It may seem obvious that one understands the utterance of a novel sentence because one knows the meanings of the words contained in it and, in some sense, knows a rule for determining the meaning of the sentence on the basis of its syntax and the meanings of its words. (p. 179)

Nevertheless, he argues that the evidence for a compositional truth-theoretic semantics is pretty glib, because one can give a correct model of language understanding and productivity without assuming a compositional truth-theoretic semantics.

In the seventh chapter of the book he suggests a counterexample to the compositional view about language understanding. He describes a possible world in which a human computer, Harvey, understands a language E, as complex as English. The author analyzes Harvey's comprehension of some sentences and he draws a picture in which heuristic tools, such as the 'conceptual roles' of some expressions of Harvey's neural language of thought, allow him to show that "there could be a correct psychological model of a person's language processing that does not presuppose a compositional semantics for the mastered language" (p. 205).

But one might object that if compositional semantics is not needed in order to account for language understanding, it is needed in order to explain what Schiffer calls "the platitude", i.e., the idea that the meanings of sentences are determined by their syntax and the meanings of their words. In Chapter 8, Schiffer argues against this objection by introducing other heuristic notions, such as the "saying-potential" and the "processing role" of linguistic expression. In the sentence "Michel believes that his car was stolen", the word "believes" has a processing role that determines its saying potential each time the word is used. "Believes" is a semantic primitive, "but it is not a semantic primitive in any sense appropriate to a compositional semantics, for no base axiom, no satisfaction clause, can be written for 'believes' that could take its place in a true truth theory for English" (p. 216).

Schiffer does not want to deny all the aspects of semantic compositionality, nor that natural languages contain truth-affecting iterative devices (p. 208). What he denies is the relevance of truth-theoretic semantics to an account of language understanding and productivity. He denies that something like analytic philosophy is possible, but in the meantime he suggests that the compositionality of natural language should be explained via cognitive models of linguistic behaviour. At the very end of his book, he seems to set up an alliance with cognitive science in order to explain facts about language which do need explanation. They are facts about language comprehension, about the ways in which we store, represent, and process information. But, Schiffer says, these "are not philosophical questions (although the skills of the philosopher would be relevant to answering them)" (p. 271).

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MACHINE TRANSLATION TODAY: THE STATE OF THE ART (PROCEEDINGS OF THE THIRD LUGANO TUTORIAL, APRIL 1984)

Margaret King (ed.)
(Institute for Semantic and Cognitive Studies, University of Geneva, Switzerland)

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It is always regrettable when the proceedings of conferences appear a long time after they were held, in this case nearly four years, but it is even more so in a rapidly changing field such as machine translation (MT). Developments since this MT tutorial was organized by the Dalle Molle Institute for Semantic and Cognitive Studies (ISSCO) in early 1984 mean that many of the contributions have now predominantly historical interest. They are, however, no less valuable since many are accounts of MT systems which have not been bettered in comprehensiveness before or since. In keeping with its historical character and its originally-intended role as a general introduction to the state of the art in MT, the volume contains a mixture of historical surveys, discussions of linguistic and computational problems, and detailed descriptions of major systems. It does not include papers on practical implementations of MT systems, on comparative evaluations of MT output, or on the impact of MT on the translation industry. Some readers may regret their absence but the value of the collection lies precisely in its emphasis on the linguistic features of MT systems, and on the more theoretical aspects of MT research. Contributions have been divided into three sections: Part 1, containing essentially background papers; Part 2, devoted mainly to software; and Part 3, to accounts of particular MT systems.

Part 1 opens with two general historical overviews by Beat Buchmann covering MT history until the notorious ALPAC report in 1966, and by Susan Warwick on developments since 1966. Although necessarily brief,

both are reasonably balanced surveys summarizing what is now becoming fairly familiar territory for most MT researchers (but which may well not be for others). Buchmann describes the pioneer efforts of Troyanskii, Booth, Weaver, Reifler, and Bar-Hillel, the 1952 conference (raising issues that are "still important"), and evaluates the Georgetown-IBM 1954 experiment, Bar-Hillel's influential 1960 survey (seen in hindsight as "realistic" rather than wholly destructive), the growing disillusion with 'brute-force' methods and with early theory-oriented projects, and the ALPAC report itself; there are some minor inaccuracies and omissions (e.g., the Cambridge Language Research Unit and important Russian projects), but overall this is a sound survey of the early period. Warwick covers reactions to ALPAC, the development of the Systran and Logos systems (describing Logos incorrectly as a Vietnamese-to-English system), the university-based projects GETA, TAUM, METAL, etc., the emergence of the transfer design as an accepted standard (which seemed more true in 1984 than today), and the appearance of restricted systems (METEO, TITUS), interactive systems, and AI approaches.

The next four papers are concerned with the role of linguistic theory and artificial intelligence in MT research. On this issue there have been basically two views: on the one hand, that MT research pays insufficient attention to advances in linguistics and AI and its failures are attributable to this neglect; and on the other, that MT research needs to develop its own independent theory or theories, in which the proper application of linguistics, AI, computation theories, etc., can be judged and evaluated. The first view is coupled generally with advocacy of one particular theory; the second view is accompanied generally by an eclectic pragmatic approach to MT system design.

The early (pre-1966) debate is presented by Anne De Roeck in a paper that complements Buchmann's general historical survey examining the linguistic theories underlying MT projects in this period. However, she limits her discussion by excluding all direct systems ("unless an MT system incorporates at some stage a static representation which describes the text being translated it is difficult to assess what linguistic information has been used . . ."), all non-generative models (only generative grammars are held to be theoretically well founded), all "MT systems not explicitly concerned with syntax", and all pre-1955 activity (on the justifiable grounds that many MT pioneers were either ignorant of or antagonistic to current linguistics). After a brief account of the influence of information theory on Weaver and Yngve and of structural linguistics on the empiricist approaches of the RAND project, she concentrates on the influence of generative ideas: Bar-Hillel's early work on categorial grammar and Chomsky's transformational grammar. It is admitted that the influence of Chomsky was indirect (even at MIT the MT researchers were very critical of many aspects of TG

theory), and that the contribution of other theories—dependency and stratificational, in particular—was greater. There is a good outline of the linguistic framework of the CETA approach (at Grenoble), described as "generative in spirit". The conclusion, however, is that linguistic work in MT went on quite independently of linguistics, that MT research was often "violently opposed" to current theories, and that "in the period . . . the possible advantages to be gained for MT by reference to theories in linguistics ha[d] not really been exploited".

Eric Wehrli repeats this common criticism by linguists, viz., that MT fails to pay sufficient attention to developments in linguistic theory. He then proceeds to outline government-binding theory as a framework for MT systems. Whatever the merits of this or any other contemporary theory, MT researchers have to live with the long-term effects of commitments to particular linguistic theories—practically useful MT systems require many years of development, and researchers are naturally reluctant to implement theories that have yet to be fully tested and evaluated. There is a similar dilemma with advances in AI techniques. Patrick Shann illustrates the problems in a paper discussing the implementation of AI models and techniques in MT. There is a detailed and positive description of Wilks's preference semantics, an evaluation of Schank's use of scripts and MOPs and the problems of going beyond limited domains, and a description of experimental systems (SALAT and CON³TRA) using world-knowledge sources and inferential semantics. Shann concludes, however, that "existing AI techniques are not ready for large-scale MT systems", and that MT systems should apply AI methods as adjuncts to rather than replacements of existing techniques.

Geoffrey Sampson presents what he considers a "nonconformist" view, arguing that MT research has adopted a mistaken conception of the "problem of translation": it is aiming for "100% fidelity" and "perfectionism" when there can be no such thing in translation (it is an open-ended problem-solving task with no 'correct' solutions); hence, MT should be looking for techniques that give good results, not perfect ones. However, Sampson's criticism is misdirected: theoretical linguists and some researchers in AI and computational linguistics may well be seeking 'complete' solutions, but even a cursory examination of current MT efforts (including systems described in this volume) demonstrates that the perfectionist goal has long been abandoned in MT research; "interesting minor problems" are not the focus of MT research, but methods giving good results in the majority of cases. Sampson's own inclination is in the direction of statistical and probabilistic methods. Many MT researchers would probably agree that these have a place—however, not instead of, but alongside linguistic and AI techniques of various kinds.

The second part of the collection is devoted to MT

software needs. As in the first part, it is a mixture of background papers and discussions of major issues. Dominique Petitpierre defines some basic terminology, Jean-Luc Cochard outlines software architecture and chart parsing, and Alan Melby describes his now-familiar ideas about translation workstations. Christian Boitet then gives one of his usual masterly expositions of the research framework of GETA (Grenoble University), covering the aims and design of the multilingual ARIANE-78 system, the distinction between implicit (linguistic) and explicit (knowledge base) information, the advantages of multilevel interfaces, the development of "lingware" tools, workstations for linguist researchers, and the VISULEX tool for dictionary consultation and editing, the GETA contribution to the French National MT project, and the overall objectives of research at Grenoble: an "expert system for translation", not perfectionist, but concentrating on frequent 'damaging' errors of translation. (Boitet describes ARIANE-78 in this paper; although the basic philosophy remains, it should be noted that the latest version, ARIANE-85, incorporates a number of changes and modifications in both design and software.)

The final paper in Part 2 is by Rod Johnson and Michael Rosner on the objectives of MT software design. They argue convincingly that the aim should be the development of software tools enabling linguists (and others) to work on problems within relatively familiar, well-defined (theoretical) frameworks. But the difficulty is, as they point out, that MT is not a well-defined problem—in other words, MT lacks an independent theoretical framework.

The third part of the book, in size over half the total, comprises descriptions of current operational and experimental MT systems. In many respects it contains the most valuable contributions in this volume, because although many of the details may now have only historical interest, these descriptions are among the most comprehensive accounts of MT systems to be found anywhere. The richness of the contents of many of the descriptions can only be alluded to in this review—all will repay close reading by anyone at all interested in the problems and development of MT.

The first paper by Sophie Ananiadou is a survey of systems that are not treated in depth in the following chapters. Succinct and essentially accurate accounts are given of CULT, ALPS, Weidner, LOGOS, and TITUS. Next, Peter Wheeler provides what is probably the most definitive and detailed description of the linguistic foundations of Systran (still undoubtedly the most successful operational MT system), concentrating on the implementation in the European communities and particularly on the English-French and French-English versions (and saying nothing about the Russian-English system at USAF). It is followed by Heinz-Dieter Maas's equally detailed and equally definitive description of the influential SUSY system at Saarbrücken, which admirably illustrates the immense

(sometimes seemingly intractable) complexities of linguistic analysis and synthesis in MT systems.

The following contribution by Pierre Isabelle is a comprehensive history of the TAUM English-French project at Montreal, including the development of Q-systems, the successful design of the METEO system for the restricted domain of weather reports, and the AVIATION project for translating hydraulic maintenance manuals for aircraft (which failed ultimately because the system was too restrictive in range, but which did produce sophisticated methods for evaluating MT systems in general). Isabelle concludes his clear and honest account of this influential project with a valuable summary of the strengths and weaknesses of 'second-generation' MT systems (of which TAUM is an acknowledged exemplar) and of the continuing importance of the sublanguage approach.

In a paper complementing Boitet's general description of the GETA approach, Jean-Philippe Guilbaud details the design and development of an experimental German-French version of ARIANE-78. The paper is valuable as almost the only detailed account of this particular project. Most attention was devoted to German morphology and syntax, since French generation was based on an adaptation of programs for the existing GETA Russian-French system. It is followed by Jonathan Slocum's account of the development of the METAL system at the Linguistics Research Center (LRC) of the University of Texas. After stressing the importance of software tools (for dictionary updating, text formating and reformating, editing, etc.), Slocum defends the LRC adoption of phrase structure (LFG-like) grammar and a minimal use of semantic analysis (primarily to deal with prepositions during transfer) against semantics-based and understanding approaches, claiming that good results have been achieved without semantic features and that it is just not feasible to undertake detailed semantic analyses of the vocabulary of 100,000-page technical texts. He justifies the emphasis (as in most MT projects aiming for operational implementation) on effective 'shallow' analysis, on plausibility screening of multiple parsings, and on producing some kind of output—when dealing with thousands of pages, no practical system can "indulge in the luxury of simply replying with an error message stating that the sentence cannot be interpreted". Slocum is convinced that there is "no evidence that today's advanced but experimental NLP techniques will soon (in this decade or even century) be able to supplant the more primitive techniques that are currently effective in a large-scale application such as ours".

The most experimental and innovative system described is the Rosetta project at Philips (Eindhoven). Jan Landsbergen's paper provides a definitive account of the theoretical foundations of the system. It is based on Montague semantics and the notion of isomorphic grammars, i.e., the 'attuning' of source and target language grammars to each other, so that for each

expression or syntactic rule in one there is a corresponding expression or syntactic rule in the other with the same meaning. Rosetta differs from the strict Montague model in making no use of intensional logic or of categorial grammar, but it adheres to the compositionality principle (in relating syntactic rules and semantic structures). The paper includes many formal proofs and only trivial sentence examples—which might well not impress those skeptical of the value of a project whose influence on MT theorists has been considerable in recent years. It is followed by a description of another experimental system (albeit less radically innovative in linguistic conception), an account by Margaret King and Sergei Perschke of the Eurotra project of the European Communities. After outlining the historical background (the need for a decentralized multilingual project capable of stimulating MT and computational linguistic research in each of the participating countries), the basic features are described: a linguistics-based transfer model, modular and robust, no interactive facilities, multilevel tree-structure interfaces, a controlled production system operating on series of well-defined grammars, etc. Eurotra is admitted to be relatively traditional in its linguistics, but it is claimed to be more advanced in its computational design and to have been successful in promoting the study of languages not previously the subject of MT or detailed linguistic research.

This book represents a primary source of information for some of the most significant and influential MT projects in the last decade. It is greatly enhanced by a substantial bibliography, which includes not only all references by the contributors, but also many other items covering the historical development of MT, the current (1984) state of research, and related topics in computational linguistics and artificial intelligence. The publication delay has not diminished the value of the contributions: many papers provide the most detailed and comprehensive accounts of individual MT systems. Only in the cases of Rosetta, GETA, and Eurotra can it be said that there have been substantial changes in the years since the Lugano tutorial. There are some omissions in the historical surveys as already noted, and readers should also be made aware that a number of systems current at the time are not mentioned at all, e.g., the DLT system in Utrecht, the PAHO system in Washington, many of the largely AI-inspired projects in the United States, the systems in the Soviet Union, and the activity in Japan (e.g., the influential Kyoto research). These are minor points. This is a publication that will remain for many years an invaluable source on MT research and it deserves to find a place on the shelves of anyone seriously interested in computational linguistics and in machine translation.

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Advances in Natural Language Generation is the proceedings of the European Workshop on Natural Language Generation held in January 1988 at the Abbey de Royaumont, France. As such, it gives a fairly broad snapshot of the work in this area going on in Europe (with a few notable omissions, such as Wahlster, Reithinger, and Danlos). The introduction by editors Zock and Sabah, and the foreword by David McDonald emphasize the youth of natural language generation (NLG) as a field and the importance of workshops such as this one in bringing together researchers from diverse areas, such as psychology, linguistics, and artificial intelligence, to contribute to this growing field.

Perhaps due to the youth of the field or perhaps due to a lack of rigor on the part of the workshop organizers and editors, the book lacks unity. The papers themselves vary a great deal in quality and in audience, some presenting an introduction to some aspect of the field and others assuming the reader knows the particular details of a linguistic framework. Some address themselves directly to the problems of NLG, while others report on just their own work and leave the connections to NLG to the reader.

The first paper in the book, "Language Generation and Explanation" by McKeown and Swartout, is aimed at a wide audience and presents issues and approaches rather than particular advances in the field. It is not a paper from the workshop itself, but rather a reprint from the *Annual Review of Computer Science*, and as such is a very good general overview of previous work, particularly in text planning and explanation. Unfortunately, it does not provide adequate background for the papers in this collection; in particular, it does not supply any introduction to the different kinds of grammars in use, such as LFG, SFG, and FUG.

As the title of the book suggests, many of the papers are reports on work that has in some way furthered the state of the art in NLG. These papers are aimed at those who already know the field, at least to some degree, and who know some of the background behind the problems being addressed. The best of the papers were those that