press.

2. UBELL, E. Science in the press: newspapers vs magazines. *Journal of Communication*, 1963, **40**.

3. KRIEGHBAUM, H. *Science and the mass media*, 1986.

4. DAVIES, R. & L. SKLAIR. *Science and technology coverage in four British newspapers, 1949-1969,* 1972.

5. JONES, G., I. CONNELL, & A.J. MEADOWS. *The presentation of science by the media*, 1978.

6. HINKEL, G. & W.R. ELLIOTT. Science coverage in three newspapers and three supermarket tabloids. *Journalism Quarterly*, 1989, **66**(2).

7. ENTWISTLE, V. & M.M. HANCOCK-BEAULIEU. Health coverage in the quality and popular press in the UK. *Proceedings of the International Conference on Public Communication of Science and Technology*, 1991.

8. MOTT, F.L. Trends in newspaper content. In: W. Schramm, *Mass communications*, 1969, pp. 371-379.

9. JONES *et al.*, ref. 5, p. 1.

10. HINKEL & ELLIOTT, ref. 6, 354.

11. LOGAN, R.A. Events, contexts and conflicts: a content analysis of the Los Angeles Times and the New York Times' reporting of science and biomedicine.

Proceedings of the International Conference on Public Communication of Science and Technology, 1991, 6.

12. KING, J. An input-output study of science news in the press. *Australian Journalism Review*, 1986, **8**(1/2).

13. MEADOWS & HANCOCK-BEAULIEU, ref. 1.

14. WEISS, C.H. & E. SINGER. *Reporting of social science in the national media*, 1988.

15. BOSTIAN, L.R. How active, passive and nominal styles affect readability of science writing. *Journalism Quarterly*, 1983, **60**.

16. FRIEDMAN, S., S. DUNWOODY & C. ROGERS. *Scientists and journalists. Reporting science as news*, 1986.

17. BERELSON, B. *Content analysis in communication research*, 1971, p. 18.

18. WEBER, R.P. *Basic content analysis*, 2nd ed., 1985, p. 10.

19. MEADOWS, A.J. Quantitative study of factors affecting the selection and presentation of scientific material to the general public. *Scientometrics*, 1991, **20**, 118.

20. WEBER, ref. 18, pp. 9-10.

21. BERELSON, ref. 17, p. 18.

22. ROBERTS, C.W. Other than counting words: A linguistic approach to content analysis. *Social Forces*, 1989, **68**(1), 147-148.

23. BERELSON, ref. 17, pp.18-20.

24. JONES *et al.*, ref. 5, pp. 1-4.

25. VAN DRIEL, B. & J.T. RICHARDSON. Print media coverage of new religious movements: a longitudinal study. *Journal of Communication*, 1988, 38(3), 39.

26. WEBER, ref. 18, p. 9.

27. MEADOWS, ref. 19, 118.

28. BERELSON, ref. 17, pp. 135-136.

29. *Ibid.*, p. 148.

30. WEBER, ref. 18, pp. 12-17.

31. *Ibid.*, p. 16.

32. *Ibid.*, pp. 21-24.

33. BUDD, R., R. THORP & L. DONOHEW, *Content analysis of communications*, 1967, pp. 50-51.

34. *Ibid.*, p. 50.

35. BERELSON, ref. 17, p. 163.

36. BUDD, THORP & DONOHEW, ref. 34, p. 54.

37. *Ibid.*, p. 53.

38. MILLER, S. *Experimental design and statistics*, 1984, pp. 64-65.

39. *Ibid.*, p. 61.

40. *Ibid.*, p. 65.

41. SOKAL, R.R. & F.J. ROHLF. *Biometry*, 2nd ed., 1981, pp. 731-747.

42. COHN, V. *News and numbers. A guide to reporting statistical claims and controversies in health and other fields*, 1989, p. 54.

CHAPTER 3

RESULTS

INTRODUCTION

The results are split into three sections, and results of the hypotheses tested are placed in the appropriate section. Where appropriate, the results of statistical tests are included. Notation has been used to allow a more concise write-up. The results of the tests are either shown as 't=...', 'df=...', 'p=...', or 'G=...' with the rest of the result in the same format. 't' and 'G' are are the values of t or G for each t-test or G-test performed. 'df ' is the degrees of freedom for each test, and 'p' is the probability of the result being due to chance. This will be either 'not significant', '<0.05' or '<0.001'. 'Not significant' indicates a non-significant result at the 5% confidence limit, '<0.05' indicates significance at the 5% level, and '<0.001' indicates significance at the higher 1% confidence limit. The notation in the tables is in the form of $x\ (y)^{ns/*/**}$. Here '*x*' is the t or G value and '(*y*)' is the degrees of freedom. 'ns' indicates a non-significant result at the 5% confidence limit, '*' significance at the 5% confidence limit and '**' significance at the 1% confidence limit. 'nt' in a table indicates that no test was performed because there was not enough data. 'CA' denotes content analysis.

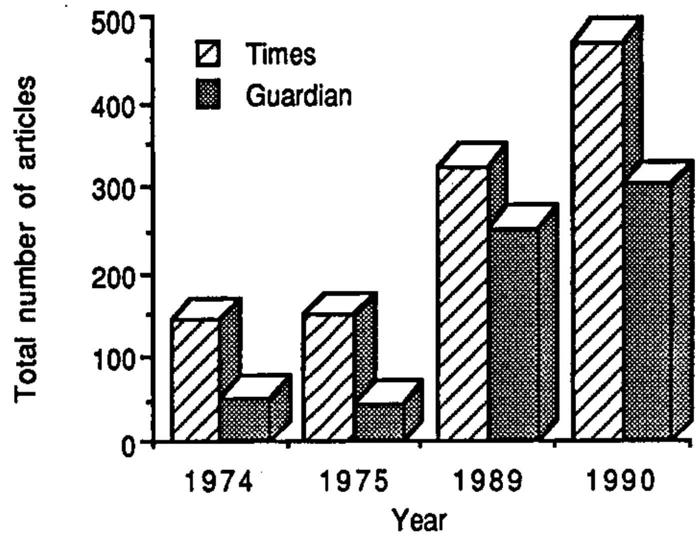
3.1 CHANGES IN THE REPORTING OF SCIENCE AND TECHNOLOGY OVERALL

3.1.1 TOTAL NUMBER OF SCIENCE AND TECHNOLOGY ARTICLES PRESENT

Graph 1 shows the total number of such articles present in both the Times and the Guardian in all four of the years chosen for the survey.

GRAPH 1

Total No. articles present each year: Times & Guardian



It was hypothesised that the total amount of reporting would be the same in the Times as it was in the Guardian in both time zones (section 2.2, point 2.1) but this was shown to be incorrect, as the Times contained more articles than the Guardian in all the years examined. It was also hypothesised that over time there would be an increase in the overall amount (ie. the number of articles) of science and technology reported (section 2.2, point 3a). Both papers did show a significant increase in reporting between time zones (1974-1975 and 1989-1990). For the Times $t=5.82$, $df=6$, $p<0.05$, for the Guardian $t=16.51$, $df=7$, $p<0.001$. It should be noted that the increase in the Guardian is very significant, more so than the change in the Times, and warrants further study. Less marked changes occurred within time zones. The number of articles present in the Times increased in each year studied, 145 in 1974, 151 in 1975 ($t=0.22$, $df=3$, not significant), 325 in 1989 and 472 in 1990 ($t=2.53$, $df=3$, not significant), whereas the Guardian shows a slight, but not significant, decrease between 1974 and 1975, from 51 to 47 ($t=0.32$, $df=4$, not significant) and an increase between 1989 and 1990 from 252 to 305 ($t=5.3$, $df=4$, $p<0.05$). This is a significant increase but it is not as large a change as that which has occurred between time zones and so an upward trend in reporting science and technology events and issues over the past fifteen years is clearly illustrated.

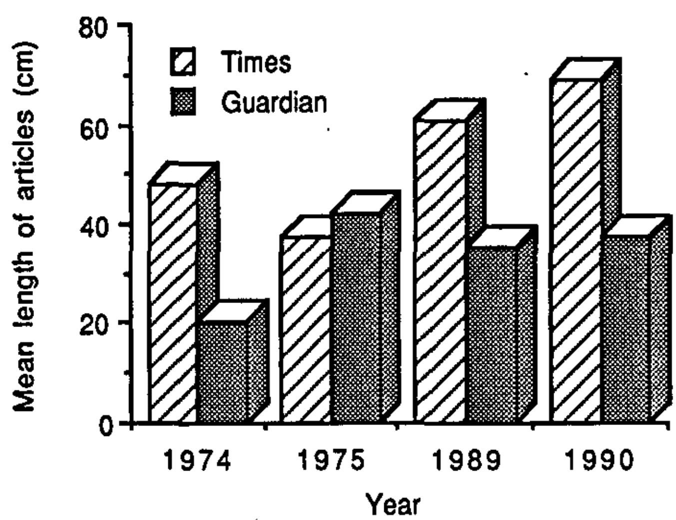
The increases seen in the Times are not happening at a constant rate, the increase between 1974 and 1975 being 4% whilst the increase between 1989 and 1990 was 45%. For the Guardian, the number of articles fell between 1974 and 1975 by 8%, whilst the rise between 1989 and 1990 was 21%. The changes within time zones can probably be attributed to natural fluctuations, whereas the changes between time zones are far too large for that to be the only explanation.

3.1.2 MEAN LENGTH OF SCIENCE AND TECHNOLOGY ARTICLES

Graph 2 shows the mean length of all articles present in both the Times and the Guardian, again in all four years chosen for the survey.

GRAPH 2

Mean length of articles in each year: Times & Guardian



It was hypothesised that over time there would be an increase in the mean length of articles (section 2.2, point 3b). T-tests on the mean article lengths for each year and each paper (Table 1) show no significant differences within time zones in either the Times or the Guardian. Articles in the Times appear to get longer with time and indeed there is a significant difference between zones for the Times but not for the Guardian. Naturally the mean length of articles varies each year, as Graph 2 shows, but for the Guardian there is no significant change over time.

TABLE 1

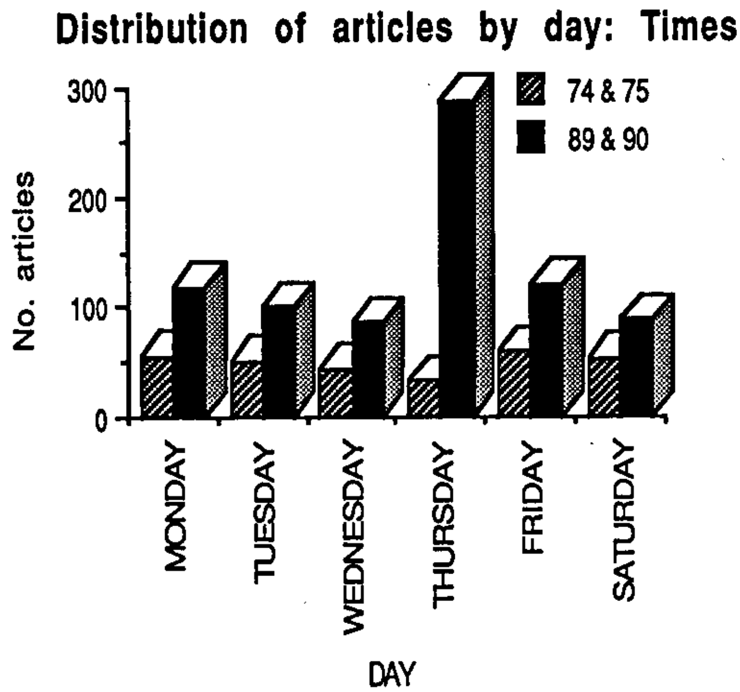
Results of t-tests on mean lengths of all science and technology articles in each year: Times & Guardian

	YEARS COMPARED		
PAPER	74-75	89-90	74&75 - 89&90
TIMES	2.19 (4) ns	1.16 (4) ns	5.41 (10) **
GUARDIAN	1.59 (2) ns	1.83 (3) ns	0.64 (5) ns

3.1.3 DISTRIBUTION OF ALL ARTICLES BY DAY

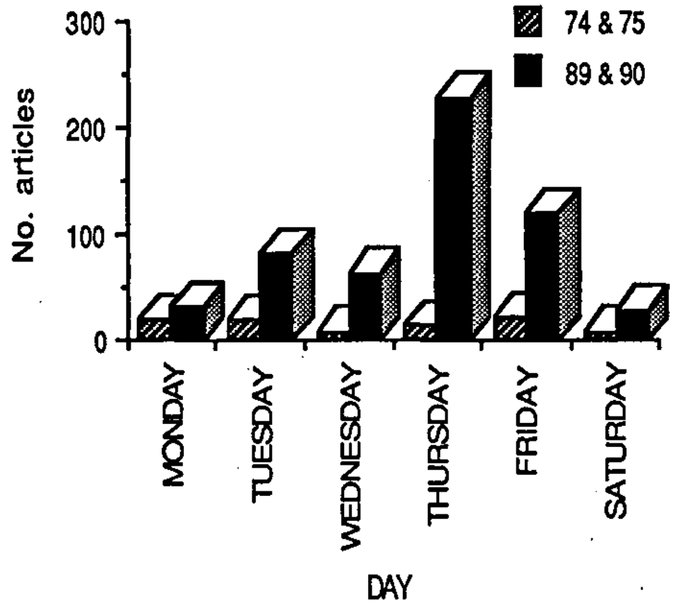
The day on which an article appears may say something about how much emphasis the editor wishes it to have. It was hypothesised that there would be a relationship between day of publication and the number of articles appearing, but that this relationship, would be less apparent in 1974 and 1975 than in 1989 and 1990 (section 2.2, point 1b). As Graphs 3 and 4 show, in 1974 and 1975 there is no clear relationship in either the Times or the Guardian. Data for these two years was amalgamated after G-tests showed that there was no significant difference for either the Times (G=4.13, df=5, not significant) or the Guardian (G=2.05, df=5, not significant).

GRAPH 3



GRAPH 4

Distribution of articles by day: Guardian



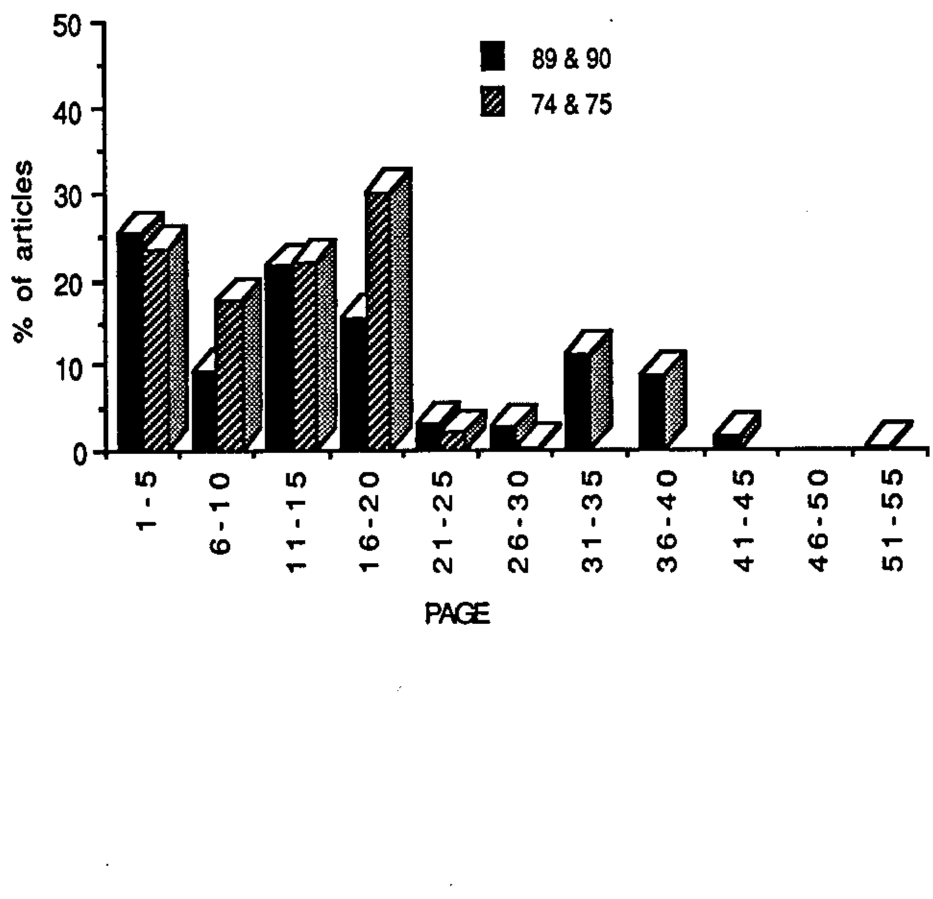
In contrast, by 1989 and 1990 there has been a definite increase in the number of articles published on Thursdays in both papers, and also on Fridays in the Guardian. Reporting has increased on all the other days as well but on Thursdays the difference is even greater. Data was also amalgamated for 1989 and 1990. Again for the Times there was no significant difference between the two years (G=6.31, df=5, not significant) but this was not the case for the Guardian (G=84.56, df=5, p<0.001). Over the fifteen years which the study considered there was a significant change in the distribution of articles by page for the Times (G=74.43, df=5, p<0.001) and the Guardian (G=44.41, df=5, p<0.001).

3.1.4 DISTRIBUTION OF ALL ARTICLES BY PAGE

Hypothesis 1a (section 2.2) was that there would be a relationship between page of publication and the number of articles published. Graphs 5 and 6 show the percentage of all articles appearing on certain pages for both time zones, firstly for the Times and then the Guardian. In the Times the content on the front page does not change appreciably, falling from 3.7% to 2.1% of the total reported. In 1974 and 1975 most articles appear in the 14-19 page range, with very few coming after this. In 1989 and 1990 the percentage of articles in the 1-5 page range has increased very slightly, whilst the percentage in pages 6-20 has fallen. Instead a relatively small but consistent amount of reporting is now found in pages 25-40.

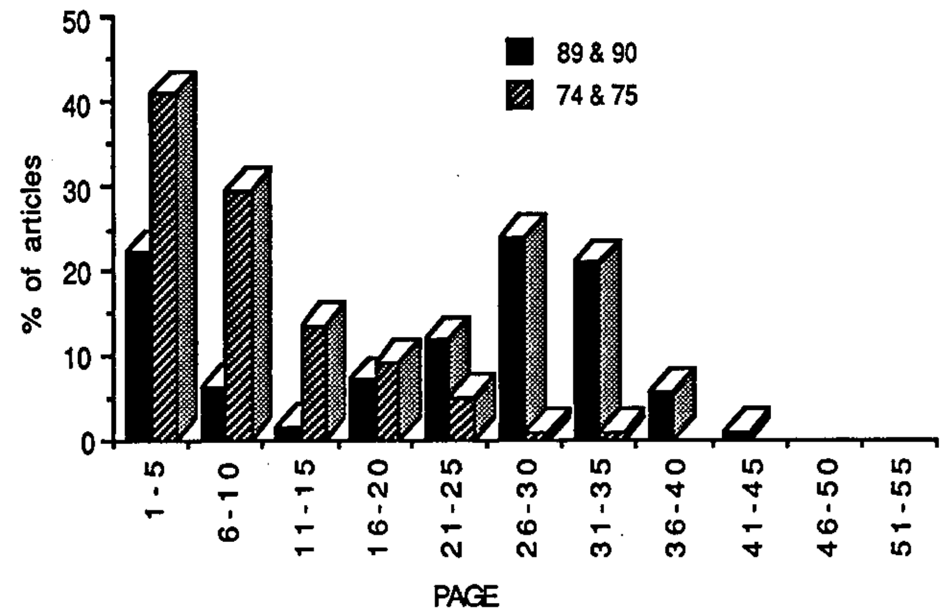
GRAPH 5

Distribution of articles by page: Times



GRAPH 6

Distribution of articles by page: Guardian



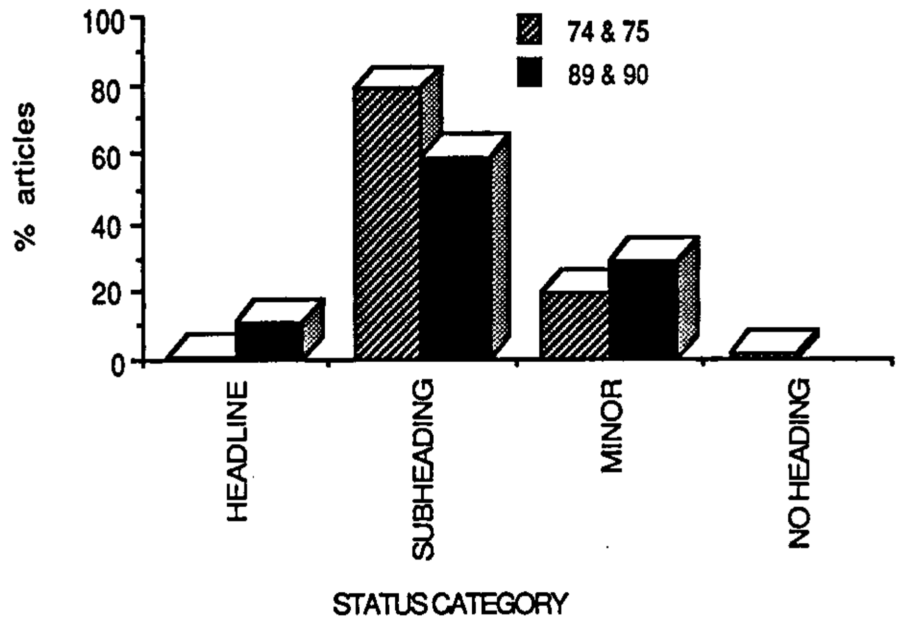
The Guardian also shows a fall in the percentage of articles on the front page, from 5.1% to 1.3%. In 1974 and 1975 most articles appear on pages 1-5 with the amounts decreasing as one moves through the paper. In 1989 and 1990 the pattern has changed and more reporting is on pages 21-36. A change in the pattern of reporting is indicated for both papers.

3.1.5 DISTRIBUTION OF ALL ARTICLES BY STATUS CATEGORY

It was hypothesised that there would be a change in the overall status of articles over time (section 2.2, point 4b). Graphs 7 and 8 show how the percentage of articles in each status category has changed over time in the Times and the Guardian respectively.

GRAPH 7

% of articles in each status category: Times



No appreciable alteration in the style or typeface used for headings was seen over time which might account for changes in heading status. For the Times significant changes between time zones occurred in the percentage of articles given subheadings and minor headings (see Table 2a), which fell from 78.7% to 59.3% and rose from 19.3% to 29.2% respectively. The only significant change within time zones was between 1989 and 1990 for articles with subheadings. This change is less significant than the corresponding change between time zones.

TABLE 2a

Results of t-tests on all science and technology articles in each status category in each year: Times

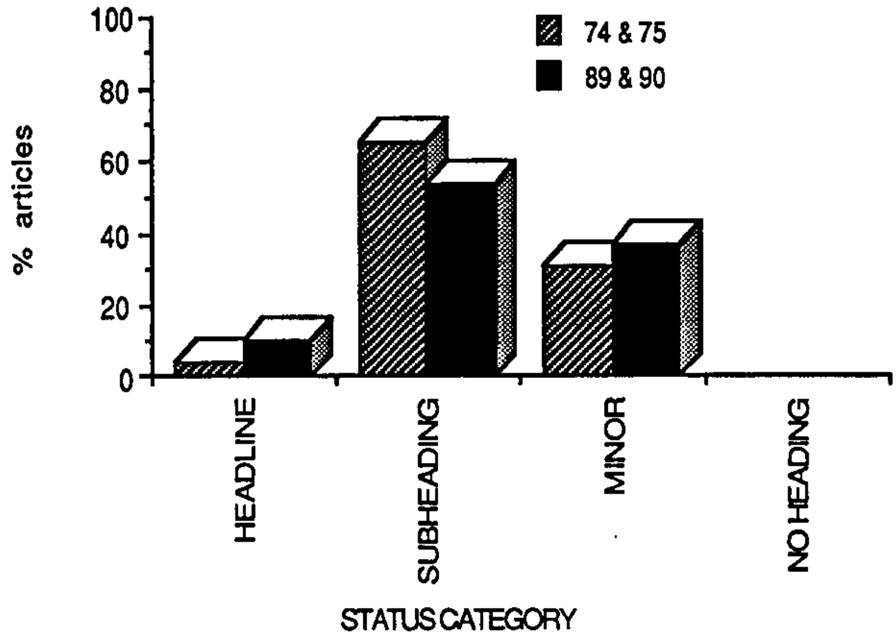
	YEARS COMPARED		
STATUS	74-75	89-90	74&75 - 89&90
HEADLINE	nt	0.34 (3) ns	nt
SUBHEADING	0.74 (4) ns	4.98 (3) *	7.76 (8) **
MINOR	1.46 (3) ns	1.93 (2) ns	3.22 (5) *
NO HEADING	nt	nt	nt

The percentage of articles with headline status also increased but there was not enough data to carry out a test for significance. The number of articles consisting of graphics only (status category 'no heading') was very small in both time zones, falling from 1.3% to 0.3%, again, too small to test statistically.

Graph 8 for the Guardian shows a similar change in statuses with the percentage of headline and minor headed articles increasing (4.1% to 9.7% and 30.6% to 36.3% respectively) and the percentage of subheaded articles decreasing (65.3% to 53.9%).

GRAPH 8

% of articles in each status category: Guardian



All these changes over time are statistically significant (see Table 2b). There is also a significant difference between 1989 and 1990 for minor headed articles, but this is not as significant as the corresponding change between time zones.

TABLE 2b

Results of t-tests on all science and technology articles in each status category in each year: Guardian

	YEARS COMPARED		
STATUS	74-75	89-90	74&75 - 89&90
HEADLINE	1.0 (3) ns	0.87 (3) ns	7.1 (6) **
SUBHEADING	0.46 (4) ns	0.22 (3) ns	20.42 (10) **
MINOR	1.77 (4) ns	6.25 (4) *	7.3 (6) **
NO HEADING	nt	nt	nt

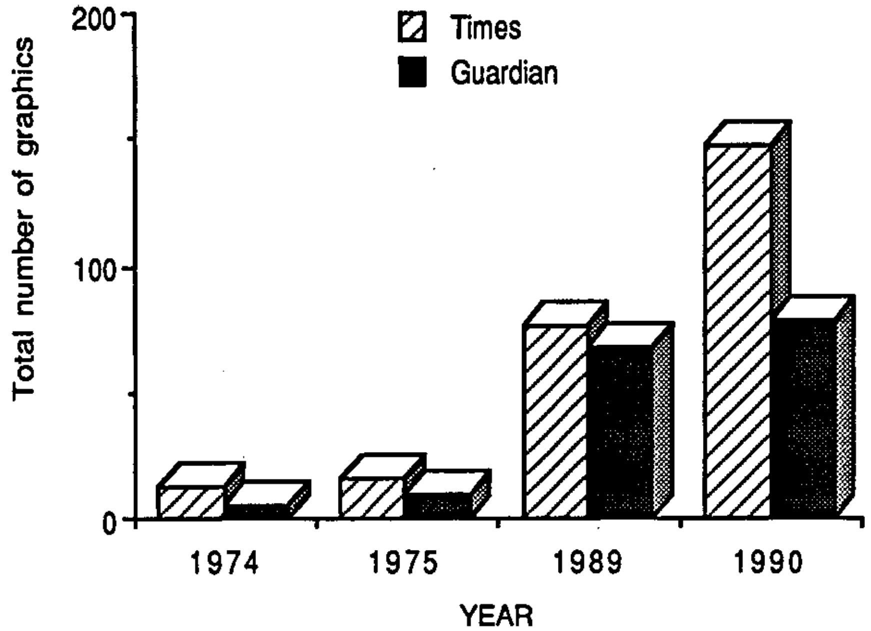
Despite these changes, the majority of articles in both papers are still given subheadings.

3.1.6 TOTAL NUMBER OF GRAPHICS PRESENT

Over time more science and technology articles were present in both papers as we have already seen, so it is reasonable to assume that there will also be more graphics, and this was hypothesised in section 2.2, point 4c. Graph 9 illustrates the increase in graphics use over time for both papers.

GRAPH 9

Total No. graphics present each year: Times & Guardian



In the Times, between time zones, the number of articles without graphics increased by 214% and the number of articles with graphics increased by 772%. A G-test on these changes shows a significantly disproportionate increase in the number of articles with graphics (G=46.19, df=1, $p<0.001$). A similar result is seen in the Guardian where the number of articles without graphics increases by 501%, the number with by 912% (G=4.72, df=1, $p<0.05$).

3.1.7 MEAN LENGTH OF ALL GRAPHICS PRESENT

It was hypothesised that there would be a change in the mean length of graphics used to illustrate science and technology (section 2.2, point 4ci), and although the mean lengths did vary yearly, as shown by Graph 10, t-tests showed that there was no significant difference in mean graphics length either within or between time zones for either paper (see Table 3).

GRAPH 10

Mean length of graphics in each year: Times & Guardian

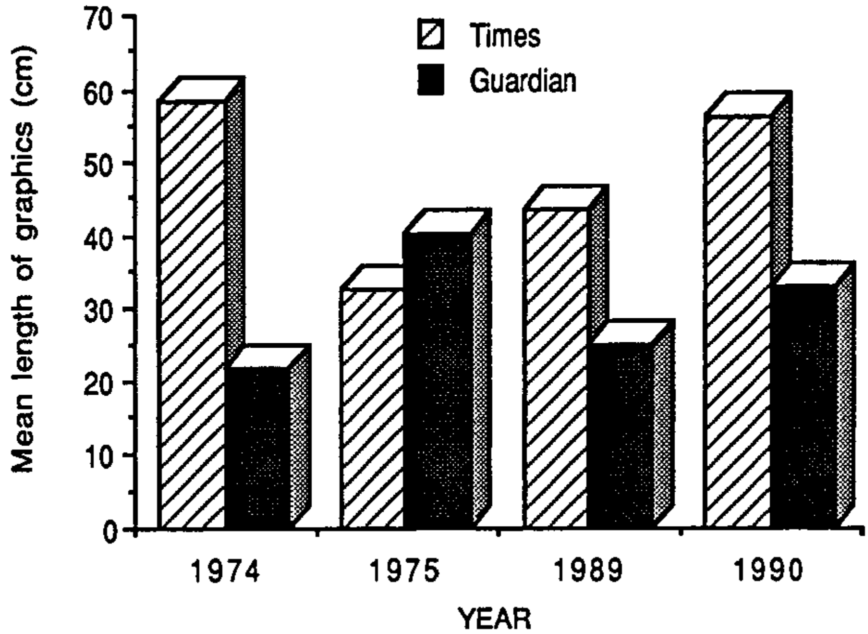


TABLE 3

Results of t-tests of mean lengths of all science and technology graphics in each year: Times & Guardian

	YEARS COMPARED		
PAPER	74-75	89-90	74&75 - 89&90
TIMES	1.83 (2) ns	1.71 (3) ns	0.48 (7) ns
GUARDIAN	2 (3) ns	1.5 (4) ns	0.6 (7) ns

3.2 ANALYSIS OF CHANGES BY SUBJECT

3.2.1 PERCENTAGE DISTRIBUTION OF ARTICLES BY SUBJECT

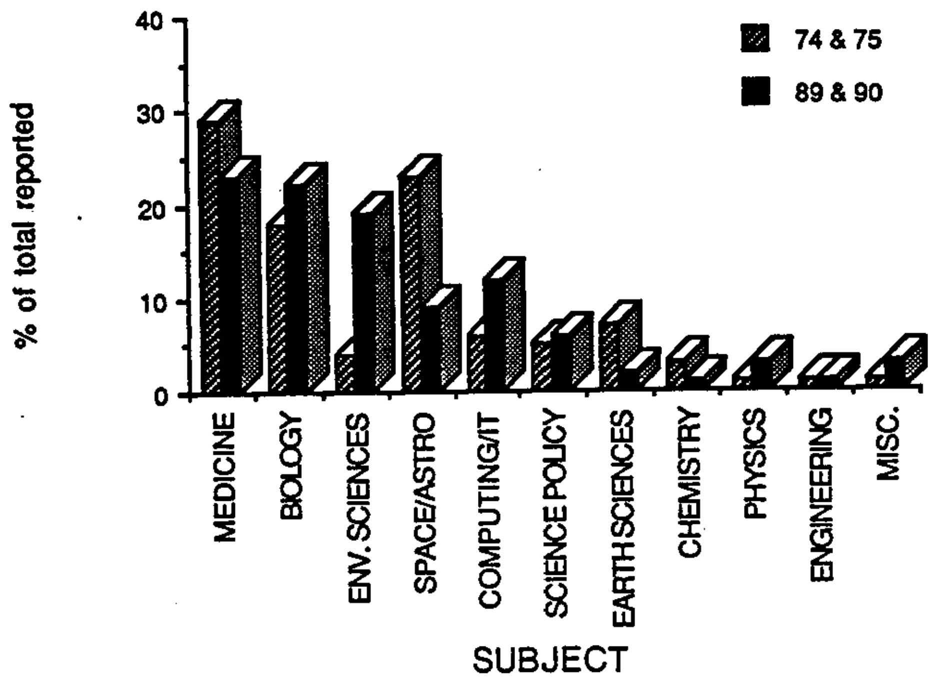
Two hypotheses were submitted with regard to the subject breakdown of science and technology and its change over time. Firstly that there would be no difference between the papers with regard to subject composition (see section 2.2, point 2), and secondly that there would be a change is composition over time (see section 2.2, point 4a). Graphs 11 and 12 show how the distribution of articles has changed with time in the Times and the Guardian respectively.

Comparing between graphs indicates that the general composition of science and technology in 1974 and 1975 was not very different in the two papers. The proportions of all the subjects are similar. Medicine and space/astronomy are well represented with a slightly higher percentage of the former in the Times (29.1% as compared to 23.3%) and a slightly lower percentage in the Guardian (22.5% compared to 26.5%). Biology receives similar space (Times 18.2%, Guardian 15.3%) but environmental sciences are better covered in the Guardian (11.2%) than the Times (4.4%). The other subjects all receive small amounts of coverage, again in both papers. So few articles appear on these other subjects that the results obtained cannot often be treated statistically and so any inferences made from them should be treated with caution.

Over time the compositional changes which occur vary with paper and so they are not as comparable in 1989 and 1990 as they were in 1974 and 1975. The Times shows large increases in the percentage of environmental science (4.4% to 19.2%), and computing (6.4% to 12.2%) articles only. The percentage of space/astronomy falls to 8.5% and earth sciences from 7.1% to 2%. Other subjects vary but not as much. The Guardian shows an even larger increase in the percentage of computing/IT articles (7.1% to 37.3%), but all other subjects either remain the same of fall. Space/astronomy and earth sciences show the largest drops, from 26.5% to 6.1% and from 7.1% to 1.1%

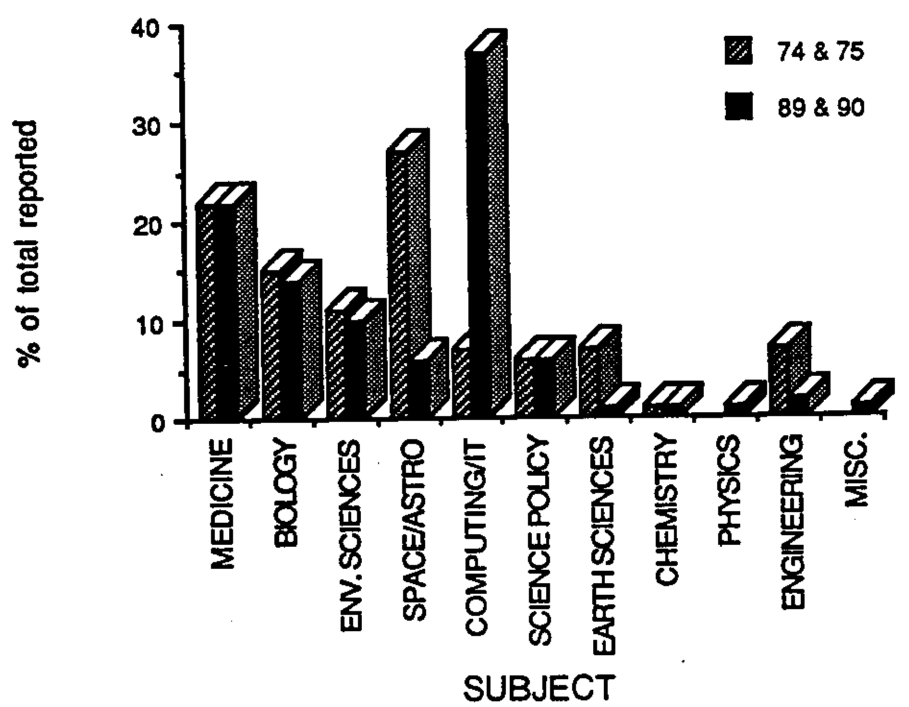
GRAPH 11

% distribution of articles by subject: Times



GRAPH 12

% distribution of articles by subject: Guardian



respectively.

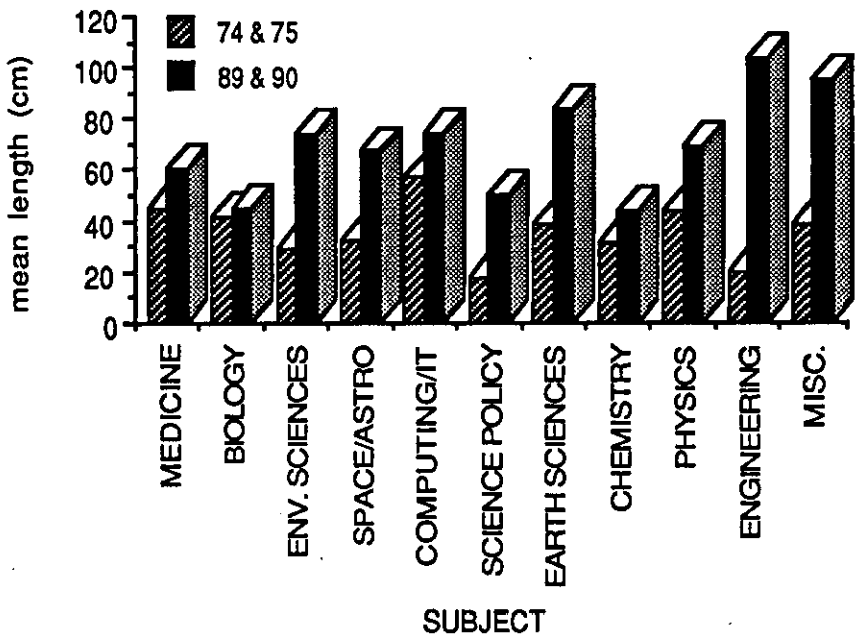
In 1989 and 1990 the composition of the papers is still similar but the enormous amount of computing/IT in the Guardian makes them appear dissimilar. In fact the relative ranks of the other subjects is still quite similar.

3.2.2 MEAN LENGTH OF ARTICLES IN EACH SUBJECT

It was hypothesised that there would be a change in the mean length of articles in each subject (section 2.2, point 4ai). This now seems unlikely in view of the results of the t-tests on the mean lengths of all articles over time (see section 3.1.2, Table 1). In fact, results vary quite widely with subject. Graphs 13 and 14 show how the mean lengths of articles in each subject vary with time in the Times and the Guardian respectively.

GRAPH 13

Mean length of articles in each subject: Times



This graph shows that in the <u>Times</u>, the mean length of articles in all subjects increased over time. T-tests are shown in Table 4a.

TABLE 4a

Results of t-tests on mean lengths of articles in each subject category in each year: Times

	YEARS COMPARED		
SUBJECT	74-75	89-90	74&75 - 89&90
MEDICINE	1.58 (4)^{ns}	0.75 (3)^{ns}	2.45 (8)*
BIOLOGY	2.13 (2)^{ns}	0.22 (3)^{ns}	0.03 (8)^{ns}
ENV. SCIENCE	4.48 (2)*	0.06 (2)^{ns}	3.44 (10)*
SPACE/ASTRO	2.95 (3)^{ns}	3.71 (3)*	2.84 (8)*
COMPUTING/IT	nt	1.32 (4)^{ns}	1.99 (6)^{ns}
SCIENCE POLICY	0.62 (3)^{ns}	0.63 (3)^{ns}	4.79 (8)*
EARTH SCIENCES	1.68 (2)^{ns}	0.04 (3)^{ns}	2.34 (6)^{ns}
CHEMISTRY	1.79 (2)^{ns}	1.15 (1)^{ns}	0.66 (4)^{ns}
PHYSICS	nt	2.67 (3)^{ns}	1.07 (6)^{ns}
ENGINEERING	nt	0.69 (4)^{ns}	1.9 (5)^{ns}
MISCELLANEOUS	nt	1.98 (3)^{ns}	1.64 (5)^{ns}

Table 4a shows that the changes over time were significant for medicine, environmental sciences, space/astronomy and science policy. There were also significant mean length increases between 1974 and 1975 for environmental sciences and between 1989 and 1990 for space/astronomy articles. These changes are however less significant than the changes between time zones for the same subjects, indicating that the changes between time zones are greater than those within. Graph 14 shows that in the Guardian the mean lengths of articles in all subjects, except earth sciences and engineering, increase.

GRAPH 14

Mean length of articles in each subject: Guardian

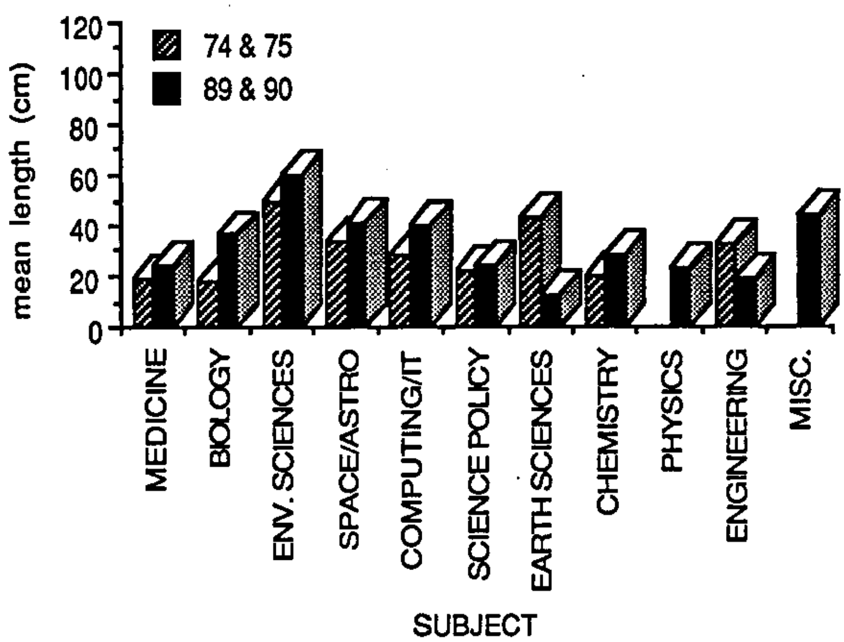


Table 4b contains the t-test results which show that only the increase between time zones for biology is significant.

TABLE 4b

Results of t-tests on mean lengths of articles in each subject category in each year: Guardian

	YEARS COMPARED		
SUBJECT	74-75	89-90	74&75 - 89&90
MEDICINE	2.9 (3) ns	1.37 (4) ns	1.32 (10) ns
BIOLOGY	2.29 (1) ns	1.03 (3) ns	3.85 (8) *
ENV. SCIENCE	0.88 (3) ns	2.25 (3) ns	0.47 (7) ns
SPACE/ASTRO	2.5 (2) ns	0.47 (3) ns	0.83 (8) ns
COMPUTING/IT	nt	1.16 (3) ns	1.25 (5) ns
SCIENCE POLICY	1.15 (3) ns	0.26 (4) ns	0.43 (8) ns
EARTH SCIENCES	0.78 (2) ns	0.05 (3) ns	0.78 (4) ns
CHEMISTRY	nt	nt	nt
PHYSICS	nt	1.09 (2) ns	nt
ENGINEERING	nt	1.44 (3) ns	1.71 (3) ns
MISCELLANEOUS	nt	nt	nt

There are no significant changes within time zones.

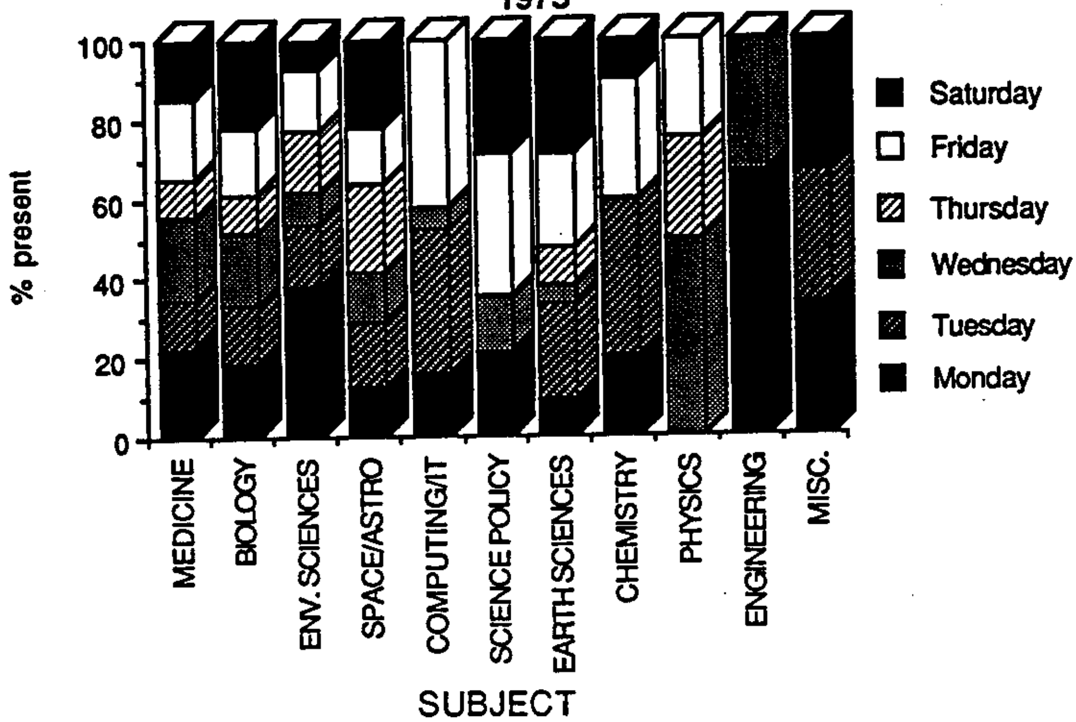
3.2.3 PERCENTAGE DISTRIBUTION OF SUBJECTS BY DAY

Hypothesis 1b (section 2.2) was that there would be a relationship between articles and the day of publication, and in 1989 and 1990 this was shown to be likely. An analysis of each subjects distribution over each of the six days of the week yields only a limited amount of information because the numbers of articles involved are now often quite small. Articles in the Times in 1974 and 1975 are quite evenly distributed for medicine, biology, space/astronomy and earth sciences. Environmental sciences seem to be more concentrated on Mondays, computing/IT on Tuesdays and Fridays, science policy on Fridays, chemistry on Tuesdays, physics on Wednesdays, engineering on Mondays and miscellaneous split evenly between Monday, Tuesday and Saturday. These distributions are illustrated by Graph 15a.

Graph 15b shows the distribution of subjects over days for the Guardian in 1974 and 1975. Medicine, biology and space/astronomy are all distributed fairly evenly over the six days. Environmental sciences, computing/IT and science policy appear to be more concentrated on Fridays, earth sciences on Tuesdays, Thursdays and Fridays. Only one chemistry article was published and this appeared on a Wednesday. No physics or miscellaneous articles were published.

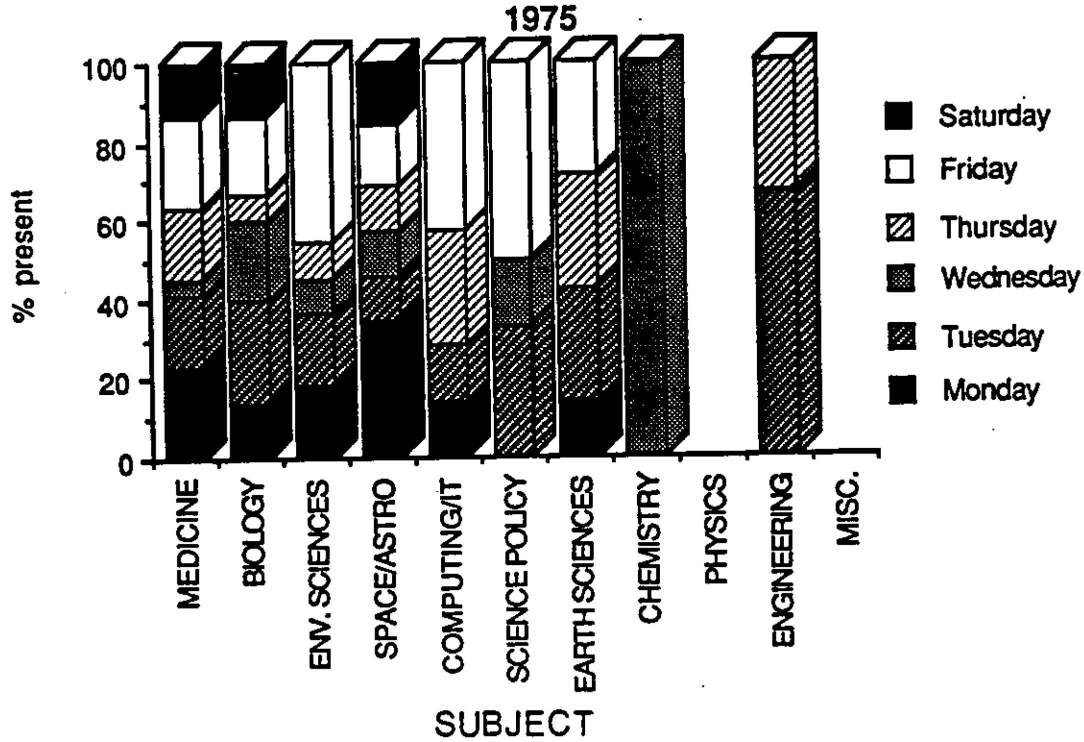
GRAPH 15a

% distribution of subjects by day: Times 1974 & 1975



GRAPH 15b

% distribution of subjects by day: Guardian 1974 & 1975

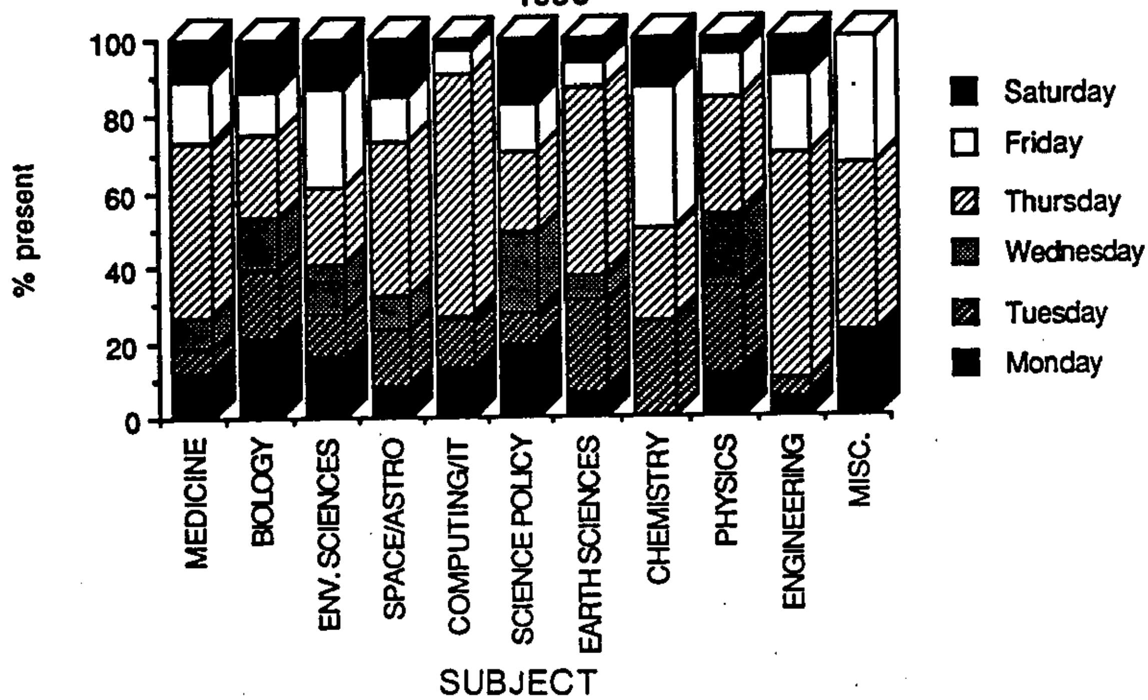


In the _Times_ in 1989 and 1990 all subjects have a higher percentage of articles published on a Thursday in comparison to the percentages for 1974 and 1975. Environmental sciences appear to have increased on Fridays but been reduced on Mondays. Science policy and physics are now more evenly distributed and chemistry seems to be more common on Tuesdays, Thursdays and Fridays. Graph 16a shows these distributions.

In the _Guardian_ in 1989 and 1990 (see Graph 16b) medicine is now more concentrated on Wednesdays and Fridays and biology on Tuesdays and Fridays. Environmental sciences are hardly changed, but space/astronomy is less concentrated on Mondays and more on Fridays. Computing/IT is now heavily concentrated on Thursdays. Science policy is more evenly distributed between Wednesday, Thursday and Friday and earth sciences seem to appear more now on Mondays and less on Fridays than they did in 1974 and 1975. In this time zone their were two chemistry articles, one of which appeared on a Tuesday and one on a Friday. Physics is more evenly distributed over the whole week, whilst engineering and miscellaneous appear to be more concentrated on Tuesdays.

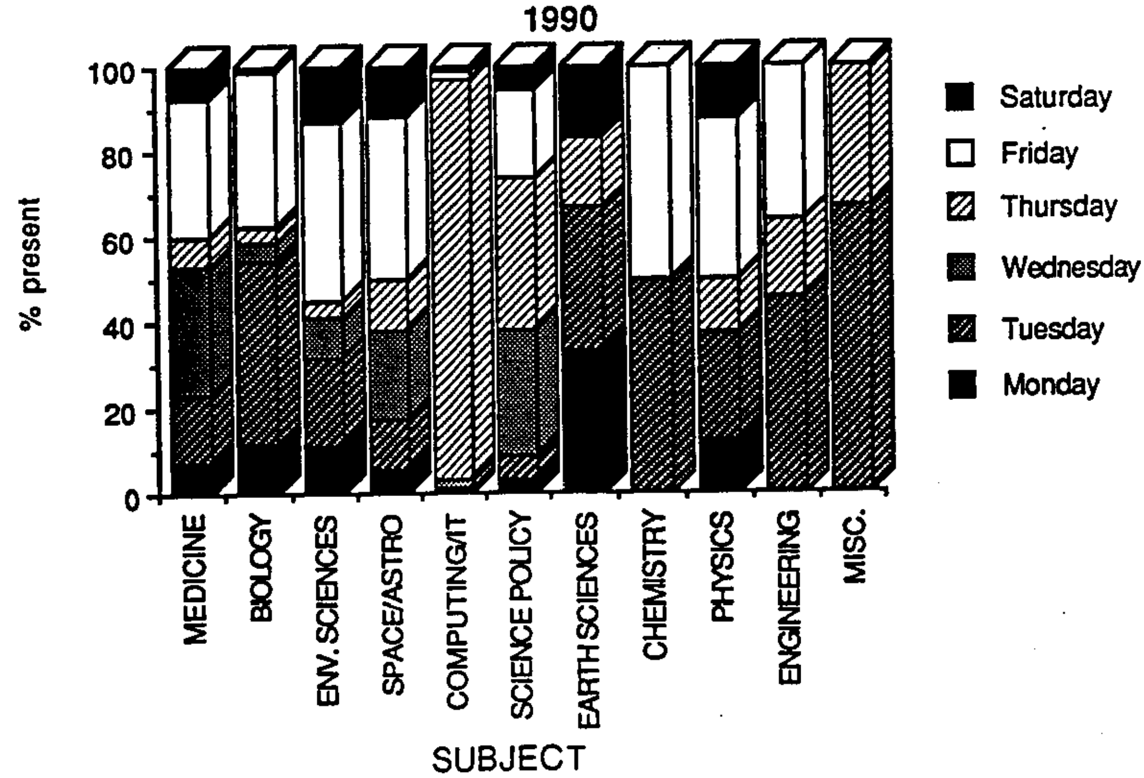
GRAPH 16a

% distribution of subjects by day: Times 1989 & 1990



GRAPH 16b

% distribution of subjects by day: Guardian 1989 & 1990



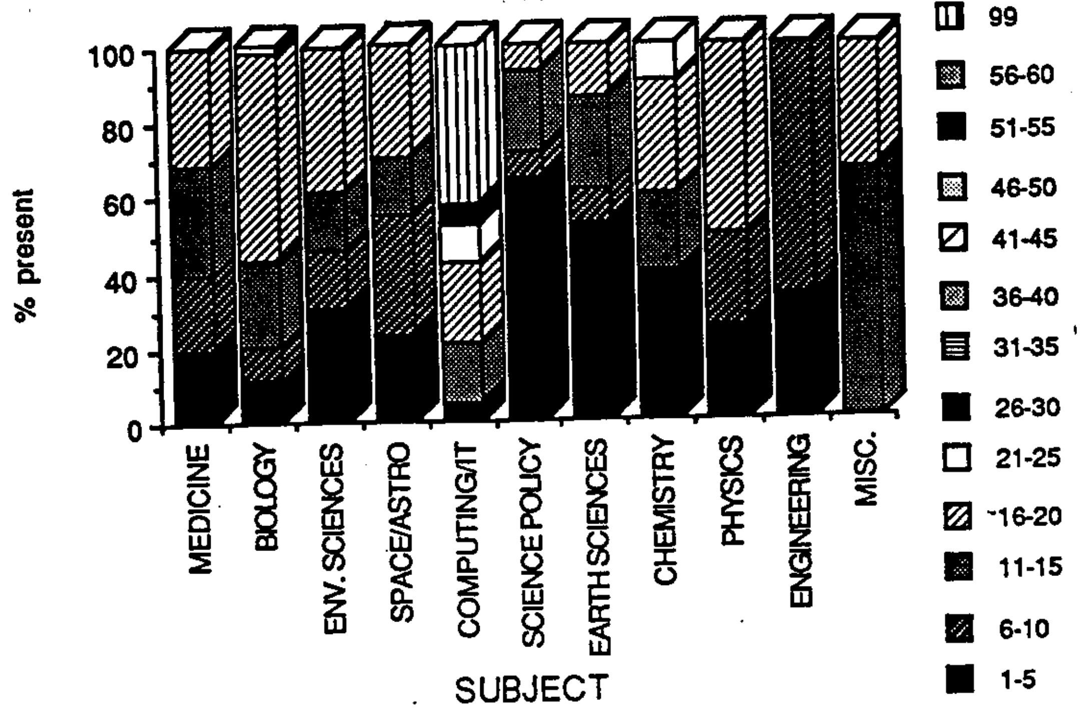
3.2.4 PERCENTAGE DISTRIBUTION OF SUBJECTS BY PAGE

Following on from hypothesis 1a (section 2.2) is a breakdown of how each subject is distributed by page over an issue. As in 3.2.3 the number of articles being counted and compared are often small so definite statements are impossible to make. Graph 17a shows the distribution of articles by page in the Times in 1974 and 1975. Medicine, biology, environmental sciences and physics all have large percentages of articles present on pages 16-20. Science policy and earth sciences have more on pages 1-5. Space/astronomy and chemistry are more evenly distributed over pages 1-10 and 16-20. Engineering is more prevalent on pages 6-10. Page 99 is the code for articles in occasional supplements. Most of the computing/IT articles occurred in such a supplement.

Graph 17b contains similar data for the Guardian for 1974 and 1975. Medical, biology, environmental sciences, space/astronomy, computing/IT and science policy articles are appear mainly on pages 1-10. Earth sciences seem to be more common on pages 1-5, whilst chemistry articles were only found on pages 6-10. Engineering was mostly on pages 16-20, and no articles for physics or miscellaneous were recorded. Both papers seem to show a concentration of articles in the first 20 pages.

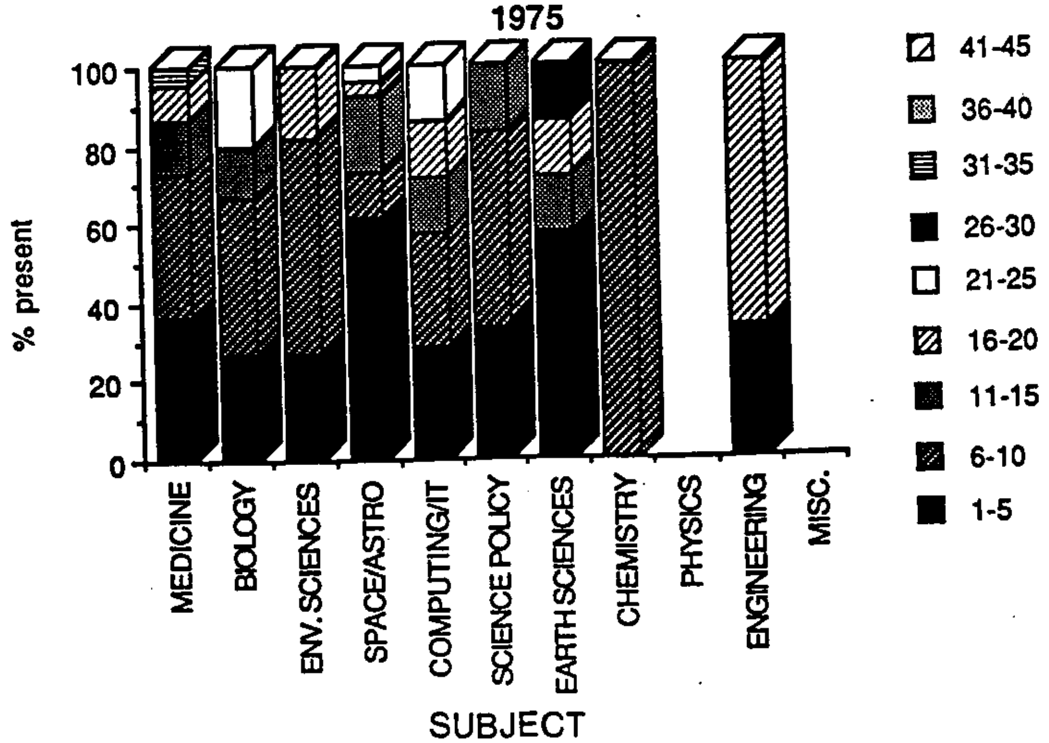
GRAPH 17a

% distribution of subjects by page: Times 1974 & 1975



GRAPH 17b

% distribution of subjects by page: Guardian 1974 & 1975

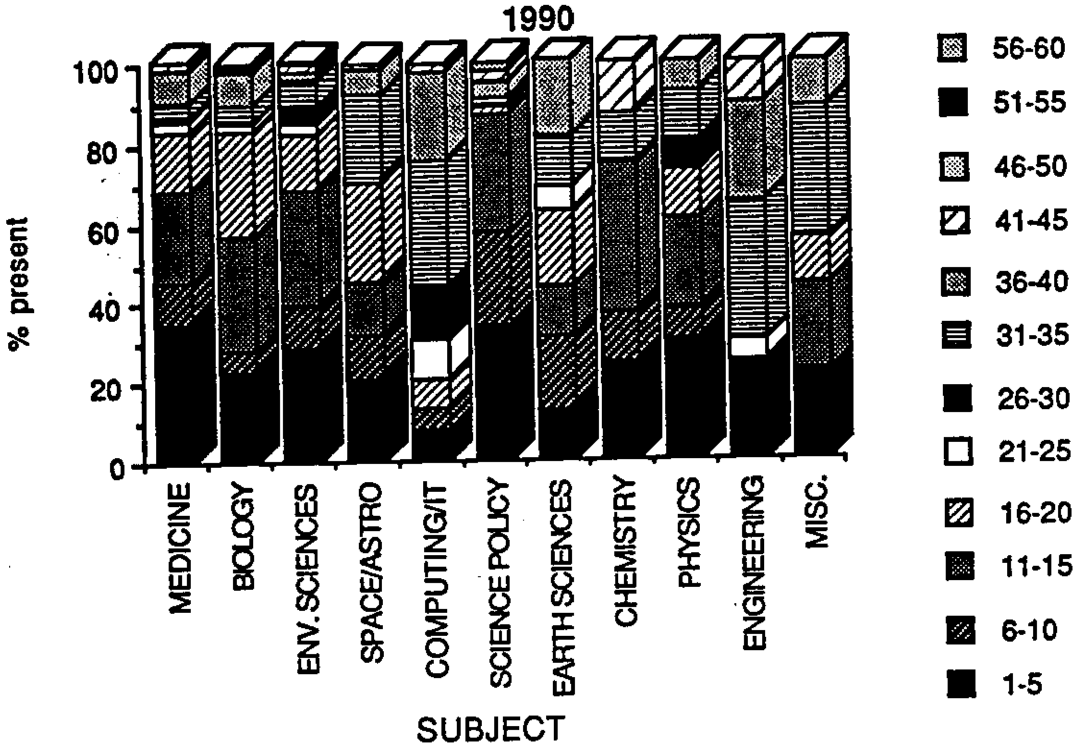


Graph 18a shows how the situation has changed in the Times by 1989 and 1990. Just over 80% of the medicine and biology articles are in pages 1-20 with about 15% now on pages 31-40. Environmental sciences show about 15% on pages 26-40. Space/astronomy and earth sciences are more evenly spread over pages 1-20 and 31-35, with computing/IT and engineering showing the largest percentages on pages 31-40. Science policy remains on pages 1-15, and chemistry has been split between pages 1-15 and 31-35 and 41-45. Physics seem quite dispersed over pages 1-40.

Graph 18b shows the Guardian for 1989 and 1990. Medicine, biology, space/astronomy and engineering show more than 20% of their articles on pages 26-30. Environmental sciences are spread more evenly over the whole paper with a move towards pages 21-30. Computing/IT articles are found mainly on pages 21-35 whilst science policy and earth sciences are still mainly on pages 1-10. Chemistry articles were split evenly between pages 21-25 and 36-40. Physics and miscellaneous show a concentration on pages 26-40.

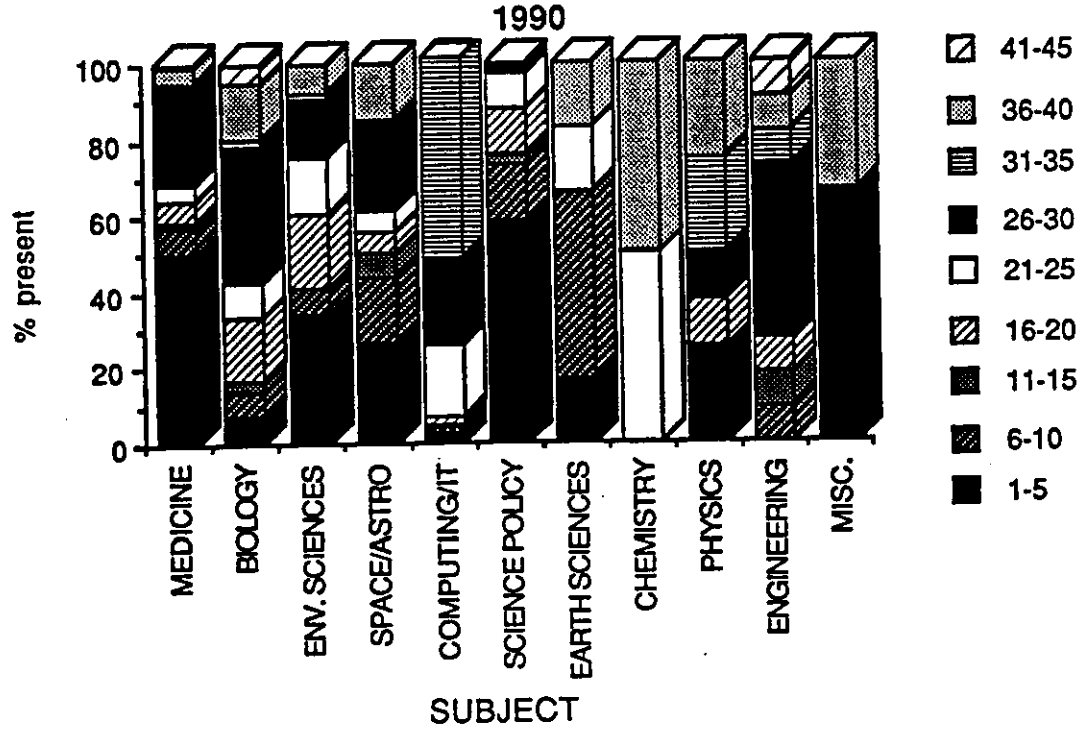
GRAPH 18a

% distribution of subjects by page: Times 1989 & 1990



GRAPH 18b

% distribution of subjects by page: Guardian 1989 & 1990



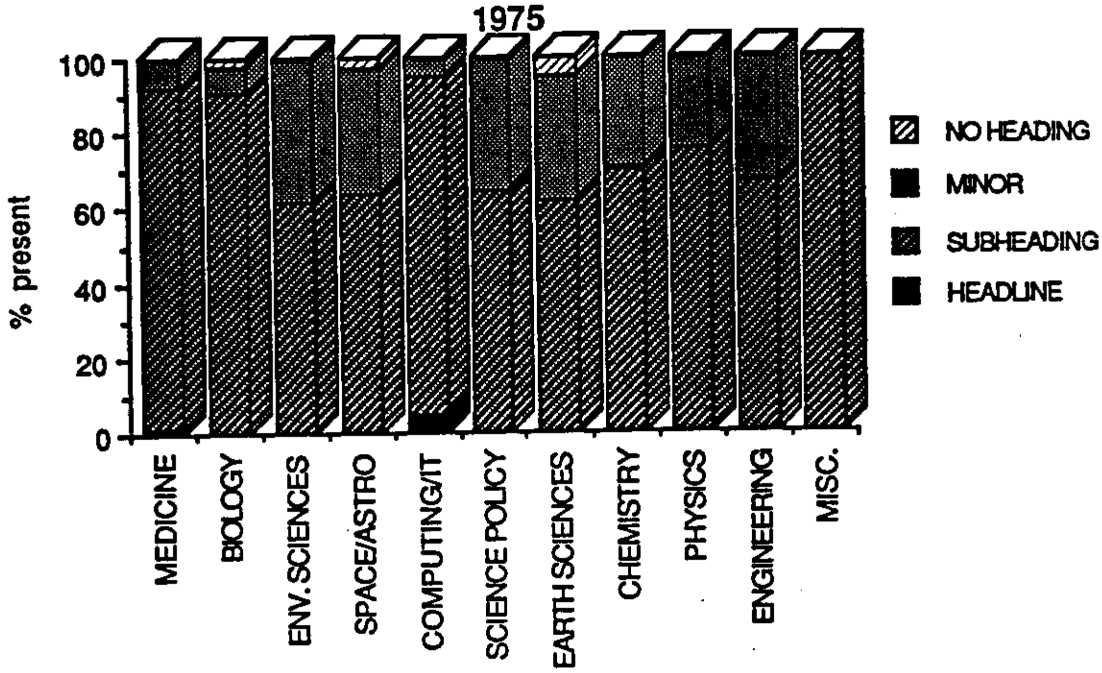
3.2.5 PERCENTAGE DISTRIBUTION OF SUBJECTS BY STATUS CATEGORY

Hypothesis 4b (section 2.2) stated that a change in the status of all articles would be found. Breaking this down by subject for both papers in 1974 and 1975 shows us that most subjects are given subheadings. In the Times (see Graph 19a) only medicine and computing/IT were given any headlines at all. All subjects had varying but low percentages of minor headings, but the modal status was a subheading. Biology, space/astronomy and earth sciences articles appeared with graphics but no text. In the Guardian (see Graph 19b) only environmental sciences, space/astronomy, computing/IT and earth sciences were given any headlines and no articles appeared as graphics alone. Again the modal status was a subheaded article for all subjects except earth sciences which had more minor headed articles.

By 1989 and 1990 all subjects in the Times are represented by a small percentage of headline articles, but there are also generally more minor headed articles (see Graph 20a). Only environmental sciences and engineering had a very small percentage of graphics only articles so again the modal status in all subjects is articles with subheadings. The situation in the Guardian is slightly more complicated (see Graph 20b). Medicine, biology, environmental sciences, space/astronomy, computing/IT and engineering have headline articles but none of the rest. In computing/IT, science policy, chemistry and engineering there are noticeably more minor articles. Subheaded articles are the modal status for all subjects except computing/IT, earth sciences and engineering which are mostly minor articles. Chemistry is evenly split between subheaded and minor articles.

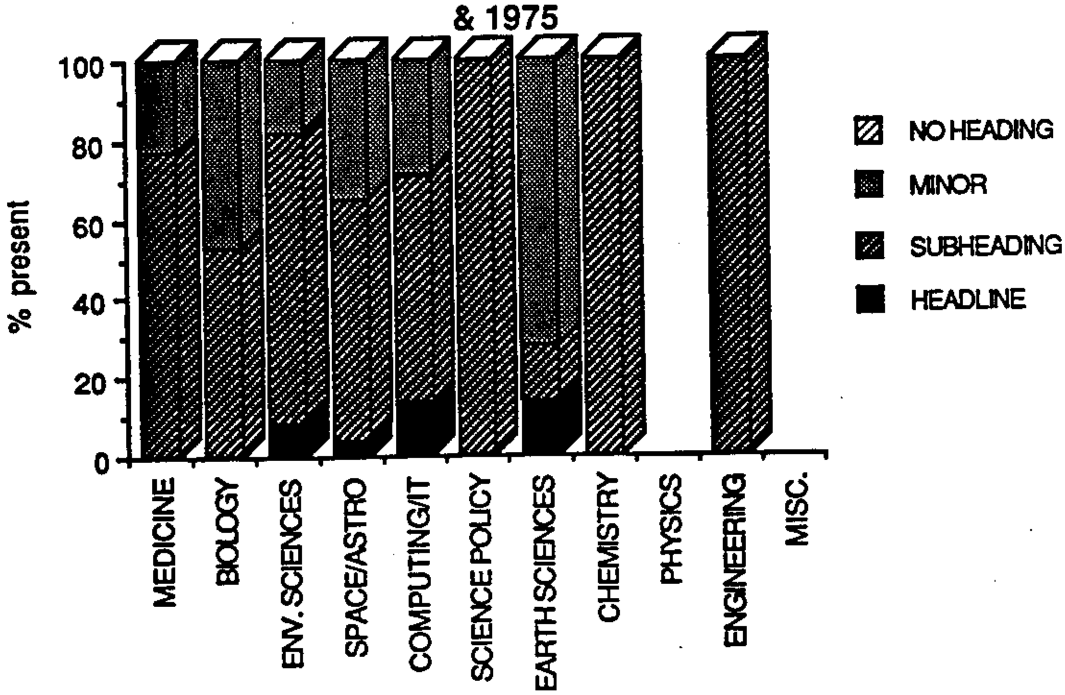
GRAPH 19a

% distribution of subjects by status: Times 1974 & 1975



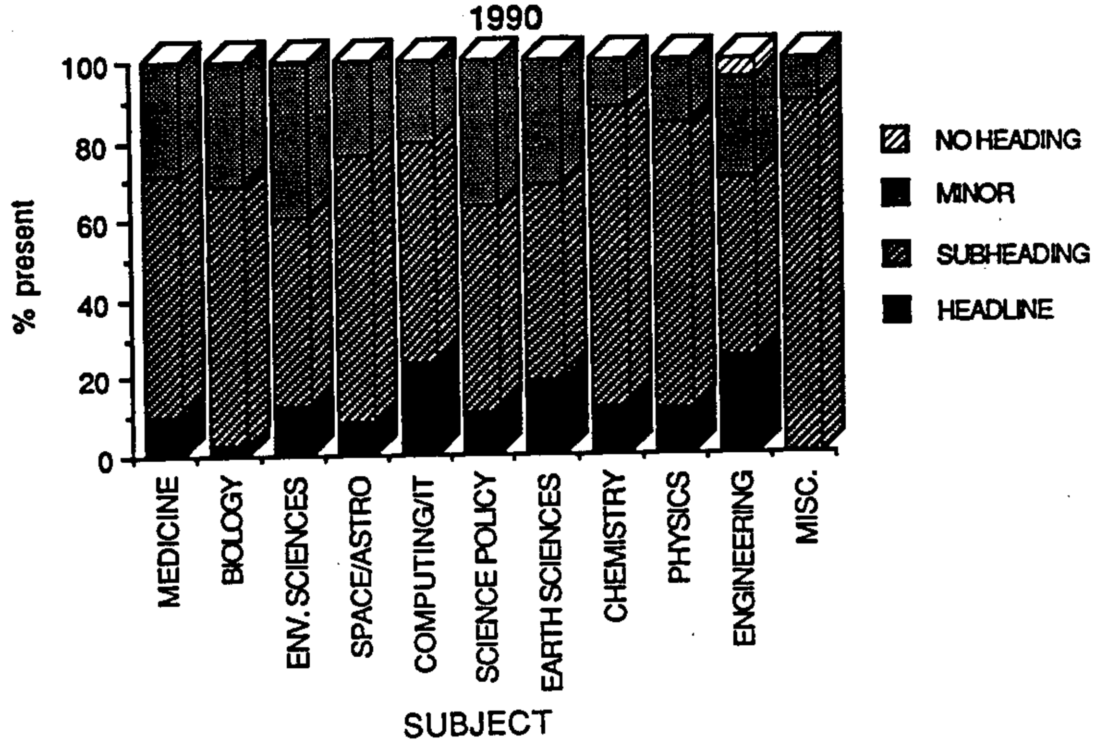
GRAPH 19b

% distribution of subjects by status: Guardian 1974 & 1975



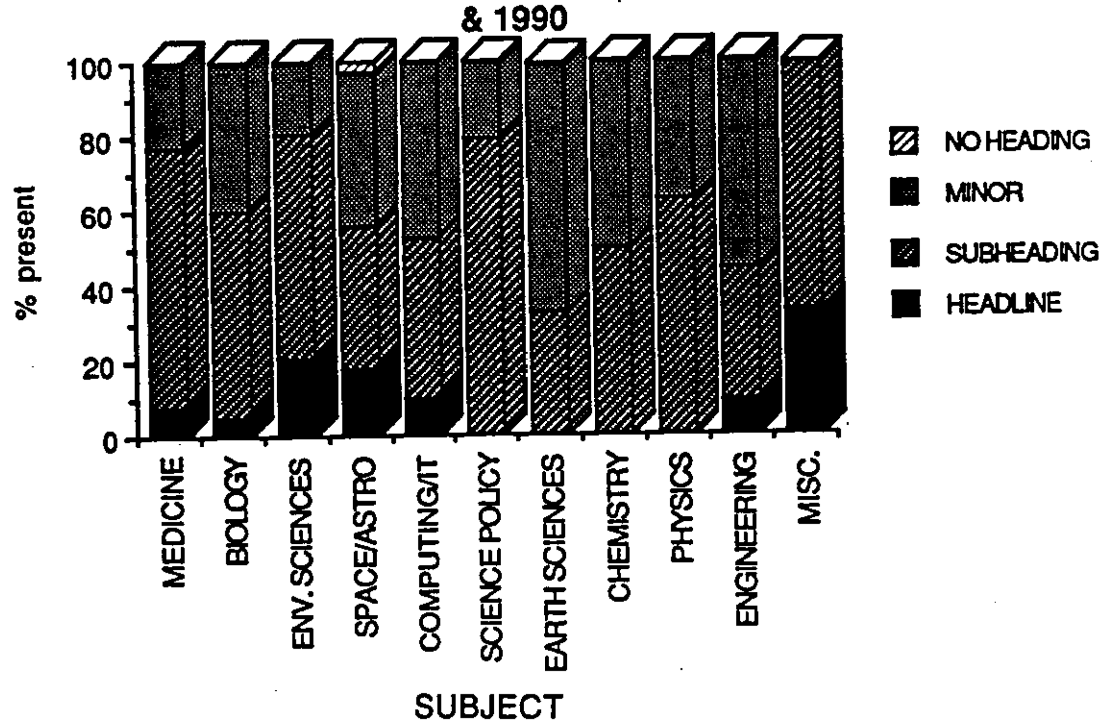
GRAPH 20a

% distribution of subjects by status: Times 1989 & 1990



GRAPH 20b

% distribution of subjects by status: Guardian 1989 & 1990

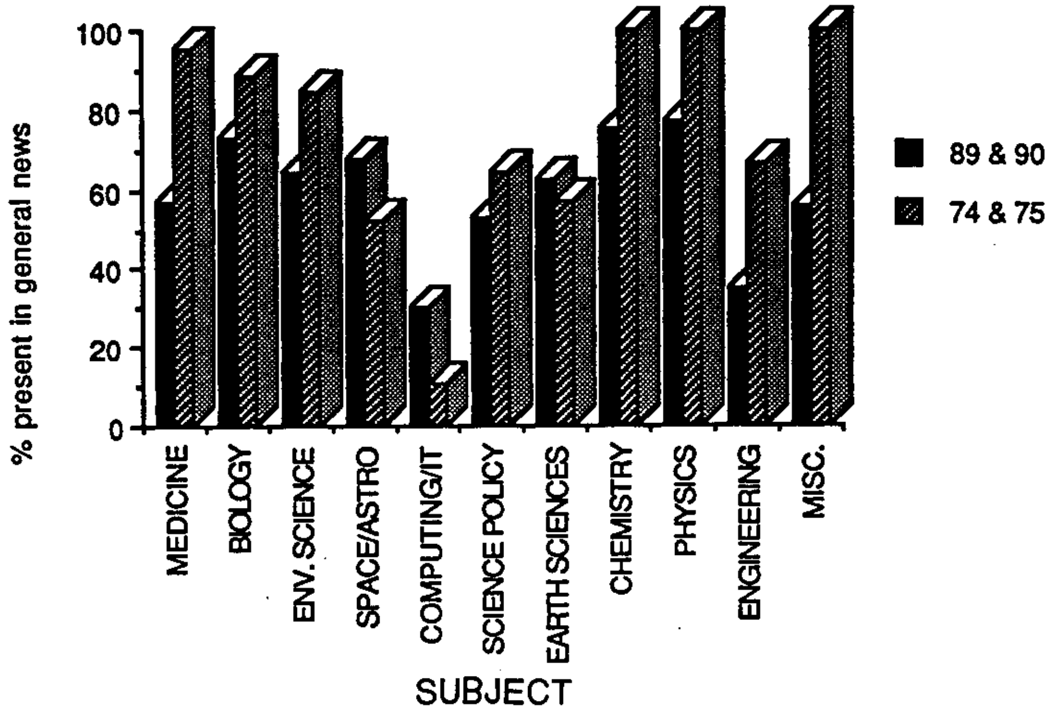


3.2.6 PERCENTAGE OF SUBJECTS IN GENERAL NEWS SECTION

Hypothesis 5 (section 2.2) was that over time more articles would appear in special sections and less in the general news. The first part of that hypothesis will be dealt with in section 3.3. Graph 21 shows the changes in the percentage of each subject present in general news in the Times, first in 1974 and 1975 and then in 1989 and 1990. The only subjects which show a rise in the percentage of reporting in general news are space/astronomy, computing/IT and earth sciences. It was not possible to perform tests for significance on this data, but scanning the data shows that these increase are similar to those which occur as part of the natural fluctuations of reporting. The other subjects all show a decrease with medicine's and engineering's being the largest, and furthest removed from natural fluctuations. Graph 22 shows the same comparison but for the Guardian. Here, all subjects which were present in both time zones show a reduced percentage of articles in general news with the largest changes in computing/IT, chemistry and engineering.

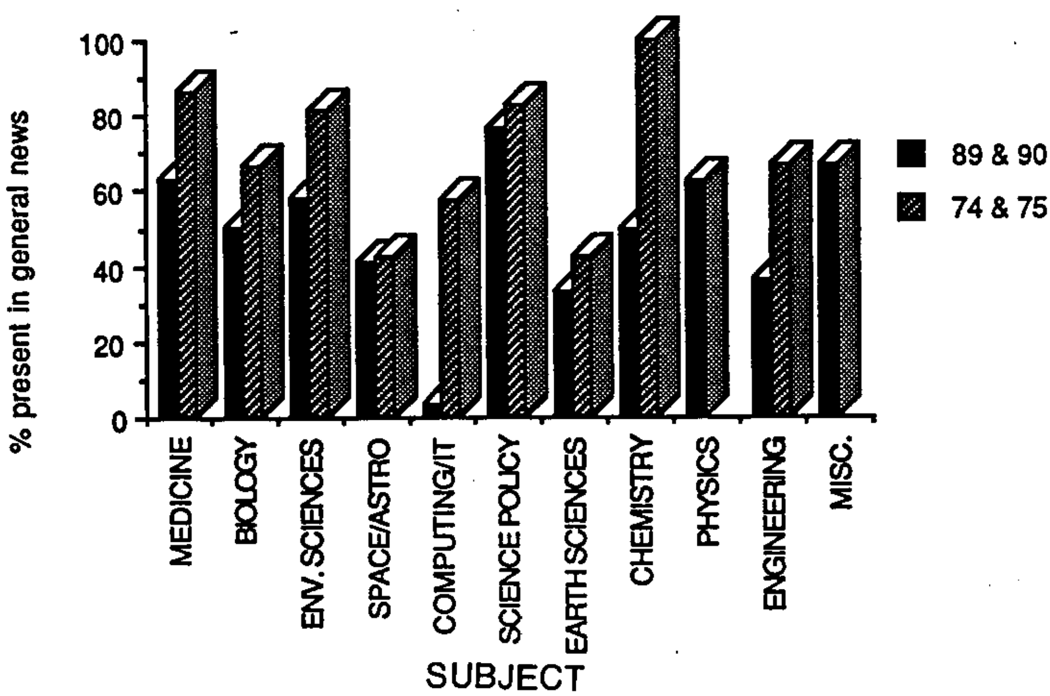
GRAPH 21

% of subjects in general news section: Times



GRAPH 22

% of subjects in general news section: Guardian



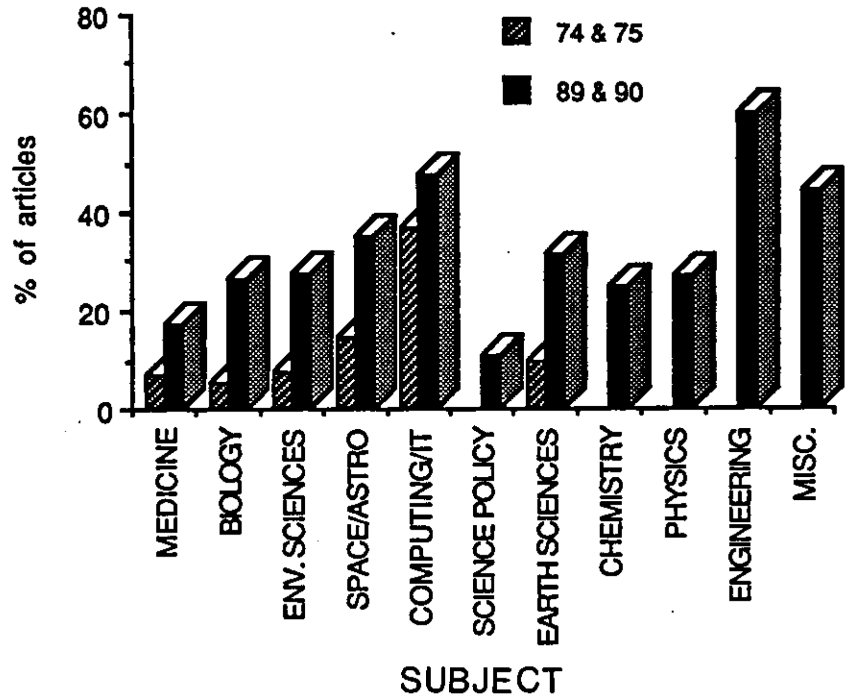
3.2.7 PERCENTAGE DISTRIBUTION OF GRAPHICS BY SUBJECT

Following on from hypothesis 4c (section 2.2) that there would be a change in the number of graphics used, an analysis of the graphics content of each subject was performed (see hypothesis 4d, section 2.2). Graph 23 shows that in the Times the percentage of articles with some kind of illustration increased in all subjects over time. For science policy, chemistry, physics and engineering there were no graphics present in 1974 and 1975. The smallest increase was shown by computing/IT. Graph 24 shows that in the Guardian, over time, two subjects (space/astronomy and engineering) experienced a fall in the percentage of articles containing graphics. Science policy had no articles containing graphics in 1974 and 1975, and chemistry and physics had no articles with graphics in either time zone.

Table 5 contains the results of G-tests to see if any of the changes within subjects are statistically significant. In the Times medicine, biology and space/astronomy show a significant increase, but only biology increases significantly in the Guardian.

GRAPH 23

% distribution of graphics by subject: Times



GRAPH 24

% distribution of graphics by subject: Guardian

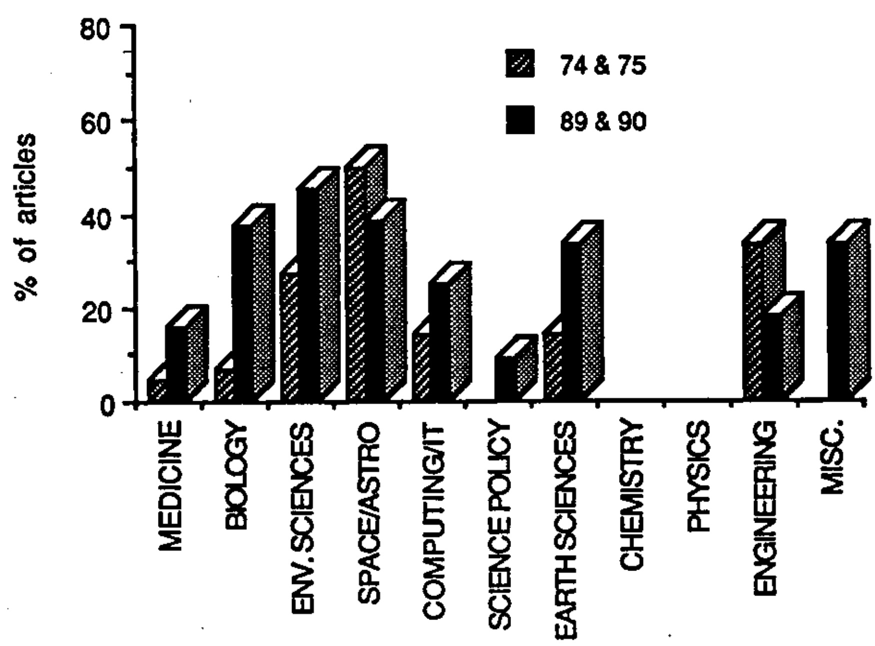


TABLE 5

Results of G-tests on graphical representation of each subject between time zones: Times and Guardian

	YEARS COMPARED; 74&75 - 89&90	
SUBJECT	TIMES	GUARDIAN
MEDICINE	5.59 (1)*	2.41 (1)ns
BIOLOGY	13.4 (1)**	6.82 (1)*
ENV. SCIENCE	3.03 (1)ns	1.26 (1)ns
SPACE/ASTRO	8.12 (1)*	0.07 (1)ns
COMPUTING/IT	0.73 (1)ns	0.47 (1)ns
SCIENCE POLICY	nt	nt
EARTH SCIENCES	2.81 (1)ns	0.67 (1)ns
CHEMISTRY	nt	nt
PHYSICS	nt	nt
ENGINEERING	nt	0.3 (1)ns
MISCELLANEOUS	nt	nt

3.2.8 MEAN LENGTH OF GRAPHICS IN EACH SUBJECT

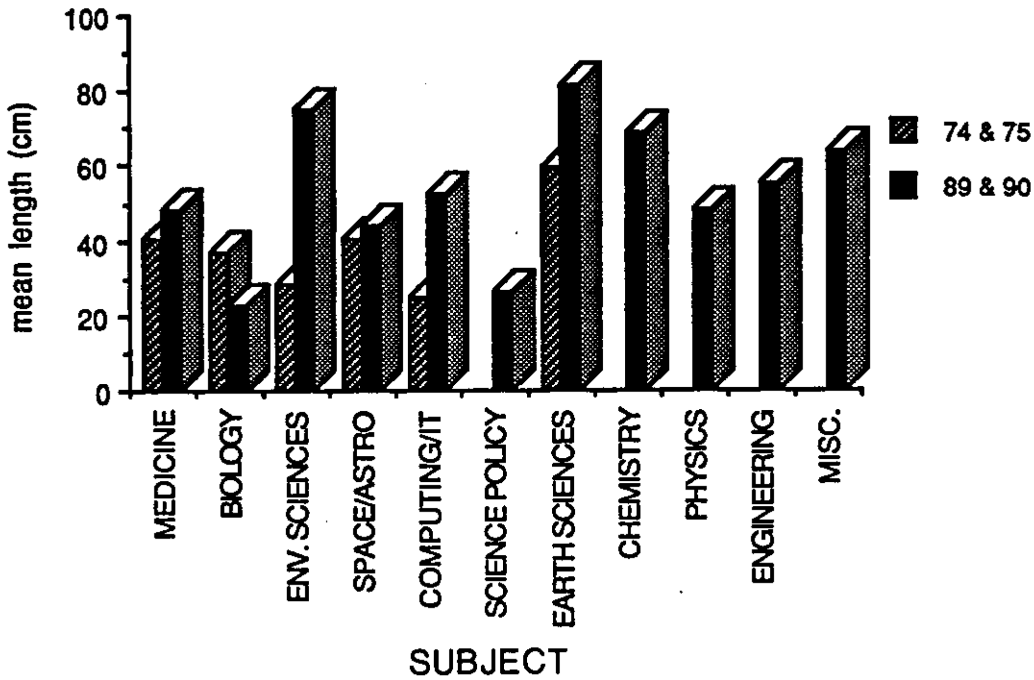
Hypothesis 4di (section 2.2) suggested that over time there would be a change in the mean lengths of graphics in each subject. Graph 25 shows the change over time in mean length of graphics for each subject for the Times. The graph shows an increase in the mean length of graphics for all subjects in which graphics were present in both time zones, except biology. Science policy, chemistry, physics and engineering were not represented by graphics in 1974 and 1975.

Graph 26 shows the change in mean graphics length over time for the Guardian. Here, the mean length increase with time in medicine, space/astronomy, computing/IT and engineering articles. Biology, environmental sciences and earth sciences show a decreases mean length. Science policy and physics did not have any graphical representation in 1974 and 1975, and chemistry articles had no graphics in any year.

T-tests on the data from the Times (see Table 6a) show that none of the changes over time were significant. There is not enough data to do tests on most of the subjects. The difference between 1989 and 1990 for space/astronomy was significant.

GRAPH 25

Mean length of graphics in each subject: Times



GRAPH 26

Mean length of graphics in each subject: Guardian

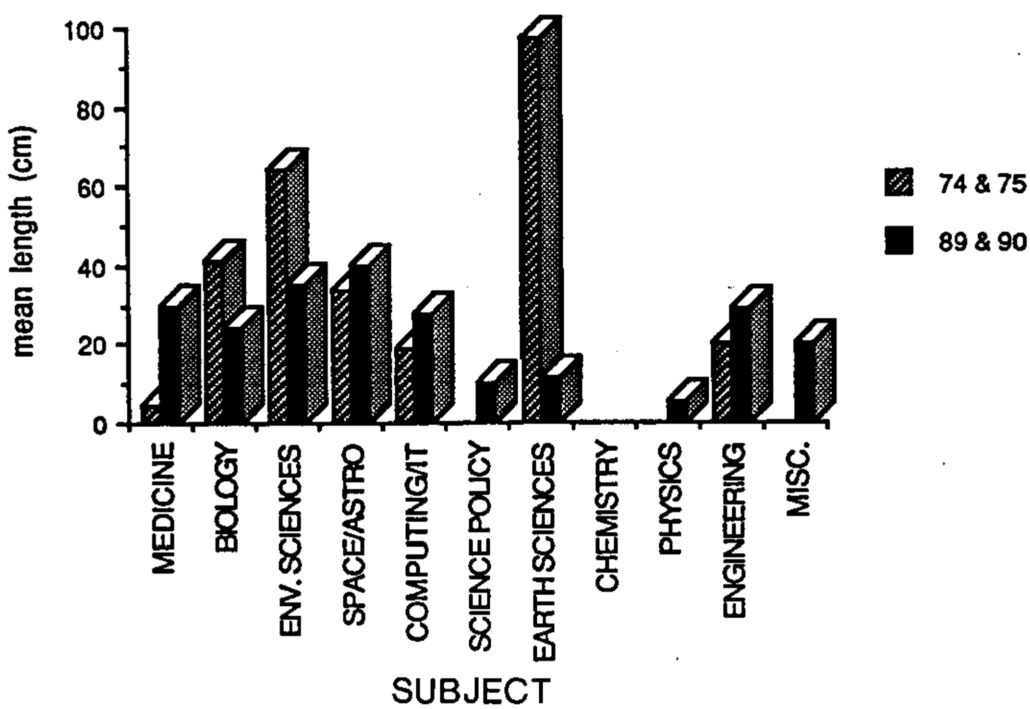


TABLE 6a

Results of t-tests on mean lengths of graphics in each subject category in each year: Times

	YEARS COMPARED		
SUBJECT	74-75	89-90	74&75 - 89&90
MEDICINE	1.74 (1)^{ns}	0.75 (3)^{ns}	0.68 (7)^{ns}
BIOLOGY	nt	0.25 (4)^{ns}	1.87 (6)^{ns}
ENV. SCIENCE	nt	0.65 (2)^{ns}	nt
SPACE/ASTRO	1.75 (2)^{ns}	4.48 (2)*	0.36 (7)^{ns}
COMPUTING/IT	nt	2.4 (4)^{ns}	2.35 (5)^{ns}
SCIENCE POLICY	nt	0.58 (1)^{ns}	nt
EARTH SCIENCES	nt	2.41 (1)^{ns}	0.53 (3)^{ns}
CHEMISTRY	nt	nt	nt
PHYSICS	nt	0.47 (3)^{ns}	nt
ENGINEERING	nt	0.69 (4)^{ns}	nt
MISCELLANEOUS	nt	nt	nt

Table 6b gives the t-test results of the changes over time for the Guardian, where data allows, and shows that none of them were significant.

TABLE 6b

Results of t-tests on mean lengths of graphics in each subject category in each year: Guardian

	YEARS COMPARED		
SUBJECT	74-75	89-90	74&75 - 89&90
MEDICINE	nt	0.48 (3) ns	nt
BIOLOGY	nt	0.41 (4) ns	nt
ENV. SCIENCE	nt	1.99 (4) ns	1.47 (5) ns
SPACE/ASTRO	0.76 (2) ns	1.42 (3) ns	0.31 (6) ns
COMPUTING/IT	nt	1.09 (4) ns	nt
SCIENCE POLICY	nt	nt	nt
EARTH SCIENCES	nt	nt	nt
CHEMISTRY	nt	nt	nt
PHYSICS	nt	nt	nt
ENGINEERING	nt	nt	nt
MISCELLANEOUS	nt	nt	nt

3.2.9 POSITIVE AND NEGATIVE TERM DISTRIBUTION IN MEDICAL AND SPACE/ASTRONOMY ARTICLES

TABLE 7

Results of the analysis of positive and negative term distribution, and overall balance of article attitude

	1	2	3	4	5	6	7	8
CA VARIABLE	TIMES MEDICAL 74&75	GUARDIAN MEDICAL 74 &75	TIMES MEDICAL 89&90	GUARDIAN MEDICAL 89&90	TIMES SPACE/ASTRO 74&75	GUARDIAN SPACE/ASTRO 74&75	TIMES SPACE/ASTRO 89&90	GUARDIAN SPACE/ASTRO 89&90
+VE TERMS	38%	14%	75%	44%	80%	44%	25%	0
-VE TERMS	62%	86%	25%	56%	20%	56%	75%	100%
BALANCE	-	-	+	-	+	-	-	-

The next three paragraphs all refer to Table 7.

TIMES V. GUARDIAN

Comparing column 1 with 2, and 7 with 8, shows that for medical articles, in 1974 and 1975, and space/astronomy articles in 1989 and 1990, in both the Times and the Guardian, there were a higher percentage of negative as opposed to positive terms. The overall balance of article attitudes was negative for both papers. Comparing column 3 with 4, and 5 with 6, shows that for medical articles, in 1989 and 1990, and space/astronomy articles in 1974 and 1975, in the Times more positive terms were used, whilst the opposite is true of the Guardian. The balance of article attitude was positive in the Times in both cases, and negative in the Guardian, although the latter were much closer to neutral.

MEDICAL V. SPACE/ASTRONOMY

Comparing column 1 with 5, and 2 with 6, shows that for both papers, in 1974 and 1975, medical articles contained more negative terms whilst space/astronomy contained more positive terms in the Times, and slightly more negative terms in the Guardian. Overall, the balance of terms in medical articles was negative for both papers, whilst space/astronomy articles it was positive in the Times, and just negative in the Guardian. Comparing column 3 with 7 shows that for the Times, in 1989 and 1990, medical articles contained a higher percentage of positive terms, space/astronomy more negative terms. Comparing column 4 with 8 shows that for the Guardian, in 1989 and 1990, medical articles contained slightly more negative terms, and space/astronomy all negative terms.

1974&1975 V. 1989&1990

Comparing column 1 with 3, and 2 with 4, shows that in both papers, medical articles used more negative terms in 1974 and 1975, and the Times used more positive terms in 1989 and 1990, whilst the Guardian still used slightly more negative terms. Comparing column 5 with 7 shows that in the Times, space/astronomy articles contained a higher percentage of positive terms in 1974 and 1975, but more negative terms in 1989 and 1990. The balance of terms moved from positive to negative. Comparing column 6 with 8 shows that in the Guardian, space/astronomy articles had slightly more negative terms in 1974 and 1975, but solely negative terms in 1989 and 1990. Overall article attitude remained negative.

3.2.10 QUOTE DISTRIBUTION AND ATTRIBUTATION IN MEDICAL AND SPACE/ASTRONOMY ARTICLES

TABLE 8

Results of the analysis of quote distribution and attributation

	1	2	3	4	5	6	7	8
CA VARIABLE	TIMES MEDICAL 74&75	GUARDIAN MEDICAL 74 &75	TIMES MEDICAL 89&90	GUARDIAN MEDICAL 89&90	TIMES SPACE/ASTRO 74&75	GUARDIAN SPACE/ASTRO 74&75	TIMES SPACE/ASTRO 89&90	GUARDIAN SPACE/ASTRO 89&90
SPECIALIST QUOTES	94%	13%	89%	74%	35%	53%	67%	25%
LAYPERSON QUOTES	0	0	5.5%	4%	40%	12%	0	25%
GENERIC QUOTES	6%	87%	5.5%	22%	25%	35%	33%	50%

The next three paragraphs all refer to Table 8.

TIMES V. GUARDIAN

Comparing column 1 with 2 shows that in medical articles in 1974 and 1975, the Times favoured quotes attributed to specialists whereas the Guardian had a much higher percentage of generic quotes. Comparing column 3 with 4 shows that by 1989 and 1990, both used more specialist quotes than any other type. Comparing column 5 with 6 shows that space/astronomy articles in the Times in 1974 and 1975, had a spread of quotes over the three categories, with those from non-specialists being marginally the most common. In the Guardian non-specialist quotes were used least and specialist quotes used most. Comparing column 7 with 8, shows that in space/astronomy articles in 1989 and 1990, specialist quotes were the most commonly used in the Times, as opposed to generic quotes in the Guardian.

MEDICAL V. SPACE/ASTRONOMY

Comparing column 1 with 5 shows that in the Times in 1974 and 1975, medical articles quoted specialists the vast majority of the time, whilst space/astronomy articles spread their quotes over the three categories. Comparing column 2 with 6 shows that in the Guardian in 1974 and 1975 medical articles contained more generically attributed quotes, whereas in space/astronomy articles, quotes from specialists were the most common. Comparing column 3 with 7 shows that in the Times in 1989 and 1990, named specialists were most commonly used for quotes. This is also true of medical article in the Guardian (see column 4), but generically-attributed quotes were the most common in space/astronomy articles (see column 8).

1974&1975 V. 1989&1990

Column 1 and 3 show that in the Times, medical articles quoted specialists most often in both time zones. Comparing column 2 with 4 shows that generic quotes were the most commonly used in Guardian medical articles in 1974 and 1975 as opposed to specialist's quotes in 1989 and 1990. Column 5 shows that in space/astronomy articles in the Times 1974 and 1975, lay person quotes were the most common, whilst column 7 shows that specialist quotes were the most common in 1989 and 1990. Comparing column 6 with 8 shows that in space/astronomy articles in the Guardian, quotes were well spread in 1974 and 1975, with specialists being the most common, and a wide spread was also found in 1989 and 1990, but with the most common quotes being those with generic sources.

3.2.11 ACRONYM AND TECHNICAL TERM DISTRIBUTION IN MEDICAL AND SPACE/ASTRONOMY ARTICLES

TABLE 9

Results of the analysis of acronym and technical term distribution

	1	2	3	4	5	6	7	8
CA VARIABLE	TIMES MEDICAL 74&75	GUARDIAN MEDICAL 74 &75	TIMES MEDICAL 89&90	GUARDIAN MEDICAL 89&90	TIMES SPACE/ASTRO 74&75	GUARDIAN SPACE/ASTRO 74&75	TIMES SPACE/ASTRO 89&90	GUARDIAN SPACE/ASTRO 89&90
ACRONYMS	1	29	71	55	2	0	3	1
TECHNICAL TERMS	5	10	40	46	12	21	12	1

The next three paragraphs all refer to Table 9.

TIMES V. GUARDIAN

Comparing column 1 with 2 shows that in medical articles in 1974 and 1975, both acronyms and technical terms were more widely used in the Guardian than the Times. Comparing column 3 with 4 shows that high numbers of acronyms and technical terms were used in medical articles in both papers in 1989 and 1990. Comparing column 5 with 6 shows that in space/astronomy articles in 1974 and 1975 both papers used few acronyms and a moderate number of technical terms. Comparing column 7 with 8 shows that in space/astronomy articles in 1989 and 1990, the Times used slightly more acronyms and many more technical terms than did the Guardian. Mann-Whitney U tests were performed on these comparisons, but were all found to be not significant. The same is true of the tests performed on data comparing subjects and time zones. This may be because many of the tests were between low numbers of small sets.

MEDICAL V. SPACE/ASTRONOMY

Comparing column 1 with 5 shows that in the Times in 1974 and 1975, the use of technical terms was more common than acronyms in both subjects, and space/astronomy articles contained more of the former. Comparing column 2 with 6 shows that for the Guardian in the same time period, medical articles contained more acronyms than space/astronomy articles, but fewer technical terms. Comparing column 3 with 7 and 4 with 8, shows that for both papers in 1989 and 1990, medical articles contained far more acronyms and technical terms than space/astronomy articles.

1974&1975 V. 1989&1990

Comparing column 1 with 3, and 2 with 4, shows that in both papers, more acronyms and technical terms were used in medical articles in 1989 and 1990, than in 1974 and 1975. Comparing column 5 with 7 shows that in the Times, the number of acronyms and technical terms used in space/astronomy articles was virtually unchanged over time, whereas in the Guardian (see columns 6 and 8), very few acronyms were used in either time zone, but many more technical terms were used in 1974 and 1975 than in 1989 and 1990.

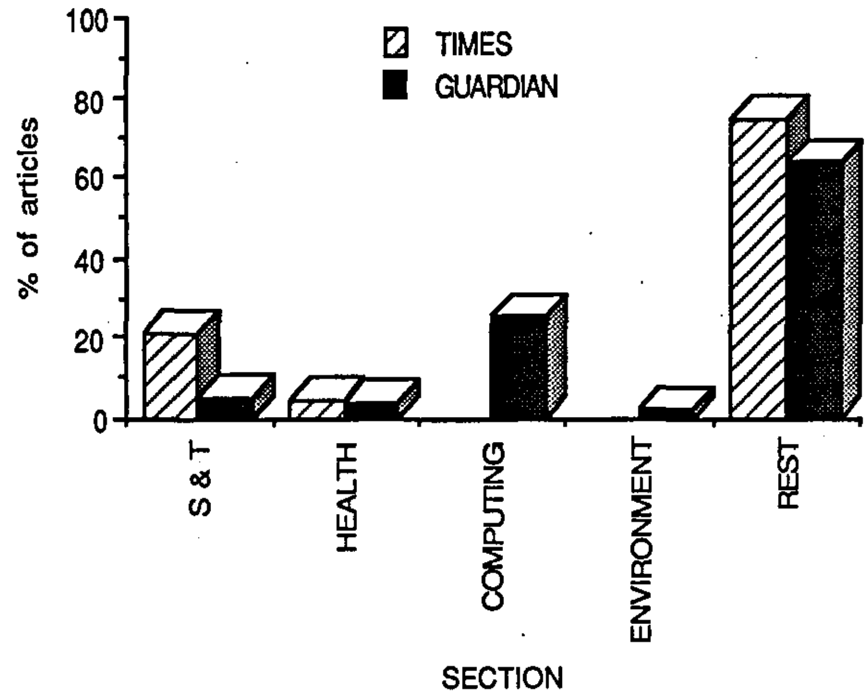
3.3 ANALYSIS OF THE ROLE OF SPECIAL SECTIONS

3.3.1 PERCENTAGE OF ALL ARTICLES IN EACH SECTION

Graph 27 shows, for the Times and the Guardian, the percentage of all articles in each section (science or general) in 1989 and 1990. It was hypothesised (section 2.2, point 1c) that there would be a relationship between articles and the section of publication, especially in 1989 and 1990. In 1974 and 1975 there were no specialist sections but by 1989 and 1990 three had been introduced into the Times, and four into the Guardian. The percentage of articles in the general news section of the Times had decreased by 25.5% and 25.4% of all articles were now present in special sections. The percentage of all articles in the general news section of the Guardian had decreased by 36.2% and special sections contained 38.2% of all articles.

GRAPH 27

% of articles in each section: 1989 & 1990



3.3.2 MEAN LENGTH OF ALL ARTICLES IN EACH SECTION

Hypothesis 6a (section 2.2) was that articles in special sections would be longer than those in the rest of the paper. Graph 28 for the Times and the Guardian shows that, for the Times, this is true. Articles in the environment section are the longest, then comes health, science and technology and lastly the rest of the paper.

For the Guardian the differences are a little less clear. Again environment articles are the longest but not to such a large degree as they were in the Times. Science and technology comes next, then computing, health and lastly the rest of the paper.

GRAPH 28

Mean length of articles in each section: 1989 & 1990

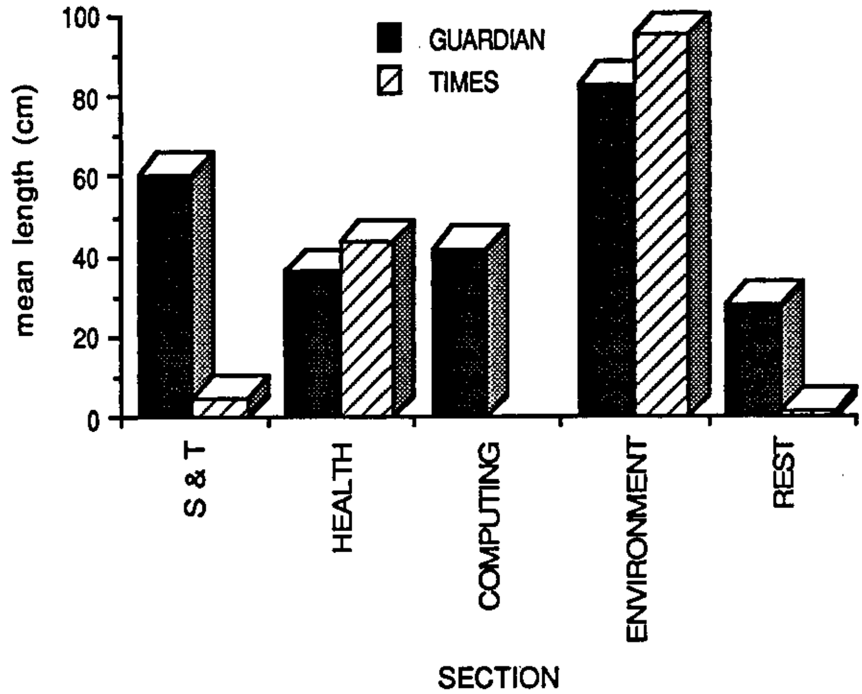


Table 10 shows which of these differences in mean length between general news and each special section is significant.

TABLE 10

Results of the t-tests of mean lengths of all science and technology articles in special sections and general news: Times & Guardian 1989 & 1990

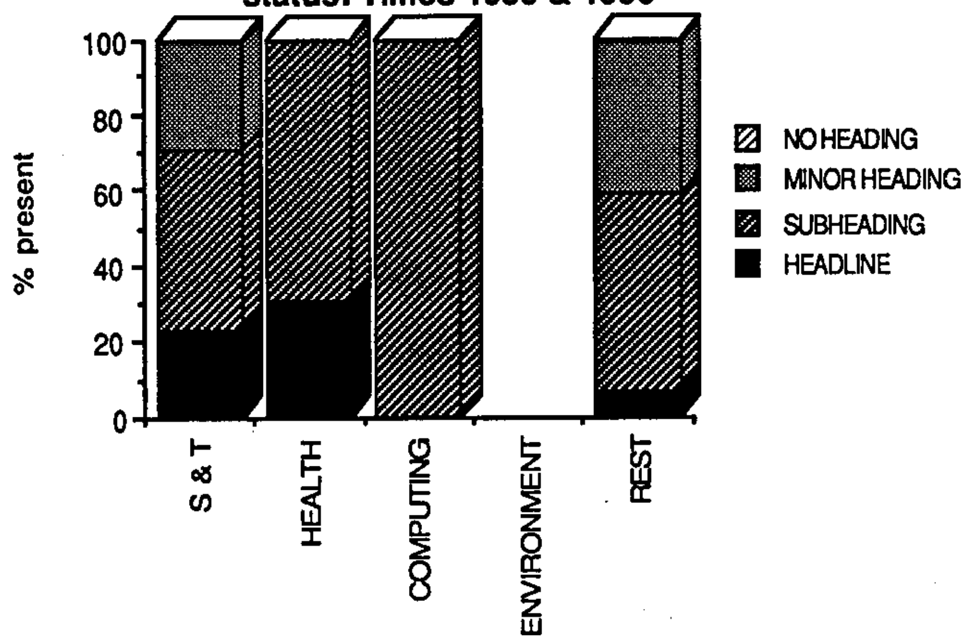
	SECTION TO BE COMPARED WITH REST OF PAPER			
PAPER	S & T	HEALTH	COMPUTING	ENVIRONMENT
TIMES	3.89 (5)*	5.33 (5)*	nt	nt
GUARDIAN	6.35 (7)**	1.57 (9)ns	1.83 (7)ns	8.98 (6)**

3.3.3 PERCENTAGE OF ALL ARTICLES IN EACH STATUS CATEGORY IN EACH SECTION

Hypothesis 6b (section 2.2) stated that articles in special sections would have larger headings than those in the general news. In fact, as Graph 29 shows the modal status for each section in the Times was subheadings.

GRAPH 29

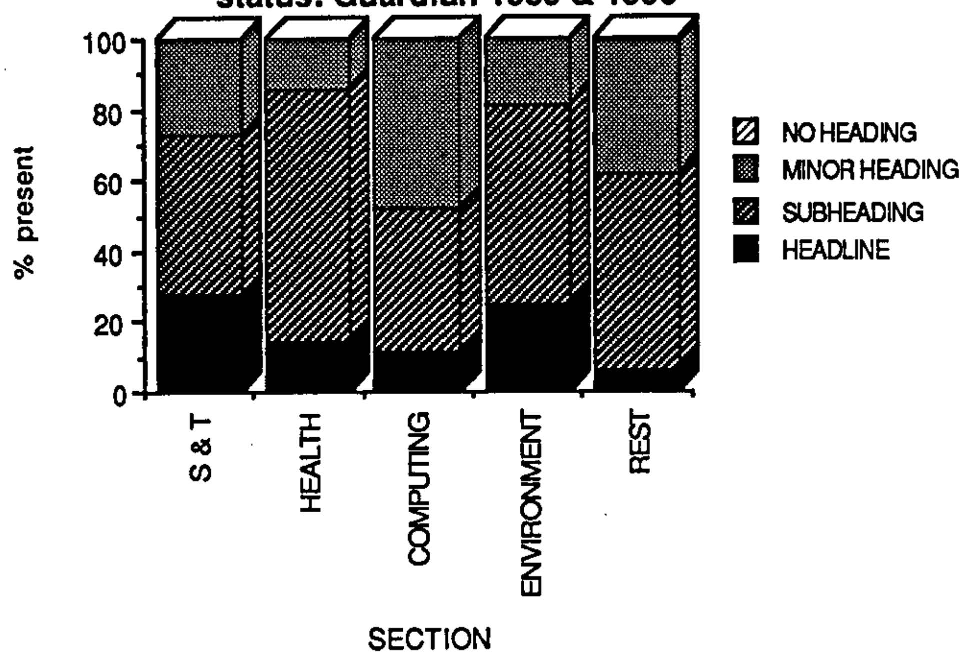
% distribution of all articles in each section by status: Times 1989 & 1990



In the Guardian, as Graph 30 shows, all articles were more likely to have subheadings regardless of the section they were in, except for those in the computing section which were more likely to have minor headings.

GRAPH 30

% distribution of all articles in each section by status: Guardian 1989 & 1990

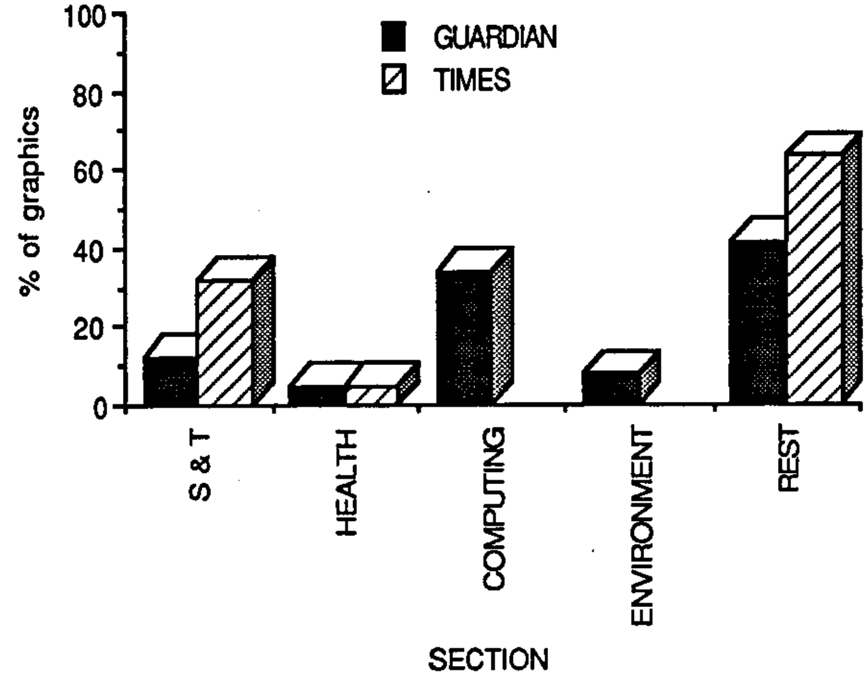


3.3.4 PERCENTAGE OF GRAPHICS IN EACH SECTION

Hypothesis 6ci (section 2.2) stated that there would be more graphics in special sections than in general news. Graph 31 shows that, for the Times, this is not true. Graphics appear in all sections except computing, but there are twice as many in the general news as there are in the science and technology section and twelve times as many as there are in the health section. The difference in the Guardian is not as marked. There are fewer graphics in the general news than were found in the Times, but even so there are 3.5 times as many as there are in the science and technology section, eight times as many as are in the health section, five times the number in the environment section and only 7% more than are in the computing section.

GRAPH 31

% of graphics in each section: 1989 & 1990



3.3.5 MEAN LENGTH OF GRAPHICS IN EACH SECTION

Hypothesis 6ci (section 2.2) stated that the graphics in special sections would be longer than those in the general news. Graph 32 shows that, for the Times, this is only marginally true and only for science and technology and health sections. Computing graphics are generally shorter than those in the general news. The Guardian shows graphics in science and technology and environment sections to be longer than those in the general news and graphics in health and computing to be shorter.

GRAPH 32

Mean length of graphics in each section: 1989 & 1990

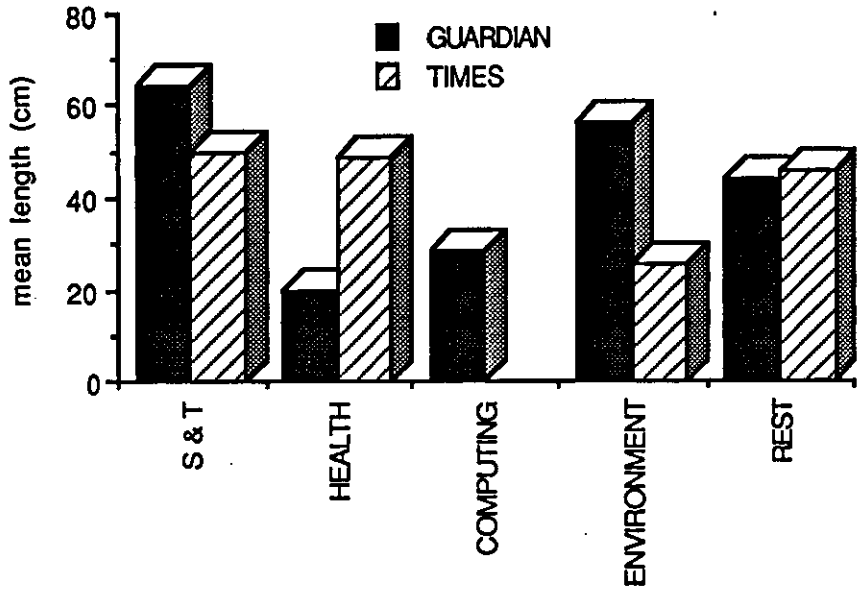


Table 11 shows that none of the differences are significant.

TABLE 8

Results of t-tests of mean lengths of all science and technology graphics in special sections and general news: Times & Guardian 1989 & 1990

	SECTION TO BE COMPARED WITH REST OF PAPER			
PAPER	S & T	HEALTH	COMPUTING	ENVIRONMENT
TIMES	0.43 (8) ns	0.16 (5) ns	_	nt
GUARDIAN	1.98 (3) ns	0.08 (8) ns	0.09 (9) ns	1.66 (4) ns

CHAPTER 4
DISCUSSION

4.1.1 TOTAL AMOUNTS REPORTED

More science and technology articles were present in the Times than the Guardian (see section 3.1.1) possibly because the Times places more importance on science news and therefore runs more stories, or because the Times is longer and so has more space to run more stories. In 1989 and 1990 the average number of pages in the Times each day was 45 but only 37 in the Guardian, suggesting that the latter possibility is correct. Both papers showed a significant increase in the amounts reported over time (see section 3.1.1). Again this could be due to an increased amount of space available for reporting or more importance being placed on science and technology reporting. The average number of pages in the Times each day increased from 27 to 45, (a 66% increase) and the number of pages in the Guardian increased from an average of 24 to 37 (a 54% increase). The number of science and technology articles in the Times increased by 170%, and by 469% in the Guardian. This means that in the Times, the ratio of number of articles to pages has increased from 0.07:1 to 0.12:1, and in the Guardian it has increased from 0.03:1 to 0.1:1. The comparisons between number of articles and paper length are not confused by such factors as changing mean article length or number of columns on a page, as both of these factors were remarkably stable over time.

So, there have been increases in reporting, in excess of the increases in the amount of space available. It is possible that science and technology have come to be considered as more important by newspaper editors and the public alike. Science is more accepted today as something in which everyone can take an interest (1). The realisation that we are affected by the changes that occur in science, has accelerated the process of science popularisation (2). The public's attitude toward science and technology is something which needs to be studied in more detail. The differing orientations and priorities of the papers also requires further study. Anyone who reads a newspaper knows that there are differences between different titles, which is why they prefer one or two, to any of the others. The Guardian traditionally has a younger readership than the Times and a more liberal attitude both in the social and political sense (3). The Times, for its part, has a solid history of science reporting in the form of the Times-Nature column which appears every week. A more detailed content analysis study, correlating attitude with content, would reveal the extent to which this kind of difference in orientation has an effect on the treatment of special subjects such as science and technology.

4.1.2 THE IMPORTANCE OF SCIENCE AND TECHNOLOGY ARTICLES

A significant increase over time in mean article length was seen in the Times, but articles in the Guardian had no significant change in length (see section 3.1.2). If this is an indication that the Times is placing more importance on science and technology, then it would follow that there would be more articles with headlines, on more prominent pages. No noticeable change was seen in the format of headings over the time span of this study, even though many changes in typeface and page design have been seen over the history of newspaper publication. Any changes in heading status between 1974 and 1990 are more likely to be due to actual changes the the importance placed on articles, rather than an anomaly caused by printing changes. In the Times, a small, but not statistically significant, increase in headline articles was seen over time, but this was balanced by a significant increase in the number of articles given minor headings (see section 3.1.5). It may be that science is being treated more like general news, although no data is available on the heading statuses given to general news stories. A small, but constant use of headline articles and minor headings, with the majority of articles given medium-sized headings, would seem to resemble the reporting of daily news stories. This is in comparison to the brief sentences which represented science reporting at its outset (4). Similar changes over time in heading status were seen in the Guardian; a significant increase in major and minor headings and a significant decrease in subheadings. If anything, the trend seems to be moving very slightly toward less prominent articles (see section 3.1.5). This may be because once a special section has been established, the articles within it do not need large headings to attract attention. This has been done by informing the reader that a special section is included in that issue, and then giving it a front page. Indeed, most articles in the Times in special sections are given subheadings. The same is true in the Guardian special sections, except computing, where the most common heading is a minor one (see section 3.3.3).

As for the page distribution of articles, rather than seeing many more stories in the first five pages of the paper, articles in both papers seem to have been shifted to the special sections created in recent years (see section 3.1.4). This is a definite change in the way science and technology is treated as compared to 1974 and 1975. Special sections give added emphasis and importance to a subject, without taking up highly prized space on the front pages which editors use for stories with more mass appeal and/or importance. Pages 1 to 5 are more likely to be read than any others. Special sections do have the added advantage of creating a break in the newspaper. An extra page, similar to the front page in design and layout, is added which draws the readers' attention in the same way. Articles on the front page of a section are much more visible than those on any other inside page (5). Consequently, the actual page location of a special section is less important than the fact that there is a special section in the paper. A more detailed study of the changes in front page *and* first page of section placement would expand the study of science and technology status. If one splits the articles into those appearing in general news and those appearing in special sections, it is seen that the percentage fall over time in the number of science and technology articles in general news is almost exactly matched by the amount now present in special sections. This is true for both papers (see section 3.3.1). Given that the amount of space available in the general news section is so much greater that the amount available in special sections, then the increase seen in special sections is actually even larger. This is to be expected though, as the nature of a special section is to concentrate on the reporting of a limited number of subjects.

The change in the distribution of all articles by day emphasises the movement of articles into special sections (see section 3.1.3). In 1974 and 1975 there were no days when noticeably more articles appeared, as compared to any other day. In 1989 and 1990 Thursdays definitely contained more articles than any other day. This is true for both papers. Fridays also seemed to be more popular, but not as much as Thursdays. Both of these days contained special sections related to science and technology, and it is probable that this is why more articles were seen to be present on these days. The Times on Thursday had a science and technology and computing section, and the Guardian had a computing section. The Times on Friday had a health section, and the Guardian had environment, health and science and technology. The Times' health section is quite small in comparison to the other special sections which would account for the smaller number of articles present on Fridays as opposed to Thursdays. The Guardian computing section contains many, small articles, making Thursday stand out from the other days. It is possible that because their environment section deals more with social issues, and orientates its reporting in that direction, that low article numbers are recorded. Thus, even though Friday in the Guardian contained three sections as opposed to one on Thursdays, the former is seen as having more articles.

4.1.3 THE CONTENTS OF SPECIAL SECTIONS

Science and technology articles in special sections do not seem to differ from those in the general news in terms of heading status. In some sections, however, the mean length of articles is greater, and it is certainly never less than articles in the general news (see section 3.3.2). Special sections remove some of the constraints of strict event reporting and potentially could allow for more in-depth treatment of science and technology (6). This may be because editors feel that special sections are set aside for science and technology articles, and so there is more space available to expand the stories and add depth. In the rest of the paper science and technology are competing with a thousand other news items of the day, which would probably be considered more important by more people, although surveys have indicated that the public are becoming increasingly interested in science news. Thus, science articles are shorter when incorporated within the general news. Expanding articles with background or technical explanations, and, therefore, making articles longer, seems to be more prevalent in the Times than the Guardian. The difference in mean article length between special sections and the general news is more marked in the former than the latter. This may be connected with the aims and audience direction of the two papers, or the fact that the Times makes more space available for reporting than the Guardian.

Graphical representation of all subjects, in both papers, is less common in special sections than in the rest of the papers (see section 3.3.4) to varying degrees. The mean length of graphics in special sections is not significantly different to the mean length of graphics in the rest of the paper (see section 3.3.5). So, it is not the case that fewer graphics are being used in special sections, but that they are generally larger. The technology is available to produce larger graphics, at a satisfactory resolution. The ability of newspapers to reproduce illustrations has paralleled the scientists' use of illustrative material (7), but this does not seem to have been exploited yet in any part of the paper. This may be because the scientific fields which are concentrated into the sections, for example computers, are not very photogenic. Graphics not in special sections have not increased significantly in length over time either (see section 3.1.7). There has, however, been a large increase over time in the number of graphics present throughout the papers (see section 3.1.6). So, as with time, graphics became easier to incorporate into text, newspapers took the opportunity and used them to add interest and importance to articles (8). It may be that the optimum size for graphics in any section has been reached, and so to look for a further increase in size is misguided. Special sections are still very new on the newspaper scene this time around (the Times ran a successful engineering section earlier in the century), and this may be why they have not yet felt the full benefits of graphics technology. In their infancy, special sections are still being moulded and changed. Obviously, text must come before graphics at the outset, so possibly once the sections are better established, an increase in the use of graphics will be seen.

4.1.4 THE REPORTING OF SUBJECTS WITHIN SCIENCE AND TECHNOLOGY

The percentage of all science and technology reporting which is devoted to each particular subject, varies with time and with subject (see section 3.2.1). Some areas of science and technology have never been considered as newsworthy as others. Examples of subjects which receive a relatively small amount of coverage are science policy, earth sciences, chemistry, physics and engineering. Science policy coverage probably varies with events which capture the public's attention, such as food safety scares and cuts in research funds. Even when these stories are at the centre of discussion, the number of science policy articles written is still very low. Earth sciences, chemistry, physics and engineering do not have the "human appeal" which is necessary to make a subject popular enough for mass coverage. They do not have a "popular level" to which the general public can relate. There is more of a balance with other, more popular subjects than there would be in a tabloid paper, which covers mainly health and medical issues (9). Physics and chemistry especially, are regarded as being mainly theoretical, with no immediate bearing on everyday life. In contrast, medicine, biology, and now computing and environmental science, are seen as impinging on daily events (10). The living world is something which everyone knows something about, so immediately they are more inclined to want to know more. This is especially true of medical and health articles, which people may be reading for a specific, personal reason, not just for information value (11). This type of attitude extends naturally to more general, biology oriented articles. These two subjects are characterised by comprising roughly the same percentage of all science and technology articles in 1989 and 1990 as they did in 1974 and 1975. They are perennial topics which withstand the test of time (12).

Computing and information technology have been developed, and are being developed, at a phenomenal pace. Consequently, many people now come into contact with computing technology at some time, either at work, or increasingly, in their own homes. So, as with health information, people want to read about computing, not only for the information value, but also possibly to help them with a practical problem they have with a computer they own. This integration of computers into life has occurred largely within the last fifteen years, and this is reflected in the increased percentage of computing/IT articles in 1989 and 1990 as compared to 1974 and 1975. This is especially true of the Guardian, possibly because the audience of the Guardian is younger than that of the Times, and more likely to own a home computer, or use one extensively at work.

Environmental science is a subject which many consider to be new. This is not, of course, the case as the management of the environment has been ongoing for centuries, firstly in agriculture and then also in industry. It is only recently that the flaws in our management have been noticed and examined, and brought to the attention of more people. The Times reflects this increased awareness with a large increase in the amount of environmental science articles over time. In 1974 and 1975 the Guardian science and technology news contained a higher percentage of environmental science articles than did the Times, but the reverse is now true. The Guardian has not increased its environmental science reporting. This appears to go against the flow of interest in the subject, and conflicts with the presence of a special environment section in the Guardian. Having examined this section, this anomaly appears to be due to the fact that most of the articles are not scientific in their orientation, but are more concerned with the social and policy implications of environmental affairs. As a result, this study did not consider many of the articles to be "science" as defined at the outset, and so they were excluded. Previous studies have found that articles expounding purely scientific information with no social input, are quite rare (13). A more detailed examination of the changing face of environmental news would be needed to fully expand this point.

The final subject for discussion is space/astronomy. This was a very popular topic in the 1970s as man had just landed on the moon, and both the American and Russian space programmes were being expanded (14). Probes were being sent to planets which man had never envisaged being able to see, except through a telescope, and sensational pictures and discoveries were being made. This popularity again, is reflected in the percentage of science and technology articles on the subject. Space was the most well covered of the science subjects in the Guardian, and second only to medicine in the Times. It was destined to become a victim of fashion (15), falling behind medicine, biology, environmental science and computing/IT in 1989 and 1990. Attitudes to space exploration have changed over time. Many people see it as a waste of tax payers money, and find it hard to see the benefits, either long-term or more especially, short-term, and so space stories have taken a back seat. It may be that in the future we find that environmental science or computing are the fashion subjects of the nineties, and experience fluctuations in relative attention (16). Future studies of the evolution of science reporting will hopefully reveal that.

This discussion highlights the fact that science and technology is by no means a homogeneous group (17). Different subjects have their place in a hierarchy, which changes with time. This is a common situation which has been seen in other subject areas, for example, the social sciences (18)It is interesting to note, then, that the change in mean length of articles in different subjects, in the whole of the paper, was only significant for medicine, environmental sciences, space/astronomy and science policy in the Times, and biology in the Guardian. Articles in these subjects increased in length. Articles in the Times are generally longer than those in the Guardian, and the same theories as to why this should be, apply. A comparison of science and technology articles with those in the general news, would indicate whether the overall stability of article length (that is to say, no significant change in a majority of subjects) is unusual or not. It is possible that the small number of significant increases are the beginning of a trend which will expand in the future into the other subjects which make up science and technology, such as chemistry and physics. Special sections may be giving science writers the opportunity to write more lengthy pieces, leaving science articles in the main body of the paper more oriented toward short-term, brief, news stories and topical events. The balance of reporting between general news section and special sections will determine whether the mean length of all articles increases or not. A detailed comparison between science news and general news, such as the one begun by Hinkel & Elliott on science coverage in newspapers and magazines (19), could yield interesting results.

The suggestion that some subjects are given more importance than others, is not reinforced if one looks at the heading status of each subject (see section 3.2.5), or the graphical representation (see section 3.2.7). Over time many subjects become represented by a small number of headline articles, but there are also noticeably more minor headed articles in the same subjects. This suggests that there is not an overall increase in the status of science and technology, or any one subject within that discipline, but that it is becoming a more recognised area for reporting frequently, in newspapers. Again a comparison with the status and treatment of other subject areas would show whether or not this was the case. Most subjects experienced an increase in the proportion of articles carrying graphics, indicating that they have all had a similar rise in status. However, chemistry and physics had no graphics in the Guardian in any of the years studied, and the only subjects to experience any significant increase in graphical representation were medicine, biology and space/astronomy. Again, graphics are not getting any larger. This is an indication that not all subjects are treated equally, but that the gap between subjects is not widening.

It is possible, that rather than being a minority area, as it was in the past, science and technology is becoming more like the rest of the news. In contrast, science and technology may be moving past general news reporting to gain the best of both worlds: a higher profile in the news of the day and special sections for more in depth articles. If the latter suggestion is correct, then it should be possible to see a shift in the page distribution of some subjects, to the front of the papers for a higher profile, and the back for an expansion of the special sections (see section 3.2.4). It seems that there is a move into the special sections, with many more articles appearing on the latter pages of both papers examined. Subjects such as physics, chemistry and engineering, have so little coverage at any time, that their distribution should be treated with caution. When only one or two articles appear in any one subject, as is the case with physics, chemistry and engineering, trends which do not really exist, appear to be developing.

There does not seem to be a corresponding increase in the reporting of science and technology as general news (see section 3.2.6.). There are no significant increases in either paper, in the amount of reporting of any subject, in the general news section. It may be that even though editors, writers, and indeed readers, are more aware of science and technology, (or at least its more popular sub-sections), the opportunity to report it in the general news just does not occur as often as it does for other subjects. Political changes which people want to hear about, are happening all the time. Current affairs, as the name implies, need to be reported quickly or they are no longer newsworthy. Science is a slower, cumulative process, in which stunning breakthroughs are not commonplace. The slight move toward headline science and technology articles may indicate that when breakthroughs do occur, they are given more prominence than they formerly would have been, but the data gathered here is not specific enough to conclude any further. The overall fall in the amount of reporting in general news, which seems to coincide with the advent of special science sections, may be the start of a move toward moving all science and technology into special sections, over an extended time scale. As with business and financial sections, articles may only overflow into the general news when they are particularly important.

Certainly, looking at the day distribution of each subject, the more popular areas of science and technology are moving to the days when special sections are printed (see section 3.2.3). Different subjects move to different days according to where the different special sections are located. This move is less clear in the subjects which are rarely covered, such as chemistry, physics, engineering, earth sciences and science policy. Very few articles appear, making it look as though these subjects are attached to certain days, when there is no logical explanation for the link. It is also notable, that medicine has such wide appeal, that it is quite often reported in general news as well as special sections. Computing is one area which, especially in the Guardian, is more clearly located on a day with a computing section. This may be because it is considered a very specialised area now. Many of the articles are filled with technical and computer jargon, so possibly the articles are not considered to have the right angle for general news. Computing articles may move to the general news when they are linked with something else, such as a financial story or a medical advance.

The content analysis between medicine and space/astronomy showed that medicine articles were generally more negative, and space/astronomy articles were generally more positive in 1974 and 1975 (see section 3.2.9). In 1989 and 1990 this trend had been reversed. This indicates how the attitude of newspapers towards different subjects varies as events happen within these areas. Space/astronomy has undergone a reversal of fortune and this is reflected in the balance of article attitudes. It is interesting to note that the Guardian was more negative toward space/astronomy than the Times, in 1974 and 1975, and totally negative in 1989 and 1990. Does this indicate the unwillingness of the Guardian, given its liberal background, to be overtly in favour of events such as space launches, which have an aura of nationalism. In contrast, both papers have shown a swing towards being more positive about medicine. This may be because the emphasis today is more on self-help and healthy living, rather than the shortcomings of medical research, although this is still a hotly contested area. An analysis of the origin of quotes in both subjects (see section 3.2.10) shows that specialist have always been most popular in Times' medical articles, whereas the Guardian began by using more generic quotes ("a spokesman said...") but in 1989 and 1990 used more quotes from specialists. It is possible that this move has been facilitated by the increased awareness and knowledge of the newspaper audience. A personally attributed quote from a named specialist may be expected now, to give credence to a story, whereas a more vague, generic quote would have sufficed in 1974 and 1975. Also, medical stories often have an element of controversy, so quotes help to present several sides of an argument (20). Both papers have shown a slight increase in the number of layperson quotes, possibly indicating a slight rise in the number of stories giving case histories, or naming patients. This is usually more common in the tabloid press. The situation for space/astronomy is less clear, with the Times moving from a spread of specialist, layperson and generic quotes, to more specialists, and the Guardian moved the other way, from more specialist to more generic quotes. This may be an indication that there is no real direction or evolution to the reporting of space/astronomy stories at the moment. The negative stance of the papers together with a fall in overall reporting may corroborate this theory. The final part of the content analysis looked at the number of acronyms and technical terms used (see section 3.2.11). Generally speaking, the approach toward writing space/astronomy articles has become less technical over time in the Guardian, but is virtually unchanged in the Times. The Times was less technical than the Guardian in 1974 and 1975, but in 1989 and 1990 the opposite was true. Medical articles have become more technical over time, in both papers. Again, the Times started off being less technical than the Guardian, but in 1989 and 1990 they were virtually equal. Acronyms were far more widely used in medical articles in 1989 and 1990 than they were in 1974 and 1975. Medical articles used more acronyms than space/astronomy articles in most of the years studied, with the difference being greatest in 1989 and 1990. The use of acronyms in space/astronomy was low in all years and increased very little over time. It is already known that the readership of the quality papers are often of a higher socioeconomic group than the readership of the tabloid papers, and so they may be expected to have a higher degree of technical knowledge. This may explain the rise in technical terms in medical articles. The writers and editors are more aware of the increased knowledge of their audience and respond by supplying them with technical information. Also, in special sections there is more room to include this type of information. Another possible contributing factor is the way medicine, or at least 'popular health' itself, is evolving. Technical jargon is always a part of any science (21), but over the last few years the tendency to ascribe acronyms and codes to everything has become more obvious, especially in the medical field. Also, many of the articles examined dealt with the AIDS crisis, which is being expanded so fast, that acronyms, abbreviations and new (and therefore technical) words are appearing almost daily. Space/astronomy on the other hand, has not seen breakthroughs of that nature since the late sixties and early seventies. At that space/astronomy articles were more technical than their medical counterparts, but the articles have fallen behind as the subject itself loses in the popularity ratings.

REFERENCES

1. FRIEDMAN, S., S. DUNWOODY & C. ROGERS, eds. *Scientists and journalists. Reporting science as news*, 1986, p. xii.

2. KRIEGHBAUM, H. *Science and the mass media*, 1986, p. 73.

3. CARTER, M.D. *An introduction to mass communications. Problems in press and broadcasting*, 1971, pp. 72-74.

4. MEADOWS, A.J. & M.M. HANCOCK-BEAULIEU. The selection of scientific information by the mass media. In press, 15.

5. WEISS, C.H. & E. SINGER. *Reporting of social science in the national media*, 1988, pp. 183-184.

6. ENTWISTLE, V. & M.M. HANCOCK-BEAULIEU. Health coverage in the quality and popular press in the UK. *Proceedings of the International Conference on Public Communication of Science and Technology*, 1991, 16.

7. MEADOWS & HANCOCK-BEAULIEU, ref. 4, 16.

8. UBELL, E. Science in the press: newspapers vs magazines. *Journal of Communication*, 1963, **40**, 298.

9. HINKEL, G. & W.R. ELLIOTT, Science coverage in three newspapers and three supermarket tabloids. *Journalism Quarterly*, 1989, **66**(2), 358.

10. *Ibid.*, 356.

11. JONES, G., I. CONNELL, & A.J. MEADOWS. *The presentation of science by the media*, 1978, p. 4.

12. *Ibid.*, p. 25.

13. *Ibid.*, p. 3.

14. KRIEGHBAUM, ref. 3, p. 67.

15. *Ibid.*, pp. 76-78.

16. MEADOWS & HANCOCK-BEAULIEU, ref. 4, 4.

17. JONES *et al.*, ref. 11, p. 27.

18. WEISS & SINGER, ref. 5, pp. 188-189.

19. HINKEL & ELLIOTT, ref. 9.

20. WEISS & SINGER, ref. 5, pp. 43-44.

21. JONES *et al.*, ref. 11, p. 26.

CHAPTER 5

CONCLUSION

This survey sought to collect data which would indicate how science and technology reporting in the Times and the Guardian, changed, between 1974 and 1975, and 1989 and 1990. Several aspects of reporting were examined, and the subsequent analysis illustrated developments with time and also the degree of similarity between the two papers chosen, and the subjects which comprise science and technology. The conclusions, based on these broad comparisons, are as follows:-

1) The attitude of the two newspapers toward science and technology has changed, such that the ratio of reporting to space available, has increased. How this compares with the reporting of other subjects, (for example sport, politics or general news), requires further investigation.

2) Science and technology reporting has changed over time in several respects:- i) the relative balance of subjects within science and technology has altered.

ii) the introduction of special sections and the movement of articles in to these sections.

iii) the increased use of graphical representation in all subjects. This has increased mainly as a result of the introduction of more photographs. A more detailed analysis of graphical representation in newspapers remains to be done.

iv) the relative page and day location of science and technology articles has altered. There was a closer relationship between article number and location in 1989 and 1990 than there was in 1974 and 1975.

3) Science and technology has remained largely unchanged over the time scale in some respects:-

i) the mean length of articles, in most subjects, has not changed significantly.

ii) the mean length of graphics, in most subjects, has not changed significantly.

iii) headings on articles were mainly subheadings and this was still the case in 1989 and 1990.

4) Special science and technology sections have been introduced into both papers, and they are affecting the way in which some science and technology subjects are being reported.

5) The content of articles varies with subject, time of writing and paper of origin. This is shown for article attitude, balance of quotes and the use of technical terms and acronyms.

6) Science and technology is not treated as a homogeneous whole by newspaper reporters and editors. Some subjects are more popular and receive more attention. Fashion or public tastes, could be one of the factors which alter the treatment of subjects with time.

7) Even though the _Times_ and the _Guardian_ are both considered to be quality publications, they often have different attitudes to science and technology and how it is reported. This may stem from their different reporting aims and philosophies.

BIBLIOGRAPHY

BERELSON, B. *Content analysis in communication research.* New York: Hafner, 1971.

BOSTIAN, L.R. How active, passive and nominal styles affect readability of science writing. *Journalism Quarterly*, 1983, **60**, 635-640.

BROWN, H. *The wisdom of science, its relevance to culture and religion.* Cambridge: Cambridge University Press, 1986.

BUDD, R., R. THORP & L. DONOHEW. *Content analysis of communications.* New York: Macmillan, 1967.

CARTER, M.D. *An introduction to mass communications. Problems in press and broadcasting.* London: Macmillan, 1971.

COHN, V. *News and numbers. A guide to reporting statistical claims and controversies in health and other fields.* Iowa: Iowa State University Press, 1989.

DAVIES, R. & L. SKLAIR. *Science and technology coverage in four British newspapers, 1949-1969.* London: LSE, 1972.

ENTWISTLE, V. & M.M. HANCOCK-BEAULIEU. Health coverage in the quality and popular press in the UK. *Proceedings of the International Conference on Public Communication of Science and Technology.* Madrid: Consejo Superior de Investigaciones Cientificas, 1991.

FARAGO, P. *Science and the media.* London: Oxford University Press, 1976.

FRIEDMAN, S.M., S. DUNWOODY & C.L. ROGERS, eds. *Scientists and journalists.*

Reporting science as news. New York: The Free Press, 1986.

GASTEL, B. Presenting science to the public. Philadelphia: ISI, 1983.

HINKEL, G. & W.R. ELLIOTT. Science coverage in three newspapers and three supermarket tabloids. *Journalism Quarterly*, 1989, **66**(2), 353-358.

JONES, G., I. CONNELL, & A.J. MEADOWS. *The presentation of science by the media.* Leicester: Primary Communications Research Centre, 1978.

KING, J. An input-output study of science news in the press. *Australian Journalism Review*, 1986, **8**(1/2), 50-58.

KRIEGHBAUM, H. *Science and the mass media.* London: University of London, 1986.

KRIPPENDORF, K. *Content analysis. An introduction to its methodology.* Beverley Hills: Sage Publications, 1985.

KRISTIANSEN, C.M. & C.M. HARDING. A comparison of the coverage of health issues by Britain's quality and popular press. *Social Behaviour*, 1988, **3**, 25-32.

LOGAN, R.A. Events, contexts and conflicts: a content analysis of the Los Angeles Times and the New York Times' reporting of science and biomedicine. *Proceedings of the International Conference on Public Communication of Science and Technology.* Madrid: Consejo Superior de Investigaciones Cientificas, 1991.

MEADOWS, A.J. Quantitative study of factors affecting the selection and presentation of scientific material to the general public. *Scientometrics*, 1991, **20**, 113-119.

MEADOWS, A.J. & M.M. HANCOCK-BEAULIEU. The selection of scientific information by the mass media. In press, 1-20.

MILLER, S. *Experimental design and statistics.* 2nd ed. London: Methuen, 1984.

NELKIN, D. *Selling science: how the press covers science and technology.* New York: Freeman, 1987.

NUNN, C.Z. Readership and coverage of science and technology in newspapers. *Journal of Communication*, 1979, **56**, 27-30.

POCKLEY, P. Communicating science to the skeptics. *Impact of Science on Society*, 1988, **38**(3), 219-229.

ROBERTS, C.W. Other than counting words: A linguistic approach to content analysis. *Social Forces*, 1989, **68**(1), 147-177.

SCHRAMM, W. *Mass communications.* Urbana: University of Illinois, 1969.

SOKAL, R.R. & F.J. ROHLF. *Biometry.* 2nd ed., San Francisco: Freeman, 1981.

SOLOSKI, J. News reporting and professionalism: some constraints on the reporting of news. *Media, Culture and Society*, 1989, **11**(2), 207-228.

THOMPSON, J.B. Mass communication and the modern culture: contribution to a critical theory of ideology. *Sociology*, 1988, **22**(3), 359-383.

UBELL, E. Science in the press: newspapers vs magazines. *Journal of Communication*, 1963, **40**, 293-299.

VAN DRIEL, B. & J.T. RICHARDSON. Print media coverage of new religious movements: a longitudinal study. *Journal of Communication*, 1988, **38**(3), 37-61.

WEBER, R.P. *Basic content analysis.* 2nd ed., Newbury Park, California: Sage Publications, 1990.

WEISS, C.H. & E. SINGER. *Reporting of social science in the national media.* New York: Russell Sage Foundation, 1988.

Willings Press Guide 1991. 117th ed., East Grinstead: Reed Information Services, 1991.

APPENDIX 1

Layout of the survey instrument.

PAPER 1. GUARDIAN 2. TIMES No........ CA

TITLE...

DAY 1. Mon 2. Tue 3. Wed 4.Thur 5.Fri 6.Sat

DATE..........................(day:month:year) **PAGE**................. **Column**...........

SUBJECT 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.

STATUS 1. major 2. subheading 3. minor 4. no heading

SECTION 1. general news 2. foreign 3. financial 4. science & technology

5. editorial 6. letters 7. political 8. miscellaneous 9. health

10. sport 11. computing 12. motoring 13. environmental

GRAPHIC 1. yes 2. no

No. column cm Article.....................................

No. columns Article..................................... Page..........................

No. column cm Graphic....................................

No. columns Graphic....................................

APPENDIX 2

Survey used to determine whether the technical terms identified by the experimenter were, in fact, technical in the eyes of a random group of people.

Thank you for agreeing to take part in this survey.

I am interested in people's opinions of certain words and phrases. Please look at each of the words/phrases in turn. If you think the word/phrase is technical, that is to say, specialised in its use and meaning, then place a tick ( ) in the box following it. If you think the word/phrase is not technical because it is used in normal, everyday communication, then place a cross ( ) in the box following it. If you are unsure whether the word/phrase is technical or not, then leave the box empty.

Here is an example;

TREE		FLOWER		MULTIPLEXER	
CHAIR		PHOTOSYNTHESIS		HAT	

Thank you for your help.

Here is your list of words...

PNEUMOCYSTIS CARINII		NEUROCHEMICAL PATHWAY		ANTIBODY/CELLULAR RESPONSE	
NUCLEAR REPROCESSING		REVERSE TRANSCRIPTASE		MULTIBAND OPERATION	
ELECTROLYTIC IMBALANCE		PLANETARY CONFIGURATION		TRACKING AND DATA RELAY SATELLITE	
INHERITED GENETIC DISORDER		GEOSYNCHRONOUS ORBIT		NEUROLOGICALLY IMPAIRED	
HUMAN IMMUNO-DEFICIENCY VIRUS		ENVIRONMENTAL EPIDEMIOLOGY		INFECTIOUS MONONUCLEOSIS	
EPILEPSY		AMMONIA		SUB-ORBITAL	
ZIDOVUDINE		PAEDEATRIC CARDIOLOGY		GYROSCOPE	
AFLATOXIN		GENETIC RISK		OCTUPOLE	
QUADRUPOLE		OXIDES		SPECTROGRAPH	
PANDEMIC		SPECIFIC		CLINICAL STATUS	
INHERITED DISORDER		HERPESVIRUS SAIMIRI		TRANSISTOR	
ACOUSTIC		SOLAR ORBIT		BURKITT'S LYMPHOMA	

DERIVATIVE	NEUROLOGY	ASPERGILLUS
CHEMICAL INHIBITOR	HEAVY METAL	BLOOD-BRAIN BARRIER
EPSTEIN-BARR VIRUS	HERPESVIRUS	POLARISATION
METABOLIC	PROTEASE INHIBITOR	INACTIVATED
X-RAY DENSITY	TRAJECTORY	PULSAR
SLOW VIRUS	BENZODIAZEPINES	MOLECULE
OXY-GAS	SODIUM	TRANSTERRIN
MUTAGENIC	MOLECULE	BIOAVAILABLE
KWASHIORKOR	LUNAR	SUPERNOVA
ELECTROMAGNETIC	POTASSIUM SALTS	CONGENITAL
ANTACID COMPOUND	CHROMOSOME	VARIANT
REFRACTED	IONISING	SCLEROSIS
PROTEASE	SALIVA	INOCULATED
PATHOLOGIST	SOLAR WIND	KAPOSI'S SARCOMA
HORMONE	ALZHEIMER	ISOTOPE
POLARIMETRY	ENZYME	LEUKAEMIA
ARGON	MAGNETOMETER	PNEUMONIA
CANCER CLUSTER	ALUMINIUM SULPHATE	TERRESTRIAL
SPECTRAL SIGNATURE	INFRARED RADIOMETRY	ANTI-VIRAL ACTIVITY
IMMUNE SYSTEM	GENETIC ENGINEERING	DIPOLAR
ANALOGUE	METHANE	RENAL DIALYSIS
BIOCHEMISTRY	MAGNETOSPHERE	RETROVIR

APPENDIX 2a

List of technical/specialised words/phrases identified as part of the content analysis. At least 50% of the survey respondents identified these terms as being technical.

MEDICAL	SPACE/ASTRONOMY
PNEUMOCYSTIS CARINII	MULTIBAND OPERATION
NEUROCHEMICAL PATHWAY	PLANETARY CONFIGURATION
ANTIBODY/CELLULAR RESPONSE	TRACKING AND DATA RELAY SATELLITE
ANTI-VIRAL ACTIVITY	GEOSYNCHRONOUS ORBIT
NUCLEAR REPROCESSING	MAGNETOMETER
REVERSE TRANSCRIPTASE	SUB-ORBITAL
ELECTROLYTIC IMBALANCE	MAGNETOSPHERE
NEUROLOGICALLY IMPAIRED	OCTUPOLE
HUMAN IMMUNODEFICIENCY VIRUS	QUADRUPOLE
ENVIRONMENTAL EPIDEMIOLOGY	SPECTROGRAPH
INFECTIOUS MONONUCLEOSIS	SPECTRAL SIGNATURE
ZIDOVUDINE	X-RAY DENSITY
PAEDEATRIC CARDIOLOGY	INFRARED RADIOMETRY
AFLATOXIN	PULSAR
GENETIC RISK	OXY-GAS
OXIDES	DIPOLAR
PANDEMIC	SUPERNOVA
SPECIFIC	REFRACTED
INHERITED DISORDER	IONISING
HERPESVIRUS SAIMIRI	SOLAR WIND
BURKITT'S LYMPHOMA	POLARIMETRY
GENETIC ENGINEERING	

RENAL DIALYSIS
ALUMINIUM SULPHATE
CHEMICAL INHIBITOR
RETROVIR
BLOOD-BRAIN BARRIER
EPSTEIN-BARR VIRUS
HERPESVIRUS
PROTEASE INHIBITOR
INACTIVATED
SLOW VIRUS
BENZODIAZEPINES
TRANSTERRIN
MUTAGENIC
BIOAVAILABLE
KWASHIORKOR
CONGENITAL
ANTACID COMPOUND
CHROMOSOME
VARIANT
PROTEASE
KAPOSI'S SARCOMA
ARGON
CANCER CLUSTER
ASPERGILLUS

APPENDIX 3

Column format of SuperCalc 5 spreadsheets. All data was entered in code or the actual number, as with number of columns or lengths.

Column 1 = newspaper
Column 2 = running number
Column 3 = day
Column 4 = time zone
Column 5 = year
Column 6 = month
Column 7 = page
Column 8 = subject
Column 9 = status
Column 10 = section
Column 11 = graphic Y/N
Column 12 = article length
Column 13 = columns covered by article
Column 14 = columns on page
Column 15 = graphic length
Column 16 = columns covered by graphic
Column 17 = actual article length
Column 18 = actual graphic length