CHAPTER 1: General introduction

Machine translation is the application of computers to the translation of texts from one natural language into another.

There have been many different reasons for attempting it. The principal reason is a severely practical one: scientists, technologists, engineers, economists, agriculturalists, administrators, industrialists, businessmen, and many others have to read documents and have to communicate in languages they do not know; and there are just not enough translators to cope with the ever increasing volume of material which has to be translated. Machine translation would ease the pressure. Secondly, many researchers have been motivated by idealism: the promotion of international cooperation and peace, the removal of language barriers, the transmission of technical, agricultural and medical information to the poor and developing countries of the world. Thirdly, by contrast, some sponsors of machine translation activity have seen its importance in military and intelligence contexts: to help them find out what the 'enemy' knows. Fourthly, there are 'pure research' reasons: to study the basic mechanisms of language and mind, to exploit the power of the computer and to find its limitations. Finally, there are simple commercial and economic motives: to sell a successful product, or to maintain a high standard of living in a competitive world.

At certain periods in the nearly forty years of the history of machine translation, some of these motives have been more prominent than others. In the United States during the 1950's and 1960's fear of Soviet technological prowess (particularly after the launch of the first sputnik in 1957) stimulated much governmental and military support for Russian-English translation. In the 1970's the mulitlingual problems of the European Communities encouraged research on translation systems to deal with administrative, economic and technical documentation within the languages of the communities. At the same time, commercial interests began to gather pace. In the 1980's the Japanese 'fifth generation' project, in which machine translation plays an important role, has been launched to establish for Japan a major position in the future world economy. Throughout, however, there have always been researchers motivated by idealism and by scientific curiosity, and there have been sponsors willing to support basic research.

Machine translation was one of the first non-numerical applications of computers. For more than a decade until the mid 1960's it was an area of intensive research activity and the focus of much public attention; but early expectations were not fulfilled, promises of imminent commercially viable systems came to nothing, and the problems and linguistic complexities became increasingly apparent and seemed to be ever more intractable. After a widely publicised report compiled for the major US sponsors, the 'notorious' ALPAC report (ch.8.9), machine translation was generally considered to have been a 'failure', and no longer worthy of serious scientific consideration.

Critics and sceptics have been fond of repeating alleged mistranslations, howlers which no human translator would perpetrate, in order to ridicule the whole enterprise. The most popular example has been a story involving the translation of two idioms from English into Russian and then back again from Russian into English: *Out of sight, out of mind*, and *The spirit is willing but the flesh is weak*. According to some accounts the first came back as "invisible insanity" and the second was as "The whiskey is all right but the meat has gone bad"; according to others, however, the versions were "Invisible and insane" and "The vodka is good but the meat is rotten"; and yet others have given "invisible lunatics" and "the ghost is willing but the meat is feeble". There have been various other permutations and variants; such variety is typical of hearsay, and indeed, some accounts give the languages as German and English, and others assert they were Chinese and English. Nevertheless, the supposed translations are repeated to the present day as genuine examples of the 'literal-mindedness' of machine translation.

It would seem that a likely source was an article by John A.Kouwenhoven 'The trouble with translation' in *Harper's Magazine* for August 1962:

> Our own attempts to communicate with the Russians in their language may be no more successful. Thanks to Robert E. Alexander, the architect, I can pass along this cheering bit of news. According to Colonel Vernon Walters, President Eisenhower's official interpreter, some electronic engineers invented an automatic translating machine into which they fed 1,500 words of Basic English and their Russian equivalents, claiming that it would translate instantly without the risk of human error. In the first test they asked it to translate the simple phrase: "Out of sight, out of mind." Gears spun, lights blinked, and the machine typed out in Russian "Invisible Idiot." On the theory that the machine would make a better showing with a less epigrammatic passage, they fed it the scriptural saying: "The spirit is willing, but the flesh is weak." The machine instantly translated it, and came up with "The liquor is holding out all right, but the meat has spoiled."

It is a good story, but its superficial plausibility is damaged by the lack of any evidence of a US system at the time which could translate from English into Russian – for obvious reasons the Americans wanted to translate from Russian into English – and by the discovery that both examples were familiar apocrypha of translation before there were any machine translation systems in operation. For example, in April 1956, E.H.Ullrich was reported as saying:

> Perhaps the popular Press is the most attractive outlet for mechanical translations, because it does not really matter whether these are right or wrong and amusing versions such as 'the ghost wills but the meat is feeble' might make mechanical translation into a daily feature as indispensible as the cross-word puzzle. (Ullrich 1956)

From the mid-1960's research on machine translation continued at a reduced level, largely ignored and forgotten not only by the general public but even by linguists and computer scientists. In recent years, however, the situation has changed. There are now operational systems in a number of large translation bureaux and agencies; computers are producing readable translations for administrators, scientists, and technicians at ever increasing volumes; translation systems are being marketed on a commercial basis for microcomputers; many translators are now becoming familiar with machine translation systems and with machine aids; and there is growing scientific interest in machine translation within the Artificial Intelligence community in the United States, in Japan and elsewhere. Machine translation can no longer be dismissed, it is a reality.

With distant memories of the 'failure' of machine translation in the 1950's and 1960's and supported by apocryphal translation horrors, there are still many who do not believe that computers can translate. It is true that few systems would pass the 'Turing test' by producing translations which could never be distinguished from the output of fluent human translators (Turing 1950). This book contains numerous examples of translations produced by computer programs: some are clearly unacceptable texts by whatever criteria, others however are the equal of some human translations and would not be readily identified as computer renditions. The question of how good machine translation should be in order to qualify as 'true' translation is a particularly thorny one, and still not really resolved. What matters in most cases is whether the translation serves the needs of the recipient: a rough translation (human or machine produced) might be quite adequate on some occasions; on others only a 'perfect' finished version is acceptable. Judgments of quality are necessarily both subjective and highly constrained by

personal needs and attitudes.

What is probably most surprising to those unfamiliar with the complexities of machine translation are examples of errors which no human translator, however inexperienced, would ever make. A genuine, not apocryphal, howler from the Systran system (12.1 and 14.1 below) is cited by Wheeler & Lawson (1982): "la Cour de Justice considère la création d'un sixième poste d'avocat général" was rendered as "the Court of Justice is considering the creation of a sixth general avocado station".

Such examples are reassuring; there is no fear of being taken over by computers - and these fears are real among some translators. This book will show that machine translation is not a threat, it is not an insidious dehumanising destructive monster, it is not (in the words of Hays 1967) "Golem astride the Tower of Babel". Machine translation should be seen as a useful tool which can relieve translators of the monotony of much technical translation and spare them from the wasteful expenditure of much tedious effort on documents of ephemeral or marginal interest. Translators can then be employed where their skills are most wanted, in the translation of sensitive diplomatic and legal documents, and in the translation of cultural and literary texts.

The term 'machine translation' has now established itself as the general accepted name for any system which uses an electronic computer to transform a text in one language into some kind of text in another natural language. The related term 'machine-aided translation' to designate the use of mechanized aids for translation has likewise established itself, by and large, as the generally accepted term. Researchers and writers have commonly used also the alternative terms 'mechanical translation' and 'automatic translation', but these are now more rarely encountered. For many writers the phrase 'mechanical translation' suggests translation done in an automaton-like (i.e. uncontemplative) manner by a human translator; and this has been the primary reason for the dropping of this term. While in English-speaking countries the use of 'automatic translation' has generally been much less common than 'machine translation', this nomenclature is the only possibility for the French and Russians ('traduction automatique' and 'avtomaticheskii perevod') There is no straight equivalent for 'machine translation'. German, however, is like English: both 'maschinelle' and 'automatische' are acceptable qualifiers of 'Sprachübersetzung' (language translation), and both forms are encountered. In the earlier periods there was often talk of 'translating machines' (French: 'machines à traduire'), but since the realisation that computers do not have to be designed specifically to function as translators this usage has died away. In recent years there has been increasing use of the terms 'computer translation' and 'computer-aided translation' - terms which are certainly more accurate than 'machine translation' and 'machine-aided translation' – but in this book the traditional, long established, and still most common term 'machine translation' will be used, abbreviated throughout in the customary way as MT.

A number of other common terms need also to be defined at the outset. Firstly, it has now become accepted practice to refer to the language from which a text is being translated as the 'source language' (abbreviated as SL), and the language into which the text is being translated as the 'target language' (TL). Secondly, there are now commonly accepted terms for the processes involved: 'analysis' procedures accept source language texts as input and derive representations from which 'synthesis' procedures produce or generate texts in the target language as output. These processes may involve various aspects of language structure: 'morphology' is concerned with the inflectional forms and derivational variants of words or lexical items, 'syntax' is concerned with the ways in which words combine in sentence structures, and 'semantics' is concerned with meaning relationships among sentences and texts. Other terms will be introduced and defined as they arise.

Between fully automatic translation on the one hand and human translation on the other there are a number of intermediate possibilities where there are various kinds of collaboration

between man and machine. The intervention can take place before, during or after the machine processes. There can be human preparation of input, or 'pre-editing' in the MT jargon; there can be (as there usually has to be) human revision of the output, or 'post-editing'. There can be collaboration during the translation processes, when a human assistant (usually a translator but not necessarily) may be asked by the computer to resolve problems which it cannot deal with. Finally, a translator may do most of the work alone and call upon the machine to assist with problems of terminology. We may then refer to: MT proper (fully automatic), MT with post-editing, MT with edited or restricted input, human-aided MT (interactive MT), machine-aided human translation, and human translation with no machine aids. This book is not concerned with the last two; it is concerned only with systems where a substantial portion of the translation process is carried out by machine. The dividing line between some interactive MT systems and machine-aided translation is blurred on occasions, but in most cases there is little dispute.

This book is a history and assessment of efforts to mechanize processes of translating from one natural language into another. Although it includes some details about the development of mechanized aids for translating, i.e. primarily automatic dictionaries of various kinds, it does not include aspects of natural language processing which are not directly concerned with the translation problem. Hence, although nearly all computational linguistics, natural language processing in Artificial Intelligence and certain approaches to automatic indexing and abstracting have their origins in MT research, these 'offshoots' of MT will not be covered (except for passing references in the early stages of MT research.) Obviously, the field has to be restricted in some way. The consequence of this restriction is that methods of potential relevance to MT problems will not be dealt with in any detail if they have not in fact been applied in any MT system. Likewise research which may have been seen at one time as of potential relevance to MT but which in fact did not lead to any kind of MT system will be ignored by and large. Another area which must be excluded for obvious reasons is the development of computer technology and programming, except where these developments have direct bearing on particular features of MT systems or MT research methodology. In brief, this book aims to be restricted exclusively to developments in machine translation.

Inevitably, this account has been written from a 'Western' perspective. An attempt has been made to be as comprehensive as possible and to be as balanced as possible in the evaluation of the contributions of the many MT projects in the forty years' history of MT research. However, the literature is both voluminous and multilingual; access to documentation is frequently difficult, and for personal reasons some foreign language material is inaccessible. For those aspects which have been less well treated than they should have been in a truly comprehensive account of MT and its history, the bibliography should guide the interested reader to the relevant literature. Basic sources are given in sections 3.11 and 9.7 below.

The next chapter deals with the earliest history of MT from its beginnings just after the Second World War to the mid 1950's. Chapter 3 outlines some basic methods and strategies found in MT systems. The following four chapters describe individually the MT projects up to the mid 1960's when much of the impetus of MT research was halted by the notorious ALPAC report. The circumstances leading up to this event and its subsequent effects are dealt with in chapters 8 and 9. The following chapters describe the MT projects from the mid 1960's to the present day. The final chapter includes a brief summary of the present scene and considers some future possibilities.