Session 5:   GRAMMATICAL STUDIES

GERMAN SYNTAX PATTERNS

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   I had intended to present what I considered to be a completely
new and powerful method in machine translation,   a method in
which the German sentence was to be treated as a series of pro-
gressive predictions and restrictions from left-to-right in time.
From Mrs. Rhodes' talk yesterday and from Oettinger's talk and
the discussions of other papers today, I learn that this method   is
already known in part by workers in the field of machine translation
and is being used by them.   I have therefore recast my original
paper, feeling that a presentation of the background for that paper
might serve to highlight some other problems mentioned in the pre-
vious meetings; namely,   problems of communication with each other,
and the question of the value of machine translation research for
research in other fields and vice versa.
   From the inception of the idea of and research on machine
translation,   most authorities have agreed that the machine will have
to perform two essentially different operations on the source language
which may be termed <u>syntactical</u> and <u>lexical</u> operations.   That is,
the machine must at some time in its operation grammatically scan
the material to be translated.   Since, moreover, most workers agree
that the programming for such scanning requires a good linguistic
description at the outset, syntactical studies should be of great im-
portance to investigators in the field of machine translation.   It is
therefore imperative that such investigators keep abreast of develop-
ments in the field of structural syntax.   It is the purpose of this
paper to discuss some recent trends in the syntactical analysis of
German, to point out where these analyses may or may not be of aid
in programming for machine translation, and to suggest some new
areas which deserve exploration.
   Structural analysis of German syntactical patterns is a rela-
tively new thing.   The first attempt at such an analysis was made
in 1937 by Erich Drach [1].   Drach's work suffered from the lack of
a clear definition of the elements he worked with,   from the lack of a

restricted corpus, and from too much speculation; but it did offer
the beginning for a sound treatment of a number of problems, e. g. ,
word order. An idea of his method may be gotten from his model
of the German sentence:

Anterior Field	Center	Posterior Field		
		Weakpoint	Interior	Target

For him, the verb is the fulcrum (center) of the German sentence,
the final component of the posterior field being the psychological
target of the sentence. He attempts to relate these components to
the type of sentence expression, calling the pivot of the anterior
field the "conative-affective" pivot, that of the posterior field the
"rationalizing-logical" pivot. In expository prose, naturally, only
the pivot of the posterior field is important. Of value also is
Drach's invocation of a "law of parenthesis" in German, in which he
says that the cardinal principle of German syntax is incapsulation
or nesting. The importance of Drach's work is not the analysis per
se, however; he set the tone and laid down the lines for further work
in the field, most of which is either based on or inspired by his own
work.

   Though Drach's work was carried forward in the period before
and during the war, especially by Eugen Lerch and Leo Weisgerber
[2], it has made itself felt mainly in the postwar period, in the work
of Hans Glinz and Karl Boost. Glinz has primarily directed his
attention to a critique of the traditional grammatical categories and
to the attempt to set up new categories based on rigorous formal and
functional criteria [3]. His method for discovering and treating the
elements he posits principally entails the use of the commutation
test. He fails still to treat the German sentence as a structure, and
still operates in part with psychological categories. He has set up a
new and extremely promising scheme of the sentence elements. As
an illustration: There are four word-types; noun, adjective (= adjec-
tive and adverb-adjective), pronoun (= article, pronoun, numbers),
particles (= adverbs, prepositions, conjunctions). His category of
combining particles, for example, involves a number of dependency
functions: (1) case governors or prepositions (e.g. , <u>während</u> des

Vortrages = "during the speech"); (2) non-governors of case or "member conjunctions" (<u>Gliedkonjunktionen</u>) (e. g. , A ist anderer Meinung <u>als</u> sein Freund B = "A is of a different opinion than his friend B"); (3) infinitive or disjunctive conjunctions (e. g. , <u>um</u> ihm das <u>zu</u> erklären= "in order to explain this to him"); (4) governors of position or subordinating conjunctions; (5) coordinating conjunctions, which are non-governors of position. He continues on through an extremely detailed analysis of the German sentence, which cannot be given here. These examples will suffice to illustrate his method.

Boost, on the other hand, seems to take the sentence elements as givens [4]. In spite of his lack of knowledge of communication theory and his lack of a rigorous methodology, he comes very close in syntax to what Harris has done for morphology [5], in that he treats the sentence as a left-to-right progression in time with a series of sutures ("tensions" he calls them) which may be strong or weak according to the predictability of the next item. With his interest in stylistics, it was not to be expected that Boost would attempt to work out this idea in a systematic manner, but he gave the impetus for other works in the field. A number of smaller studies, among which we must mention especially a brilliant essay on the article in the European languages by Kurt Stegmann von Pritzwald [6], simply amplify techniques or ideas found in Drach, Lerch, Glinz, or Boost.

With regard to this country, it must be said that there is very little done here with German structural syntax, with the exception of some few works by machine translation investigators. One article in the field of Old High German syntax should be mentioned, however, since it seems to offer a fruitful line of research. In an article on the syntax of the Old High German Isidor, George Nordmeyer con- siders the German sentence as being composed syntactically of congruence units (dependencies) and seriation [7]. Since, according to his view, the whole of the German sentence may be said to revolve around the verb as a nucleus (cf. Drach), any sentence can be looked upon as a congruence unit (construction) with the verb as focus. Each verb is then said to be possessed of a certain valence indicat- ing its combining properties. Thus, <u>finden</u> would have a valence of two in the Modern German sentence, since a sentence with <u>finden</u>

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and a subject + direct object would be a complete sentence: Er findet es = "he finds it".   All other parts of the sentence could then be treated either as nesting structures, to be analyzed also into such components,   or as satellite structures (particles), whose dependency situation would not have to be ascertained.   Thus,   for example,   in a sentence such as: Er gab ihm,   da er gelegentlich ein paar Groschen in der Tasche hatte,   ein Trinkgeld = "he gave him,   since he hap- pened to have a couple of coins in his pocket,   a tip",   the investigator would know that the comma after ihm did not signify the end of the construction,   since geben is a trivalent verb,   requiring both subject and indirect + direct objects.   Also,   for example,   in the sentence: Ich finde ihm das Buch = "I am finding his book for him",   the ihm obviously is not constructed with the finde, which is a bivalent verb to be satisfied by a subject and a direct object.   The   ihm is then a part of the nesting satellite structure, which does not have to be accounted for as to its dependency.

To sum up,   we may say that the trend in present-day investiga- tions into the problems of German syntax *is* towards a more rigorous statement of the means of isolating sentence elements and of the permissible combinations of these elements.   None of the above mentioned works is empirical, however, and all emphasize the speculative side of things.   None is really immediately concerned with the analysis of texts per se (with the possible exception of Nordmeyer),   but rather with the methods   whereby such texts may be analyzed or utterances may be generated.   When we come to the question: What of value can the investigator in the field of machine translation derive from these studies?,   we are at a loss to answer in concrete terms.   Certainly no one who is interested in any way in German syntax can afford to overlook Glinz' new categorization; any- one who reads his work will learn a great deal about the inner work- ings of the German language.   But his statements are not rigorous enough for machine work,   and he is much too concerned with intona- tion,   sentence and word definitions,   and commutations to be of direct value to us.   We can say the same of Boost; anyone who reads his work,   and anyone interested in German should read it,   will learn a great deal from it; but it lacks rigor and is too speculative.   The value of such studies lies rather in the insights they may give us into

the workings of the German language and new techniques they may suggest.   They are too programmatic to be of direct use,   and the lack of a distinction between discovery procedures and statement procedures makes them of little value as a statement of what occurs.

The reason for this lack of a usable structural description lies in the fact that the need for such descriptions has never before been felt,   and in the fact that linguists have never learned to treat a language as a configuration of visual symbols on the page. Traditionally,   structuralists have been too involved in definitions of word and sentence,   which are givens for written German; have ignored structural symbols of written German,   such as capitalization and punctuation; and have not been rigorous because they had no way to test their assumptions.   Machine translation investigators who have attempted to bypass the necessary description of the language by making their own have been handicapped mainly by three things: (1) lack of a means of testing statements other than by costly and difficult programming; (2) lack of a treatment of the language as a whole,   so that all we have is a number of fragmentary studies; (3) all too often the person making the description does not have the necessary knowledge of the language and has to depend on informants, who are often limited in their inventiveness,   or who may offer non-utterances if pressed.   What is needed is a description which is predicated upon operation with actual texts,   but which is not a quod libet of ad hoc statements,   which also takes the over-all structure into consideration,   and which is easily testable.

This brings me to the second group of structural descriptions of German,   and to a field which is all too often neglected by investi-gators in machine translation: the teaching of German, particularly reading-German.   Actually, structural studies are more frequent in the field of pedagogy than in the field of linguistics qua linguistics. We may divide such studies into two groups: those in which German is the source language, and   those in which it is the target language, as for example in speaking and writing German.

It does not represent an innovation for me to speak of the analogies between teaching and programming; these have often been pointed out,   and pioneer studies in the field of mechanical transla-tion of German were inspired in part by teaching procedures [8].

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If what I say concerning the value of teaching reading-German for machine translation seems to echo some of those early studies,   the similarity is intentional.   Much of the recent work in the field of teaching reading-German has been strongly influenced by the pioneering article, "Proposals for the Mechanical Resolution of German Syntax Patterns", by Victor Oswald and Stuart Fletcher.

There are two different trends in present-day research in teaching reading-German: teaching to translate and teaching to read. In teaching for translation, mainly under the influence of C. V. Pollard of Texas, the attempt is made to teach the student to recast the German sentence into English word order and to interpret certain structural signals in the sentence,   ignoring irrelevant signals [9]. The rules given,   which are primarily based on a kind of Drachian idea of the end of the sentence or clause as the target,   are intended to be purely mechanical and to admit of few,   if any,   exceptions.   The rules,   as given by Pollard,   are a set of operations to be performed on the German sentence.   They are not rigorous as presently set down,   but represent a step in the right direction.   That they work is seen by their efficacy in the classroom; if the rules given by Oswald and Fletcher are added to Pollard's, the student can analyze the German sentence in a purely mechanical manner in two or three passes,   isolating the necessary functional elements and rearranging them into the English sequence.

Since the translation method only teaches the student to translate, thus hampering his reading speed, it has been recently proposed that we develop a method of teaching the student to <u>read</u> the German sentence, not to translate it into English, for the purpose of increasing his reading speed [10].   The results of this study, which was   based on the German syntax of Boost and Drach,   on Oswald and Fletcher, and on an experiment by the Russian linguist Belskaia,   were as follows: (1) investigations into the habits of reading of native Germans revealed that, with the exception of the normal saccadic eye movements, the reader scanned the sentence from left to right; (2) it was found that, with a modicum of effort, the American student could learn also to read the sentence from left to right,   and that such learning increased both his reading and his translation speed and accuracy.   The instruction of the student for

such reading emphasizes three points: (1) the function of most items
in the sentence can be determined on the basis of the immediate
surroundings,   without recourse to scanning of large segments; (2)
there is never need to scan ahead if the function of an element is not
immediately evident—one must merely reserve judgment until the
particular construction is completed,   i. e. ,   until another form
within that clause clears up the problem; (3) the student must learn
to predict at each suture what the next following element will be.
Thus,   for example, the infinitive clause has always caused trouble
for students in reading German—when they learn to predict when a
clause leads up to an infinitive clause, however,   the trouble dis-
appears.

Let us look at some of the problems which are attacked by
this technique of teaching.   Firstly, the use of a purely mechanical
method of operation in the classroom will immediately reveal any
flaws in the setting up of elements.   Let us take the German preposi-
tion, for example: this problem has been unsuccessfully attacked
in the past simply because the functions of the German preposition
are so diverse,   and because this diversity has been ignored [11].
The German preposition may be categorized as follows:

1. If it occurs at the end of a clause or is attached to a verb,
it is a separable prefix,   and must be looked up in the normal German
dictionary under the prefix,   e.g. ,   <u>aufnehmen</u>,   to be found under
<u>aufnehmen</u>,   not <u>auf</u> or <u>nehmen</u>.

2. It is a part of a verb complement when that idiom is
contained in the dictionary listing,   and it must be looked up in the
normal German dictionary under the verb,   e. g. ,   <u>Er stellte die
Fabrik in Betrieb</u>   = "He got the factory going"--the verb <u>in
Betrieb stellen</u> must be looked up under the verb <u>stellen</u>.   Students
normally have no difficulty in recognizing this construction once
they have been cautioned to expect it.   Though I have not yet systema-
tized their reactions, the clues used seem to be   a sense of the
sentence of the complement and the place of the complement in the
sentence.

3. The preposition is a part of the verb,   but not a verb comple-
ment,   as in: <u>Er forscht nach Gold</u> = "He hunts for gold",   (<u>forschen
nach</u> = "to search for").   This construction offers the most difficulty

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for the student and each verb must be taught as a separate vocabulary item.   In the classroom,   we use predictability and dependencies (valence) as an aid in finding the construction.

4.   If not in these constructions,   the preposition is a function word which we may call the "real preposition".

Thus the classroom situation has solved for us the problem as to what to put in the lexicon and what to consider a function.

The application of the left-to-right technique in teaching also shows the value of the punctuation mark as a structural signal. Thus, for example, the word <u>da</u> is ambiguous as to its function in the German sentence,   and most statements require extensive scanning to determine its function.   As will be seen from the following scheme, however,   a simple statement of the immediate environment obviates the necessity for extensive scanning:

1. mark of punctuation + <u>da</u> + . . . + verb = conjunction.
2. elsewhere, <u>da</u>   =   adverb.

The same is true of the pronoun <u>der</u>,   which may be either relative, demonstrative,   or the article.   A simple statement of immediate environments makes for a 90% valid statement,   which has not failed in my four years of teaching it.[1]

1. comma + preposition + <u>der</u> +   . . .   + verb   =   relative.
2. mark of punctuation + preposition + <u>der</u> + verb   = demonstrative.
3. elsewhere, <u>der</u>   =   article.

The use of such descriptions in the classroom affords a check on their validity,   both as descriptions of operations and as descriptions of the source language.   In describing the so-called extended attribute construction, e.g.,   <u>das langsam durch die Adern fliessende dunkelrote Blut</u> = "the slowly through the veins flowing dark-red blood",   i.e. ,   "the dark red blood slowly flowing through the veins"; I had always insisted that   it must begin with a <u>der-</u>   or <u>ein</u>-word,   since neither I nor any informants could think of contrary examples,   and since it is always so taught in school.   In the classroom situation,   however,   I came across numerous examples which

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[1] This does not mean,   of course,   that the description is now fail-safe as it stands; there are limits to the number of restrictions which can be given in the classroom situation.   It could easily be made fail-safe for machine translation.

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caused me to modify my description:

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    1              2                   3                    4
adjective  +  der-word + any number of elements +  participial
              ein-word
              preposition
              pronoun
              adverb
              indefinite adj.

        5           6
    +  adjective  + noun
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                                    1   2   3   4
The example is thus: das langsam durch die Adern fliessende
        5   6
dunkelrote   Blut.   The proper English sequence (sometimes awkward)
may be obtained by rearranging: 1,   5,   6,   4,   2,   3 .

In addition to this type of research,   where German is the
source language,   we have other articles in which German is the
target language, which should be of great importance to the output
side of machine translation,   especially when the authors have
attempted to make a fail-safe operational procedure for the student.
I should like only to point to one advance since the attempt at fail-
safe descriptions is so new.   In an article which is based on the
work of Drach and Boost, I attempted to set up a model of the German
declarative clause,   with a rigid system of word order into which any
sentence the student wishes can be cast,   with no fear of error [12] :

1	2	3	4	5	6	7	8	9
non-element	any element but 3 or 16	finite verb	pers. pron. subj.	pers. pron. obj. dir. + indir.	1-word adv. of time	noun pron. subj.	noun pron. obj. indir. + dir.	adv. phrase of time

10	11	12	13	14	15	16	17
negative	adv. of manner	adv. of place	verb	past complement	inf. part.	finite verb	double inf.

This model was tested by informant reaction and by doing all the
exercises in 9 second year German textbooks.   Though this is not
proposed as a valid test, the scheme seems fairly infallible.

The work at present in the field of reading German from the
standpoint of left-to-right predictive operations consists mostly in
trying to make explicit the methods whereby the students interpret
or may interpret the sentence.   A statement of a number of these
rules in the form of a manual may be expected soon.

I might also point out one linguistic development based on the

research in teaching reading-German by a left-to-right predictive
approach,   though it is in an unpublished monograph.   In this mono-
graph, which is based on Boost, Drach, and Harris, the authors
have devised a means of isolating the elements of the German sen-
tence by treating the sentence as a series of progressive restrictions
from left to right on the occurrence of items.   Thus,   <u>morpheme</u> is
defined as any unit of the utterance within which progressive
restrictions on the occurrence of phonemes prevail (cf. Harris),
<u>word</u> is defined as any unit of the utterance within which progressive
restrictions on the occurrence of morphemes prevail,   etc.   This
method merely requires a text and a good informant--the linguist
does not have to know the language.

It is hoped that this paper has shown the necessity for machine
translation investigators to keep an eye on what is done in the general
field of language study.   The benefits will be mutual.   I was happy to
learn from Mrs. Rhodes' paper yesterday that we are indeed
occasionally going in the same direction.

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REFERENCES

[l]   E. Drach, Grundgedanken der deutschen Satzlehre, Frankfurt, 1937.   For a good summary of Drach's book see H. A. Basilius, "A Structuralist View of German Syntax", Modern Language Journal XXXVI (1953) 130-134.   I use here Basilius' translation of Drach's terms.

[2]   See E. Lerch, Archiv für die gesamte Psychologie C (1938) 133-197; Leo Weisgerber,   for example: Vom Weltbild der deutschen Sprache, Vol. I, Düsseldorf, 1953, 245-250.

[3]   H. Glinz, Die innere Form des Deutschen, Bern, 1952; idem, Der deutsche Satz, Düsseldorf, 1957; idem, "Wortarten und Satzglieder", Der Deutschunterricht VI. 2 (1954) 108-128. Glinz also has a number of school grammars and exercise books which are useful as descriptions of German.

[4]   K. Boost, Neue Untersuchungen zum Wesen und zur Struktur des deutschen Satzes, Berlin (Akademie Verlag), 1954.

[5]   Z.S.Harris, "From Phoneme to Morpheme", Language XXXI (1955) 190-222.

[6]   Kurt Stegmann von Pritzwald,   "Der Artikel — Geschlechtswort oder Geleitwort?" Der Deutschunterricht IX. 3 (1957) 29-43.

[7]   George Nordmeyer,   "Syntax Analysis of the Old High German Isidor", Wächter und Hüter, Festschrift für Hermann J. Weigand.   New Haven, 1957, 29-39.

[8]   Cf. Oswald and Fletcher's article, mentioned later, and W. Bull's paper in the first conference on machine translation, reported in MT I, 26 and I, 54 on the analogies between machine translation and teaching foreign languages, and on the mutual benefits to be derived by both from studying the other's methods.

[9]   C. V. Pollard, How to learn German the Easy Way (The Key to the German Sentence), Austin, 1945.   In theory, Pollard has many similarities with Drach, though he seems not to have known Drach's work.

[10]   See James W. Marchand,   "The Teaching of Reading German-- a Linguistic Approach", Language Learning VI (1956) 39-46 (cf. especially p. 40 f.: ". . . we are dealing, in effect, with a code system with progressive predictions and restrictions from left to right"; idem, "Teaching, Testing, and the Ph. D. Language Requirements", The Modern Language Journal XLII (1958) 238-243.

[11]   Cf. L. Brandwood, MT V (1958) 60-66.

[12]   James W. Marchand,   "The Teaching of German Word Order-- A Linguistic Approach", Language Learning VIII (1958) 27-35.