

CHAPTER 5 CROSS-REFERENCE: DISCUSSION OF THE RESULTS

0. Introduction. Various inquiries can be made on the basis of the analysis provided in the previous chapter. Thus, one may consider the few cases in which the replacement of a referential phrase is dependent upon resolution of another, i.e., ordered or simultaneous replacements. One may also consider a more compact version of the analysis where, e.g., a referential is taken to have in its referend the resultant of a referential which is resolved within the referend-phrase. Referential phrases can be collected into various groups, e.g., in respect to their grammatical categories, and compared -- for example, as to the distance in sentences intervening between them and their referends. One may attempt to formulate procedures which would simulate the determinations of referends given in the analysis, etc.

The present chapter restricts itself to some of the major topics and hypotheses forwarded in the course of this work. The first section briefly evaluates the status of the definition of cross-reference presented in chapter 1 (section 5.3) given the results of the analyses. Most of the over seven hundred cross-references recorded in chapter 4 are in accord with the proposed definition. A number of problematic cases are noted in section 1 and elsewhere in the chapter.

One of the major hypotheses forwarded in chapter 2 is that instances of 'incomplete' sublanguage sentence-types

can be considered instances of 'full forms' by the postulation of zero-referentials. While this hypothesis holds in most cases, there are a small number of "delinquent" ones which present special interest. Section 2 reviews these cases and remarks upon conjunctival forms such as however which are analyzed as composed of a conjunction and a pro-sentential form, i.e., as in spite of this.

There are many cases of cross-reference in the article in which the referential phrase is a classifier of its referend. Some of these cases -- in which a referential-phrase classifies a referend occurring in one of the argument word classes of the sublanguage grammar -- were discussed in chapter 3 in connection with the reconstruction of zero-referentials. In section 3 these results are reviewed, and consideration of classifier-relations is extended to a number of cross-references in which the referend is an instance of a sublanguage sentence-type. The role of referential-classifiers in a fragment of argumentation from the article is briefly sketched (section 3.3). Other cross-references in which the referential phrase is a classifier are presented throughout the remaining sections of the chapter.

Section 4 presents an extensive survey of epiphora in the "Influenzal" article as well as supplementary cases culled from a review of five articles in immunology. Epiphoric occurrences of it are noted in section 4.1 which mentions as well difficulties in the analysis of the definite

article. The epiphoric status of a phrase is indicated in a variety of ways, e.g., by comparative forms, by numerical determiners (e.g., two series of studies) and the position within a paragraph of the sentence containing the phrase (section 4.3). Certain epiphoric cross-references are related to anaphoric cross-references in somewhat intricate patterns (section 4.5); others involve complicated replacements (section 4.6).

Three sections of the article receive special attention in the fifth section of this chapter. In previous work on the immunology sublanguage, sentences -- principally in sections concerned with procedures -- were not considered for reasons discussed above (chapter 2, section 3.4). Thus, it was of interest to note whether the "Methods and Materials" section is any way distinguished in respect to patterns of cross-reference, e.g., in classifier-relations obtaining between referentials and referends (section 5.1). Here I also examine whether resolution of referential phrases in sublanguage-sentences whose referends occur in sentences relating to procedures yields sentences outside of the established sentence-types of the sublanguage (cf. section 4.3 of chapter 2). The "Discussion" and "Summary" sections of the article are of interest in another connection. Many of the sentences within these sections are evidently related to sentences in prior sections, raising the possibility that the former are themselves to be considered referentials. Section 5.2 presents two sample "derivations" of "Discussion" sentences from prior sentences in the article.

Section 6 scrutinizes the division between meta-scientific segments and science-language sentences of the article in respect to cross-reference. Two of the principal hypotheses of chapter 2 were forwarded in order to examine the status of this division. One of these conjectures that referentials in science-language sentences operate "independently" of meta-scientific segments, i.e., that their referends only occur in sentences of the science-language. The other hypothesis, intimately related to the first, supposed that science-language sentences are closed in respect to the resolution of referentials which occur within them; that is, it is held that replacement of such referentials by their referends yields as a resultant another science-language sentence (an instance of a sub-language sentence-type).

To test these conjectures requires a prior specification of meta-scientific segments and of referentials in science-language sentences. One question which arises is whether the latter are identifiable as such independently of resolution of the cross-reference. These matters are taken up in section 6.1. In section 6.2, the hypotheses and the results of the tests are presented in detail.

Finally, section 6.3 translates a few paragraphs in the article into a form where meta-scientific segments are explicitly separated off from the science-language sentences with which they occur.

1. Status of the Definition of Cross-Reference. This section confines itself to some general remarks on the results presented in the preceding chapter and the extensions of the definition of referential relation which they suggest. Overall, these results support the definition of cross-reference provided in section 5.3 of the first chapter. Replacement of a given referential phrase by its often adjusted referend in respect to a particular rule of consequence or paraphrase yields a consequence or paraphrase of the text: this is in accord with the intuitively recognized relations of cross-reference obtaining between occurrences of phrases in the text. In a number of cases there may be disagreements over the choice of referend stated -- either because one of several occurrences of a particular phrase can be considered the referend (the "passim" cases in chapter 4) or because the referend stated is itself a referential phrase (in the latter case of "referential chains", the referend of the given referend, i.e., referential-phrase, may be considered as the referend of the referential in question). It should be noted that resolution of the referential phrases indicated in section 2 of chapter 4 does not imply elimination of cross-references within the article. Quite often the effect of the replacement operation is to introduce a referential phrase in the consequence or paraphrase obtained by way of it. For instance, substitution of the referend the second day following injection of the antigen (in 198.2.6) for the referential phrase that day in On that day, antibody

could generally be found in the extracts of lymphnodes in low titer (198.2.7) yields a consequence of the text (under the rule of Detachment, section 4.1, chapter 4) in which a number of referential phrases occur, e.g., the antigen. Upon replacement of the anaphoric referential phrase the extracts of lymphnodes in When the extracts of lymphnodes were tested,... (from 198.2.6) one obtains When the popliteal lymphnodes which were excised were tested,... in which the occurs determinatively (i.e., epiphorically, see chapter 1, section 8.4).

Difficulties were certainly encountered in the statement of replacement operations for occurrences of particular referentials in the course of the analysis. For instance, so and such are both taken as epiphoric to the clause beginning with as in:

(1)...the lymphnode and efferent lymph contained antibody in SUCH concentration and SO soon after the injection of antigen , as to clearly indicate some role of the lymphnodes in the formation of antibodies. (from 193.1.7)

In the notes to these referential phrases (R20-21 of the Introduction section) it is suggested that the referend (rewriting soon as was early) be taken as the complement of an appropriate modifier to a degree/extent: ...contained antibody after the injection of antigen in concentration to a degree and was early to an extent as to indicate some role of the lymphnodes in the formation of antibodies (a in a degree, an extent might then be considered as part of an epiphoric cross-reference, see chapter 1, sections 7 and

8.4). Another case presenting special problems is the occurrence of reaction with influenzal virus in:

(2) Antibodies to influenzal virus appeared in the lymphnode..., whereas normal lymphnodes or lymphnodes derived from rabbits injected with typhoid or dysentery bacilli showed no REACTION WITH INFLUENZAL VIRUS (from 198.1.6).

One question raised by the example is determination of the referend for reaction with influenzal virus. Substitution of the preceding antibodies to influenzal virus for this phrase does yield a consequence of the sentence. However, antibodies to influenzal virus is not an appropriate referend -- given the evident classifier-status of reaction (cf. section 3 on other classifiers). One option is to consider antibodies to influenzal virus appeared as the referend and adjust it to antibodies to influenzal virus appearing in the replacement. Another, making use of the results of FIS (summarized here in chapter 2, section 3.3), is to "substitute the locally synonymous was contained in for appeared in in (2) and then to transform it to the lymphnode contained antibodies to influenzal virus. The verb and its complement -- contained antibodies to influenzal virus -- is considered the referend. A series of adjustments (including deletion of showed and placement of the negation and tense onto the "carrier" do) yields did not contain antibodies to influenzal virus. The notes discuss difficulties in replacement of other referentials (see, for example, the discussion of again in the notes to R55 in section "Sequence of Events" and R69 in "Discussion"). A few of these are mentioned in the course of the present chapter.

The results bear upon some of "the open questions" raised in section 5.5 of the first chapter. Thus, simultaneous replacement of referential phrases appears to be required in:

(3) The level of antibody found in THE RESPECTIVE LYMPHNODE-EXTRACTS against THE HETEROLOGOUS VIRUS generally was about 10 to 15 per cent the level of serum-antibody (200.4.10).

For reasons noted in section 3.23 of chapter 3, here there is coordinated (simultaneous) replacement of the respective lymphnode-extracts and the heterologous virus by the lymphnode of the right Leg and Lee virus, and by the lymphnode of the Left leg and PR8 virus.¹ Ordering of replacements might also prove useful in cases such as the second day following injection of the antigen (from 198.2.6) where the antigen -- referential to an inactivated preparation of the PR8 strain...times -- occurs within the scope of injection referential to The antigen was injected into the foot-pads of suitable number of rabbits. Rather than to consider each cross-reference independently, there might be reason to preserve the resolution of the antigen in replacing injection. Generally one might suggest retention of the referend of a referential phrase which occurs as an argument of another referential phrase, e.g., yielding upon replacement of injection -- an inactivated preparation...virus was injected...

For the "Influenzal Antibodies" article, it appears that it would have proven useful to have adopted the defini-

tion of the set A of implicit assumptions offered in chapter 1 (section 2.4.2). There it was suggested that the set A be taken to include not only particular standard assumptions but all of the text (and consequences thereof) which precedes a referential phrase whose resolution is being considered. Thus, the appearance of antibodies in 198.2.12 could be construed as anaphoric to a phrase in a consequence (or: 'implicature') of the preceding sentence ...no measurable amount of antibody was present usually before the third day, namely a measurable amount of antibody was present (on the third day). Such a revised definition of the set A would also be of use if the hypothesis -- made in section 5.2 of the present chapter -- that most of the sentences in the "Discussion" and "Summary" sections of the article are consequences of particular preceding text-sentences can be substantiated.

2. Zero-Referentials: Results. Zero-referential classifiers are reconstructed as a means of extending sentences which are instances of "incomplete" sublanguage sentence-types, e.g., AV, GJ, into full forms, e.g., of the types AVT, GJB (chapter 2, section 3.2). Such reconstructions are justified in nearly all sentences in which there occur phrases taken to be sublanguage-announcers, e.g., titer, present (with subjects of word-class A), specific (cf. chapter 3, section 3.23 for a survey of sublanguage-announcers). That is, reconstruction of the zero-referential and its subsequent replacement by its (possibly adjusted) referend yields in respect to a

rule of consequence or paraphrase a sentence which is a consequence or paraphrase of the original text. Nonetheless, there are a few cases in which reconstruction of zero-referentials either cannot be made or in which the zero-referential introduced is misleading. These cases are surveyed below.

A case in which reconstruction of the zero-referential into the animal is questionable is presented by a number of sentences where use occurs in the word-class J with a subject of the word-class G. For instance, used in the phrase used as antigen occurs as J operator with a subject of the word-class G in:

(4) Undiluted allantoic fluid used as antigen produced almost a maximal antibody-response..., whereas dilution of the allantoic fluid as antigen caused the appearance of progressively smaller amounts of antibody. (from 198.1.5)

In all of its occurrences as a J-operator (cited in the note to sentence 197.3.1), use occurs without a complement of the word-class B (or: B*). Given the absence of "full" sentences in which a complement of the word-class B or B* occurs and the questionable acceptability of, e.g., Undiluted allantoic fluid used as antigen in the animal, zero-referentials were not established in these cases. However, use can be considered a pro-verbal form, or a variant of inject which is not so restricted: Substitution of inject for use would allow for reconstruction of zero-referentials.

Other instances in which zero-referentials are not established are perhaps more instructive. In:

(5) Further evidence of specificity was afforded by the experiments in which opposite legs of each rabbit received injections of different serological types of virus (204.4.1).

zero-referentials (of) the antibody, (to) the antigen for the first and second arguments of the operator specific have not been reconstructed (see chapter 3, section 3.2.3 on specific). The previous paragraph reports on results of tests designed to determine the units of virus and dilutions of tissues required to preclude non-specific reactions to a particular type of influenzal virus. In the sentence cited, different viruses are used as a control on the specificity of the antibody response. Thus, specificity relates here not to the particular antigens noted but specificity per se, i.e., considered in abstraction from certain antigens. In sentence 204.4.1, the arguments of specificity can perhaps be reconstructed, e.g., as specificity of antibody to antigen, though not as zero-referentials.

Similarly, in sentences 204.4.5-7 (see the article in chapter 4), zero-referentials are not established. The operator production in the phrase in the early days of antibody production is not considered to announce a zero-referential, e.g., (by) the tissue as no site of production is asserted (204.5). Indeed, sentence 204.4.5 states in part: The demonstration of antibodies in higher titer in the local lymphatic system than in the serum, in the early days of antibody-production, is not a necessary condition for the demonstration of antibody-production by the lymphatic tissue.

The succeeding two sentences are general sentences noting why assertion of the former sentence is not a necessary condition for assertion of the latter. In 204.4.6, the phrase at a given time is not taken to introduce (after) the injection; in 4.7 the phrase injected does not introduce, e.g., in the animal as no assertion of an injection is made. Instead, in 204.4.5 by a tissue might be reconstructed and in 204.6-7 after an injection and into an animal. Sentences which are instances of full sentence-types (AVT, GJB: AVT and GJB) are thus obtainable though not by recourse to zero-referentials.

Two related cases are presented in sentences 194.3.2 and 197.3.11. In the former, injection in Prior to any injection, each rabbit was bled from the heart cannot itself be considered referential to a sentence of the GJB type, although the arguments of injection can be reconstructed as zero-referentials, e.g. (of) the antigen, (into) the animal (the latter, for instance, can be taken to have the succeeding occurrence of each rabbit as its referend). In ...serum collected prior to injection showed no reaction (from 197.3.11), injection occurs referentially (an "injection" sentence is asserted in 197.3.1 which serves as its referend), whereas reconstruction of to the injection given the occurrence of reaction is not possible.

Aside from the sentences in which use occurs, the cases surveyed above point to a connection between assertion and zero-referentials. One hypothesis which is suggested is that

zero-referentials are not reconstructible unless reconstruction yields a sentence asserted by a text-sentence or a consequence of one.²

There are two cases in which reconstruction of zero-referentials is possible but where the particular referentials suggested in chapter 3, section 3.23 present difficulties. In:

(6) Burnet and Lush (3), infected mice with virulent influenzal virus via the intranasal route, and found antibody to influenzal virus in the medrastinal lymph-nodes in 4 to 6 days (193.3.6).

after the injection can be reconstructed on the basis of the phrase in 4 to 6 days (cf. chapter 3, section 3.23), though in this case an implicit sentence is needed to obtain a referend, e.g., Animals are infected by introduction of an antigen into the animal. In section 2 of chapter 4, the zero-referential given is after this with this referential to the first conjunct of the sentence (other difficulties presented by this sentence, e.g., in respect to the division of meta-scientific material and science-language sentences, are noted in section 6).

In the other case, reconstruction of a zero-referential is misleading. The phrase response in the sentence 198.1.5 cited at the opening of this section occurs in the position of an operator of word-class V and thus could be taken to announce (in) the tissue (here I ignore another zero-referential which response can introduce, i.e., (to) the injection.) However, the referend which could then be deter-

mined, i.e., local lymphatic system (in 198.1.4) is incorrect. As mentioned in the note to sentence 198.1.5 the correct referential would be (in) the serum. Establishment of the appropriate referential phrase requires an implicit sentence relating to immunological procedures (see the note to 198.1.5) and suggests amending the definition of referential relation so that zero-referentials may, in presumably restricted situations, be reconstructed in respect to tacit assumptions.

Referential-Quantifiers -- Phrases such as titer, volume, mm³, each can be considered announcers of zero-referentials though often at the cost of a certain prolixity, e.g., reconstruction of the referential (of) the rabbits after each rabbit in Prior to any injection, each rabbit was bled from the heart... (from 194.3.2). Some of these cases of reconstruction are made more acceptable if, in line with remarks made in section 5.5 of chapter 1, particular repetitions of a phrase are regarded as referential to earlier occurrences of that phrase. Thus, titer would be an announcer in certain of its occurrences of the referential (of) antibody (antibody in place of the antibody appears to be less stilted). The operation of these announcers is nicely illustrated in sentences 195.2.1-2:

(7) The lymph was mixed well, enough was drawn off for a white-blood-cell count, and the remainder immediately centrifuged to separate cells from plasma. Each part was frozen and stored at -10C until tested.

In the first of these sentences, both enough and the remainder introduce a referential phrase (of) it. Notice that the referend of it in the two cases is not the same (see the notes for details). The phrase each in each part introduces the referential (of) it in the second sentence (the referend is the occurrence of the lymph in 195.2.1); each part can itself be considered a referential phrase -- with components cells and plasma in its referend. The individuating effect of each is seen in the replacement of each part. The first referend-component cells is substituted in 195.2.2 with an alteration of was to were in the sentence and the resultant conjoined with substitution of the second component in the sentence (the rule of inference applied is detachment, cf. section 1 of chapter 4).

Additional Remarks -- A number of phrases in the article can, following GEMP 9.6, be decomposed into a conjunctional phrase together with a pro-sentential referential phrase, e.g., this or that. For instance, however, e.g., R8 in 198.1.4 and the single occurrence of nevertheless in 198.2.22 (R105) are analyzable as: in spite of (or: despite) this. The rewritings of these phrases with pro-sentential forms and subsequent replacement by their (adjusted) referends is a step toward organizing the counterfactual arguments "signalled" by these phrases.

The phrase also can in nearly all of its occurrences be rewritten as in addition to this with the pro-sentential form this (In 196.1.6 also is reworded similarly to this).

An exception occurs in sentence 204.2.1 of the "Discussion" section where also in the rabbit cannot be rewritten as: in the rabbit in addition to this (the phrase can be recast as in the rabbit as well, though the referential status of as well and its replacement remain unclear.

In all of its occurrences (see sentences 194.1.2, 196.1.7, 197.1.16 and 198.1.11) accordingly can be rewritten as: in accord with this/that. It was found that substitution of so for accordingly in all of its occurrences and of thus for all but the first occurrence cited (in the first case, accordingly seems to have the sense not of "it follows" but "it is in line with") yield paraphrases of the sentences in which accordingly occurs (substitution of so results in a noticeably less "formal" style). For the sole occurrence of thus in 197.2.2, accordingly, in accord with this, or so can be paraphrastically substituted (again, with substitution of so, there is a shift in formality).

There are seven occurrences of so in the article. The first occurrence (in 193.1.7), discussed in section 1 of this chapter, is perhaps analyzable as epiphoric to the adjunct: as to indicate clearly some role of the lymphnodes in the formation of antibodies. The occurrence of so in 196.2.2: ...the antibody-titers in the contents of the lymphocytes were so high that the pattern-test could be employed... may perhaps be analyzed in the same fashion with so high rewritten as high to an extent and an extent (akin to the determinative use of the, cf. chapter 1, section 8.4)

epiphoric to the restrictive adjunct. Other occurrences of so (together with that) might be rewritten as and because of this (or: for this reason), e.g., in 196.1.17: in the analysis so is considered epiphoric to that correlation could be made from one test to the next. In 204.3.3, an analysis with so referential to the adjunct introduced by that is possible. Alternatively so that can be rewritten as and because of (or: in accord with) this with anaphoric this (cf. the similar situation in 204.4.9). In 196.1.4 and 204.3.4, only an epiphoric construal of so as referential to a succeeding adjunct appears to be available. (In the former case, the result of replacement is considered somewhat artificial; so was left unanalyzed in this occurrence.)³

As the examples above illustrate, albeit briefly, paraphrastic relations can be established between occurrences of various "zero-referential" phrases (or: between occurrences of referentials and announcers taken together with the referential phrases which they introduce). Further investigation of such relations is needed. More generally, the distance (under some measure) between a zero-referential and its referend requires further examination. In the case of the "conjunctive" forms, e.g., however, thus, accordingly, the referend of the zero-referential occurs in an immediately prior sentence. In the case of those reconstructed referentials introduced by sublanguage-announcers, there appears to be greater opportunity for its

referend to occur at some distance (e.g., in respect to number of intervening sentences), e.g., the zero-referential (after) the injection introduced by the 2d to 4th days in 198.2.19 has as its referend a phrase occurring in sentence 198.2.2. The presence of similar introducers, e.g., the 3d day, with the same referend, in these intervening sentences, complicates this assessment of distance, i.e., the zero-referentials introduced in intervening sentences could be considered as proximate referends of a given zero-referential.

3. Classifier-Relations. In section 3.2 of chapter 3 below, some instances of cross-reference in which the referential phrase is a classifier of its referend were presented. These results are briefly reviewed in section 3.1 where I also consider a few cases in which the referend classified by a referential occurs in other word-classes of the sub-language grammar, i.e., not in the word-classes A, C, T, G, B (or: B*), e.g., in categories of particular local operator modifiers (chapter 2, section 3.3). Section 3.2 presents a number of cross-references where the referend classified is an instance of a "response" sentence-type, e.g., with operators in the categories V or W. Two cases not within either of the above-mentioned groupings are noted in section 3.3. This section outlines the role of referential classifiers in a fragment of argumentation from the article.

Classifier-relations are discussed in each of the succeeding sections as well. For instance, there are a good

number of epiphoric referential relations in which the referential phrase is a classifier (section 4). Classifier-relations established in cross-references also appear to play a role in the division of the article into various sections (section 5) and in the distinction between meta-scientific material and sentences of the science-language (section 6).

3.1. Review of Previous Results. Results presented in section 3.2 of chapter 3 confirm the conjecture that each of the argument word-classes of the sublanguage grammar has a referential-classifier. That is, there are occurrences of referential-phrases in the word-classes A, C, T, G, and B which (i) occur as classifiers of phrases occurring within these word-classes, and (ii) can classify all other occurrences of phrases within these classes (with the exception perhaps of occurrences of other referential classifiers within these classes -- in which event these classifiers do not serve as referends to other referential phrases, cf. the classifier case of words in B in section 3.22 of chapter 3). It was found that there is no referential-classifier for all occurrences of phrases previously grouped (in FIS) in the word-class B, e.g., animal does not classify foot-pad. However, for those phrases not classifiable by animals, there does occur a referential classifier -- the site of injection. These phrases were consequently assigned to a new word-class designated B*; the residue remains in

word-class B for which animal does serve as a referential classifier. The results thus support in the main the established word-classes of the grammar presented in FIS.⁴

Within the "Influenzal Antibodies" article, there are a few stray occurrences of classifiers for phrases within these word-categories which are not referentials. For instance, in:

...the concentration of a substance at a given time need not be higher at a site of production than in a reservoir into which it is being drained (from 204.4.6).

a substance classifies antibodies, and a reservoir is a classifier of serum in the preceding sentence; a site of production is a classifier of particular phrases in the word-classes T, e.g. lymphatic tissue or C, e.g., lymphocytes.

In the example, time occurs as a member of the "t" modifier category noted in chapter 3, section 3.2.3 and can serve as a classifier for other phrases occurring within that category, e.g., 1 day, 2 days (after injection) in 198.2.2. The phrase time occurs as a referential classifier in sentence 206.1.1 of the "Summary": At the same time there is a burst of activity in the local lymphatic tissues. Similarly, the various intervals in 198.2.10 is referential to 1, 2, 3, 4, 5, 7, 9, 10 and 15 days after injection (in 198.2.2) from which one obtains classifier-sentences such as: 3 days after injection is an interval (after injection).

There are a few cross-references in which the referential phrase classifies other phrases which serve as local

operator modifiers of the major operator categories, e.g., V, W, in the sublanguage grammar (cf. FIS, chapter 4, section 2 and section 3.3 of chapter 2 here). For instance, in 200.2.2 this peak serves as a classifier of an (adjusted) referend in the preceding sentence: weights of 0.7 g to 0.8 g to which the popliteal lymphnodes increased progressively with time after injection. Interestingly, peak here is a classifier of a phrase concerning a particular range of values. In 205.1.2 this observed value is a referential classifier of 8192 in the preceding sentence (see also the values recorded in 205.1.4); that amount is a referential classifier of its referend in 203.3.3 -- 2-fold concentrated (a 2-fold concentrate is an amount).

3.2. Classifiers of Response-Sentences. Various referential phrases occur pro tem as classifiers of sentences in which there are operators of the categories V and W. That is, these phrases are in a particular occurrence classifiers of their referend. Whether these referentials might also serve to classify other instances of sentence-types (with operators V and W) is not considered in this work. These referential-relations are illustrated under two headings according to whether the referential phrase classifies sentences in which a V-operator occurs or those in which a W-operator occurs.

Referential Classifiers of Sentences with a V-Operator --

An instance of a referential classifier of this sort is

given as example (2) of section 1. The referend of reaction with influenzal virus can be considered antibodies to influenzal virus appeared; the classifier-sentence obtained is rendered as That antibodies to influenzal virus appeared is a reaction (with influenzal virus). A nearly parallel case is presented by the occurrence of reaction in sentence 197.3.11. In example (4) of section 2, the occurrence of antibody-response (or, simply response) may be construed as epiphoric to a discontiguous phrase within the same sentence, i.e., appearance of + amount + of antibody (the dropping of the plural suffix on amount could be regarded as an adjustment required by the phrase maximal). Replacement of the referential classifier (under identity, i.e., I* of chapter 3, section 3.2.4) yields (4') Undiluted allantoic fluid used as antigen produced the appearance of almost a maximal amount of antibody.⁵

Mention should also be made here of referential classifiers to sentences of the sentence-type AV(T) in comparative constructions and as "conjoined" under operators such as before.⁶ A case of the former is illustrated by the occurrences of the differences (and this difference) in 198.2.20 (R90, 92, and 94):

(8) In some animals THE DIFFERENCES were quite marked, in others, THE DIFFERENCES were small, and in some, THIS DIFFERENCE was not apparent.

The referend of these occurrences of the differences (and this difference) is located in the preceding sentence: it is the antibody-content of lymph collected in the 2d to 4th

days was higher than that of the lymphnode or serum (Anti-
body-content of lymph...being higher than that...serum is
a difference.). Replacement of the differences in its
first occurrence yields: In some animals the antibody con-
tent of lymph...was markedly higher than that of the lymph-
node or serum.... (See the Notes to these referentials for
further discussion). An instance of the latter is the epi-
phoric referential classifier the general pattern in 203.1.3:

(9) As can be seen, THE GENERAL PATTERN
is similar to that of earlier experiments.

While -- as indicated by seen and the preceding sentence --
"reference" is made to Figures 2 and 3 (cf. chapter 3, sec-
tion 2), a "textual" referend can be discerned in the fourth
sentence of that paragraph: antibody is seen to have ap-
peared in the local lymphatic system before it was observed
in the serum, from which one obtains the classifier-sen-
tence That antibody is seen to have appeared...is a general
pattern. (Note, incidentally, that the replacement of the
general pattern -- R58 in "Experiments Involving Different
Serological Types" -- must be preceded by resolution of that
in 203.1.3; cf. section 1 above). Referential classifiers
akin to those just described are: other occasions (198.1.8
R23), these quantitative relations (198.2.16, R75), the
range of individual variation among the experimental animals
(200.1.1, R110), the pattern of appearance of antibodies to
the virus injected (200.4.5, R14), and the previous exper-
ience (200.3.7, R26).

Referential Classifiers of Sentences with a W-Operator --

In 197.3.9, the toxic effect on the local lymphatic system (R24) is anaphoric to severe destruction of lymphocytes and of the architecture of the nodes in 3.6, and both sentences 3.7 and 3.8. Each of the three referend components is classified by the referential phrase, e.g., Severe destruction of lymphocytes and of the architecture of the nodes is a toxic effect on the local lymphatic system. The second referend component contains the phrase karyorrhexis ("bursting of the nucleus of cells") which can be considered an instance of a SCW sentence type (this sentence-type otherwise rarely occurs in the earlier articles surveyed in FIS). The third component -- Outlines of the follicular architecture could barely be discerned -- is here considered an instance of the sentence type TW, though it might alternatively be analyzed as containing an instance of the M operator discussed in section 3.5 of chapter 2 (i.e., as We could barely discern outlines of the follicular architecture). Further details on the various cross-references involved here are presented in the notes to R21-24 of sentence 197.3.9 (cf. R28 the extensive damage to the lymphnodes in 197.3.10).

The referential classifier the histological picture (R31) occurs in sentence 200.3.8: Thereafter the histological picture remained fairly constant for a few days. As in the previous case, the referend has three components: these areas were clearly recognizable as secondary nodules, many of the lymphocytes were of the small type, and large

lymphocytes, some reticulum cells and transitional forms
were to be seen at the centers of the nodules. The first
two components occur in sentence 200.3.6 -- the first
component is analyzed here as an instance of the relatively
infrequent TWT sentence-type; the second is analyzable as
either an instance of CYC or -- with reconstruction of
present there after lymphocytes -- as CWT. The third com-
ponent in 200.3.7 is also of the sentence-type CWT. Unlike
the previous case, each of the three components is not
classified by the referential phrase; rather the conjunction
of the (adjusted) components is: That (1/3) and (2/3) and
(3/3) is a histological picture (for use of a fractional in-
dex to cite components, see section 1 of chapter 4). The
modifier histological in the referential phrase pertains to
tissue structure or organization; in at least two of the
components, phrases of the word-class T (classified by the
referential "tissue", cf. section 3.2 of chapter 3) occur.

Yet another case of a referential classifier to sen-
tences with W-operators is the epiphoric a burst of activity
in the local lymphatic system (R20) in ...there is a burst
of activity in the local lymphatic system (from 206.1.1).
Replacement of the referential phrase yields: there is
marked enlargement of the lymphnode, almost entirely of
cortical tissue (from 206.1.2) and a sharp rise of the
absolute and relative count of lymphocytes in the lymph
emerging from the popliteal lymphnode (from 206.1.4).

3.3 Other Cases of Referential-Classifiers. Here two instances of cross-reference outside the groupings above are briefly considered. In:

(10) It is also that THE REACTION OF THE LOCAL LYMPHATIC SYSTEM, both in terms of concentration of antibody and of cell count in efferent lymph, is not categorically different...(from 203.3.3)

the reaction of the local lymphatic system can be construed as epiphoric to concentration of antibody and cell count in efferent lymph within the same sentence. Replacement of the referential yields: It is also seen that the concentration of antibody and cell count in efferent lymph is not categorically different....

The referential classifier this property in sentence 197.3.9:

(11) In view of the experience gathered with the lymphocytopenic effect of influenzal virus preparations when injected intravenously into the rabbit (16), it was felt that perhaps the toxic effect on the local lymphatic tissue was due to THIS PROPERTY of the particular viral agent employed.

has as its referend lymphocytopenic effect within that sentence. The classifier-sentence obtained from the stated cross-reference is: Effecting lymphocytopenia is a property.

The sentence (11) also provides some preliminary indications of the manner in which cross-referential relations (in particular those involving referential-classifiers) are implicated in the organization of arguments. The argument made in sentence (11) can be roughly sketched as follows:

In 197.3.1 it is asserted that an influenzal virus preparation was used. If the synonymous injected is substituted in place of used in this sentence, a zero-referential (into) the animals can be reconstructed (cf. section 2 above on use) with its referend a particular occurrence or rabbits in the preceding text, e.g., in sentence 194.3.1. The referends of the referential phrase the toxic effect on the local lymphatic system were noted above (p. 414), e.g., severe destruction of lymphocytes. The referential phrase could also be recast as the effect on the local lymphatic system caused by the toxin, where the toxin is referential to the subject of was used (or: injected) in 3.1. From sentence (11) above one can obtain a general sentence renderable as: Influenzal virus preparations injected intravenously into rabbits effect lymphocytopenia (i.e., a reduced number of lymphocytes). The authors do not state explicitly that the injection of influenzal virus preparation is intravenous. If a corresponding implicit sentence can be elicited, one can conclude (by instantiation): the influenzal virus preparations injected into the rabbits effected lymphocytopenia. The authors then presumably making use of implicit sentences which relate lymphocytopenia to the toxic effect, hypothesize that the severe destruction of lymphocytes, etc. is due to the virus effecting lymphocytopenia. (Another instance in which referential classifiers play a role in the organization of arguments may be noted in paragraph 205.1 of the article,

cf. R106: The evidence for the lymphocyte itself as a primary source of the antibody in 205.1.1).

4. Epiphoric Cross-Reference. The present section surveys a variety of epiphoric cross-referential relations in the "Influenzal Antibodies" article. In section 4.1, epiphoric occurrences of it are presented and some difficulties in analysis of the definite article are discussed. Epiphoric cross-references should be distinguished from other epiphoric relations among phrases (e.g., sentences) in a text (section 4.2). Section 4.3 notes a number of ways in which the occurrence of a phrase as an epiphoric referential is indicated, such as use of the phrase following or nominal phrases with numerals as determiners, e.g., two series of studies. Aside from those cases noted in section 4.1, and epiphoric occurrences of so, reviewed in section 2 in connection with zero-referentials, most occurrences of epiphoric referentials are referential classifiers; in a number of these cross-references, the relation of referend to referential may be described as one of "exemplification" (section 4.4). Section 4.5 describes particular patterns of epiphoric cross-reference in which the referend (or a particular phrase in the sentence containing the referend) itself cross-refers to the referential phrase (or particular words within it). Finally, some cases in which replacement of epiphoric referentials poses particular difficulties are noted. In sections 4.2-6, I have incorporated some illustrations of epiphoric cross-reference drawn from a

survey of some 4 articles in the corpus of FIS and one which is the subject of current research in studying the immunology sublanguage.⁷

4.1. Epiphoric "It"; Analysis of the Definite Article. In nearly all occurrences in which it does not cross-refer to a preceding occurrence of a phrase, i.e., is not anaphoric, (as in, e.g., sentence 203.1.5, R70), it may be taken as epiphoric to the complement of a non-elementary operator (an operator which has among its arguments another operator, cf. the survey of operator-grammar in chapter 2, section 2.1). Some examples from the article follow (the referential phrase is capitalized and its referend enclosed in parentheses).

(12a) The experiments indicated that IT was desirable (to use an adequate, but not overwhelming amount of virus in the vaccine).
[sentence 198.1.9]

(12b) ...IT was not in each case possible (to obtain a satisfactory specimen of lymph).
[from 198.2.18]

(12c) ...IT was shown (that macrophages did not, on contact with antigens in vivo, produce antibodies).
[from 193.2.2]

(12d) ...IT might be expected (that the antibody circulating in the serum would be fixed to a greater extent, perhaps in the active lymphnode than in another tissue not directly involved).
[from 200.4.12]

In examples (12a-b), it is epiphoric to the infinitival complements of the operators desirable and possible (in terms of operator-status O_o). Examples (12c-d) present instances in which it cross-refers to the complements

introduced by that (expect and show are O_{no}). In all of the examples, the referend is substitutable for it under a paraphrastic identity transformation. The occurrence of it in example (10) above and that in (13), presents difficulties.

(13) IT was found (that the test could
be carried out by this micro-method),....
[from 197.2.4]

Replacement of it in (13) by the referend indicated and of it in (10) by the complement of was seen is questionably acceptable. In the notes to the analysis, it is suggested that the difficulty in replacement resides in the status of find and seen as O_{nn} operators; their occurrence in positions in which they take sentential complements is due to a "metaphoric" extension of their selection (cf. GEMP 67-68). If for found in (13) and seen in (10), one substitutes locally synonymous phrases such as discovered and noticed, (both discover and notice are O_{no} operators), replacement of it is acceptable.⁸ If this adjustment is not regarded as licensed, it, in the examples given and others in the text, may simply be taken as non-referential.

A fair number of occurrences of the definite article present particular difficulties. In phrases such as: the virus introduced [193.3.5], the particular viral agent employed [197.3.9; see example (11)], the lymph collected [198.2.3], and the data presented [204.1.1], the definite article can be construed as determinative (and hence, epiphoric, cf. section 8.4 of chapter 1) or as anaphoric. It

may be noted that replacement of the first-mentioned phrase by its candidate referend active vaccine-virus [193.3.3] presents no difficulties, whereas replacement of the data presented does (see notes to R1 in 204.1.1), but this is to beg the question as to the anaphoric or determinative status of the definite article in these phrases. In the analysis of the article presented in chapter 4, such phrases -- of the form the N V-ed -- are considered to be anaphoric.

The ambiguity between the determinative and anaphoric construal of the in these cases is in accord with Robbins' analysis of the definite article (1968), briefly presented in section 8.4 of the first chapter. As was noted there, Robbins derives anaphoric occurrences of the from epiphoric (determinative) occurrences in which the N is followed by a right adjunct (generally a relative clause). Thus, repetitively-based zeroing of the wh-adjunct in the contrived example:

(14) Sylvia has a cat. The cat which
Sylvia has is an Angora.

is said to yield an anaphoric occurrence of the cat. In the cases presented above, there is "partial" reduction of wh-adjunct, e.g., in the virus introduced, which together with is has been zeroed (cf. the virus which was introduced, GEMP 3.51 for this reduction) and the phrases may thus be considered -- in respect to Robbins' analysis -- "in between" an anaphoric and determinative use of the

definite article, in line with the ambiguity mentioned. Support for Robbins' analysis is given by replacements of anaphoric occurrences of the (or: these, this) in which the definite article occurs as determinative in the resultant, e.g., replacement of the anaphoric these areas in ...these areas were clearly recognizable as secondary nodules (from 200.3.6) yields: the circular areas into which there were beginnings of groupings of small lymphocytes were clearly recognizable as secondary nodules in which the occurs determinatively. In her analysis, Robbins -- working with elementary (two-sentence) texts -- did not consider occurrences of the in phrases such as The antibodies in these tissues [in sentence 204.1.4]. Here these tissues is anaphoric as is the entire phrase the antibodies in these tissues. Replacement of the latter referential phrase yields: The antibodies to the viral protein injected which appear in the lymphnode and in the lymph emerging from that node.⁹ The results of the present work do not suffice for a definitive evaluation of Robbins' analysis. In many occurrences of an anaphoric phrase, e.g., the serum, the referend is said to occur passim or is taken to be a preceding occurrence of the serum which is itself referential. I do not consider whether further replacements yield sentences in which the occurs in its determinative use (in the case of a referend occurring passim, this assessment is made more difficult).

4.2 Epiphora and Epiphoric Cross-Reference. Epiphoric relations between sentences or sentence-segments of a text are clearly wider than those indicated by particular cross-references. In one of the articles surveyed, it is stated: The experiment left much to be desired [McMaster 792.4.1]; succeeding sentences provide the grounds for this statement (cf. 194.1.1-2 of the "Influenzal" article for a related case). In Harris, et al (167.4.1), the sentence The finding of these diverse cell types ...raises the question of whether there are, in fact, two different cell lines which produce antibody or whether all of these forms may represent different stages of development of a single cell-line is followed by sentences discussing the questions raised. Sections of an article introduced by either of these sentences without a "follow-up" would be taken as odd, and questionably coherent. Thus, these sentences may in a certain sense be regarded as epiphoric, although neither contains an epiphoric cross-referential. "Epiphoric" relations of this kind suggest the possibility that certain issues current in "pragmatics", e.g., conversational maxims, can be reformulated in terms amenable to investigation by discourse-analytic methods.

Some of these wider epiphoric relations are evidently connected to instances of epiphoric cross-reference. In:

(15) TWO OF THE EARLIER STUDIES MENTIONED had been concerned with the sequence of events following injection of active virus [193.3.2].

two of the earlier studies...mentioned is epiphoric to McMaster and Kidd (2) in [193.3.3] and Burnet and Lush (3) in [193.3.6]. The phrase the sequence of events...virus is, however, not considered as an epiphoric referential (there is no suitable referend in the succeeding sentences) although it may be considered to "summarize" portions of the succeeding text. Similarly, in:

(16) In recent years, A SERIES OF DEVELOPMENTS has pointed to the role of the lymphatic system in the formation of antibodies [193.1.1].

a series of developments is an epiphoric referential, the phrase the role...antibodies is evidently related to succeeding sentences within the paragraph although it is not referential to them.

4.3 Indications of Epiphoric Referentials. Epiphoric referentials in the articles surveyed are indicated in a variety of ways (these ways are not to be taken as mutually exclusive).

(a) Occurrences of following and related forms: In the "Influenzal Antibodies" article, there is a single occurrence of following in an epiphoric referential phrase:

(17) ...and at various intervals thereafter THE FOLLOWING MATERIALS collected: lymph from the efferent lymphatic vessel of the popliteal lymphnode, the node itself, and heart-blood [from 194.1.3].

In (17), the referential classifier the following materials has as its referend those phrases which succeed the colon. Other occurrences of following

in the articles surveyed involve cross-reference across sentence-boundaries, e.g.,

(18a) ...the materials to be tested for antibody content were obtained in THE FOLLOWING MANNER [from McMaster 784.2.1].

(18b) The general plan of the experiment was as FOLLOWS.

(18c) The problem of finding and examining single-plague-producing cells was solved in THE FOLLOWING WAY [Harris, et al 163.4.1].

In (18a) and (18c), the capitalized referential phrases involve classifiers (as in (17) above). However, the classifiers are not manner or way by themselves but rather, e.g., a manner of obtaining and extracting the materials to be tested for antibody content. Replacing the referential phrases in such cases generally requires a change of the preceding preposition to, e.g., by, and a nominalization of the referend (or, of each of its components), e.g., replacement of the referential in (18a) yields: the materials...were obtained and extracted by placing on its back with forelegs slightly extended the mouse anesthetized with ether or luminal and painting the neck with paraffin oil....

(b) Occurrences with comparative-related forms: In the "Influenzal" article, there are three cases of epiphoric referentials with determiners of comparative form: another series of experiments [200.4.1, R1], another group of proteins [204.1, R28], and further

evidence of specificity [204.4.1, R51]. The first and third of these referentials are classifiers of their referends (see below) and occur -- as is indicated by their citation-numerals -- in the initial sentence of a paragraph. The comparative form may in some of these cases be taken to announce a zero-referential (cf. notes to these sentences).

(c) Occurrences with numerals as determiners: In the "Influenzal" article, there are several instances of epiphoric cross-reference in which the referential phrase contains a numerical determiner. These include: two series of studies [193.1.3, R7], two of the earlier studies mentioned [193.3.2, R47], two convenient methods [196.1.1, R74], and two reasons (204.4.5, R79). All of these referentials are connected in various ways to particular anaphoric cross-references; some of these connections are described in section 4.5. Similar epiphoric referentials are found in others of the articles surveyed, e.g., three types of experiments in Three types of experiments were devised to control the possibilities just discussed [McMaster, 791.1.1].

(d) "Evidence" as a classifier: The classifier noun evidence occurs as part of epiphoric referential phrases on two occasions in the "Influenzal" article: one, noted under (b), is further evidence of specificity [204.4.1, R51]; the other is the evidence for the

lymphocyte itself as a primary source of the antibody [205.1.1, R106]. In the articles surveyed, there are a number of similar epiphoric referential classifiers:

(19) Dougherty and White seem to have produced FURTHER EVIDENCE IN FAVOUR OF THE LAST MENTIONED OPINION [Fagraeus, 1.1.3].

(20) Experimental procedures which deplete lymphoid tissue of small lymphocytes have provided CIRCUMSTANTIAL EVIDENCE THAT SMALL LYMPHOCYTES PLAY A PART IN PRIMARY IMMUNE RESPONSE [McGregor, 303.1.1].

(21) In spite of the lack of conclusive data..., CONSIDERABLE EVIDENCE exists to suggest that alterations in availability of adrenal cortical hormone are of importance in the immunologic response [Craddock, 160.2.1].

It may be noted that the referential classifiers in both the "Influenzal Antibodies" article and in (19-21) occur in initial sentences of paragraphs. In all of these cases but (21), evidence occurs as a relational noun: the complement of the noun is to be considered part of the referential classifier. Some of these cases are discussed further in section 4.6.

The grouping of epiphoric referentials under the headings (a)-(d) is admittedly rough. With the exception of (a), these indications of epiphoric cross-reference cannot be considered criteria for the occurrence of a phrase as an epiphoric cross-referential, at least not without further qualifications. Many of these occurrences are in initial sentences of paragraphs. It is possible that occurrence

in initial sentences plus some one of these "indicators" suffices to delimit particular phrases as epiphoric.

4.4. "Exemplification". In the articles surveyed there are a few epiphoric cross-references in which the referend may be said to indicate an "exemplification" or "sample" of the class named by the referential phrase.¹⁰ A clear case of this relation is seen in:

(22) A reaction of lymphnodes to infection is recognized in A MULTITUDE OF DISEASES, - as e.g. in plague, in typhoid, and frequently in tonsillar infection [McMaster 783.1.6].

In (22), use of "e.g." indicates a sampling of a multitude of diseases ("e.g." itself can be considered to be an announcer of an anaphoric referential -- for an example of this). In (22), the referential phrase is replaceable by the sample diseases mentioned.¹¹ The sentence given above as (21) is followed by:

(21') Dougherty and co-workers have reported (an appreciable augmentation of serum antibody titer in mice by injections of adrenal cortical hormone or by exposure of the animals to various noxious stimuli designed to promote increased hormonal secretion by the adrenal cortex, such as roentgen radiation). [Craddock 160.2.2]

The evidence reported in the parenthesized referend in (21') does not necessarily exhaust the considerable evidence spoken of in (21) but is interpretable as comprising a sample of it. Within (21') there is an epiphoric cross-reference between various noxious stimuli...cortex and roentgen radiation; roentgen radiation (as indicated by the phrase such as) is one of (i.e., a sample of) the

various noxious stimuli considered. A consequence of (21') is: Dougherty and co-workers have reported...by exposure of the animals to roentgen radiation in which the epiphoric classifier has been replaced by its referend. Replacement of considerable evidence in (21) by the referend indicated yields:

(23) In spite of the lack of conclusive data..., an appreciable augmentation of serum antibody titer in mice by injections...suggests that alterations in availability of adrenal cortical hormone are of importance in the immunologic response.

which is a consequence of (21) -- (on the deletion of the weak verb exist in the replacement, see the discussion of replacements in section 4.6).

A possible case of "exemplification" within the "Influenzal Antibodies" article is the relation between the epiphoric the range of individual variation among the experimental animals in 200.1.1 and its referend in the succeeding two sentences (cf. text). The referend-sentences do not exhaust the data, i.e., sentences, obtainable from Table II (see page for Table II) but provide a sampling (replacement of the referential classifier is discussed in the notes to sentence 200.1.1, R110).

4.5. Patterns of Epiphoric Cross-Reference. A number of epiphoric cross-references, particularly those in which the referential phrase contains a numerical determiner (see (c) in section 4.3), are variously associated with anaphoric referential relations. In example (15), noted in section 4.2, the epiphoric referential two of the earlier studies

mentioned contains within its scope the anaphoric referential the earlier studies mentioned. Determining the referend of the former referential as the phrase McMaster and Kidd (2) in [193.3.3] and Burnet and Lush (3) in [193.3.6] assists in recognizing the referend of the latter. The citation-numerals '2' and '3' indicate that referend as the occurrence of Early investigations (1-3) in [193.1.2]. Expansion of the anaphoric referential into the studies mentioned earlier than the other studies appears forced. The use of the comparative form in the referential is, however, explicable given the zero-referential announced by more in [193.1.3]: more recently than these. The referend of these is determinable as early investigations (1-3); replacement of the zero-referential in [193.1.3] yields:

(24) More recently than the early investigations (1-3), two series of studies have been concerned with the relation of the lymphatic system to the production of antibodies.

from which sentence it may be concluded: Two series of studies are more recent than the early investigations. The converse of this sentence is: The early investigations are earlier than two series of studies, thus accounting for use of the comparative earlier (the epiphoric referential in example 24 -- two series of studies -- is addressed below).

The epiphoric referential classifier two reasons in sentence [204.4.5] has as its referend the sentence following first in [204.4.6] and the sentence succeeding second

in [204.4.7]. The phrases first and second may be regarded as metalinguistic announcers of a zero-referential and be rewritten as: The first/second of them is:, where them cross-refers to two reasons.¹²

A like dependency between epiphoric and anaphoric cross-reference is seen in considering the referend for two series of studies in 193.1.3 (cf. example 24). The relevant fragments of the succeeding sentences are:

(25a) In one of these, that of White and Dougherty ([193.1.4].

(25b) In the other series of studies Ehrich and Harris made.... [193.1.5].

As may be readily discerned, replacement of two series of studies requires prior resolution of the anaphoras in (25a-b). The referend of these in (25a) is the epiphoric referential phrase two series of studies; the referend of that is indifferently the occurrence of series of studies in 1.3 or its occurrence in 1.4 upon replacement of these. The result of replacing that is the series of studies in (25a). Given both of these replacements it may be noted that one of two series of studies can be taken as itself epiphoric to the series of studies of White and Dougherty. The first component of the referend is determinable as either one of two series of studies or the series of studies of White and Dougherty; the latter is adopted in the analysis (upon replacement, two series of studies is effaced in this component). In (25b), the other series of studies is not expandable to the series of studies other than that;

in line with the discussion of other in chapter 3 (section 3.1), the other series of studies names one member of two-membered set. The phrase may accordingly be rewritten as: the other of [THE series of studies] where the bracketed referential phrase has as its referend the occurrence of two series of studies in [193.1.3]. This phrase may also be said to "contrast with" or "allude to" the first referend-component.¹³ The second component of the referend is identifiable as the other series of studies in (25b).

The dependence of epiphora upon anaphora in such cases accounts for an adjustment made in the replacement of two series of studies: replacement here requires that the anaphoric occurrences of the in the components of the referend be rewritten as: a(n).¹⁴ Upon replacement of two series of studies, one obtains:

(26) More recently, a series of studies of White and Dougherty and another series of studies have been concerned with the relation of the lymphatic system to the production of antibodies.

(Insertion of: of Ehrich and Harris from 25b after another series of studies may be made given the resulting parallelism with the first component of the referend.)

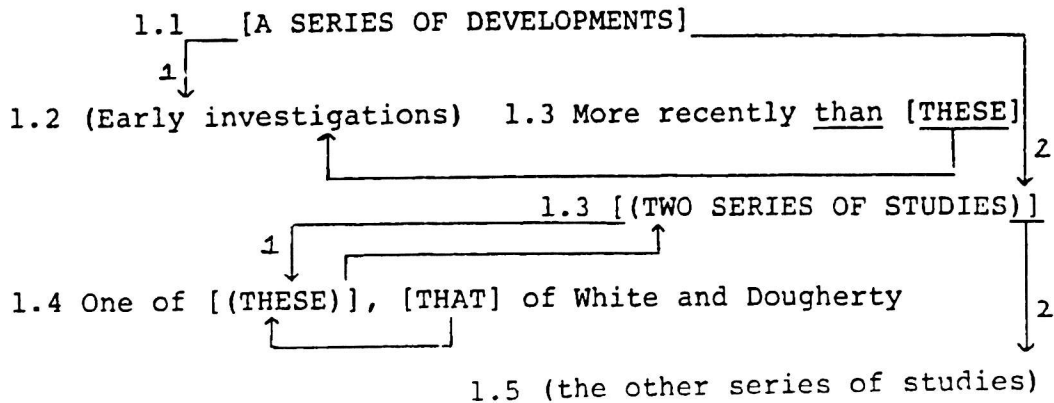
In this connection mention might be made of epiphoric referentials with determiners such as a(n) or another: a series of developments [193.1.1, R1], an expression [195.2.1], another series of experiments [200.4.1, R1], another group of proteins [204.1.7, R28], and a burst of activity in the local lymphatic system [206.1.1, R20].

The first epiphoric referential of this listing -- a series of developments -- is also the first referential which occurs in the article. It presents especial difficulties both in determination of its referend and in replacement (the Note to R1 of sentence 193.1.1 gives an extensive discussion). For purpose of the present discussion, the referend of a series of developments can be given as: early investigations (1-3) and indicated that following introduction...[from 193.1.2] and two series of studies and have been concerned with the relation of the lymphatic system...[from 193.1.3]. Replacement yields:

(27) In recent years, early investigations (1-3) which indicated that following the introduction of an antigen into the tissues of an animal, antibodies could be found in the regional lymph-node, often appearing there earlier than in the blood serum, and two series of studies which have been concerned with the relation of the lymphatic system to the production of antibodies have pointed to the role of the lymphatic system in the formation of antibodies.

The resultant form, while unwieldy -- given the length of the referend -- is nonetheless acceptable, and a consequence of the text. It should be noted that one of the referend-components of a series of developments is the epiphoric referential two series of studies just discussed. If attention is restricted to the M-segments (cf. chapter 2, section 3.5) of the referend of a series of developments, some of the referential relations in the first paragraph of page 193 covered above can be illustrated as follows. In the diagram, referential phrases are capitalized and bracketed and zero-referentials are underlined. The referend is

enclosed in parentheses. Arrows are drawn from the referential phrase to the referend; a downward arrow indicates an epiphora, an upward directed arrow an anaphora (numbers next to the arrow indicate the first or second component of a referential):



4.6 Replacement of Epiphoric Referentials -- Some Examples.

To conclude this discussion of epiphora, two cases from the "Influenzal" article (another series of experiments and further evidence of specificity) are considered in which determination of the referend and/or replacement poses difficulties. Replacements of two of the epiphoric referentials presented under (c) in section 4.3 are also reviewed.

The referential phrase another series of experiments occurs in (28):

(28) ANOTHER SERIES OF EXPERIMENTS was done to confirm the specificity of the reaction [200.4.1, R1].

(In this and the following case, the comparative forms, which may be considered to announce zero-referentials, are not considered). The referend of the referential is determinable as sentence 4.2 and possibly 4.4:

(28') Each rabbit received 0.2 ml of PR8 vaccine in the right foot-pad, and 0.2 ml of a Lee vaccine in the left foot-pad [200.4.2]; After suitable intervals of time the lymph, lymphnode, and serum were collected and all specimens were tested for their antibody-content to both PR8 and Lee virus [200.4.4].

The intervening sentence can be taken as a parenthetical remark, optionally inserted after the first component [200.4.2] of the referend. The phrase series of experiments is thus related to each rabbit (or: each rabbit receiving 0.2 ml of PR8...pad) as a classifier (if sentence 200.4.4 is considered the second referend-component, series can perhaps be related to the occurrence of intervals of time). Such classifier-relations are crucial to the discussion of metascientific segments and science-language sentences in section 6. To replace the referential phrase, a paraphrastic transformation is applied to (28), permuting to confirm...reaction to the front. Under the rule of detachment for epiphora (cf. section 1 of chapter 4; this rule is used in all of the cases discussed here), the semantically weak verb was done is deleted in (28) and sentence 200.4.2 (or 200.4.2 conjoined with 200.4.4) is substituted, yielding:

(28") To confirm the specificity of the reaction each rabbit received 0.2 ml of a PR8 vaccine... and after suitable intervals of time the lymph, lymphnode, and serum...viruses.¹⁵

In the second case, further evidence of specificity is referential to the parenthesized phrases in (29):

(29) FURTHER EVIDENCE OF SPECIFICITY was afforded by the experiments in which opposite legs of each rabbit received injections of different serological types of influenzal virus. The (differences in titers to the homologous and heterologous virus) (are clearly marked)...[204.4.1-2].

To replace the referential here, the first sentence of (29) is first depassivized. The adjusted referend is differences in titers to the homologous and heterologous virus which are clearly marked (classified by evidence of specificity) which is transformable to clearly marked differences in titers.... The resultant form is more acceptable if for afford in (29) a local synonym, e.g., provide, is substituted. These replacement operations yield:

(29') The experiments in which opposite legs of each rabbit received injections of different serological types of influenzal virus provided clearly marked differences in titers to the homologous and heterologous virus.

The next two cases, drawn from outside the "Influenzal" article, are presented to provide an indication of particular difficulties in replacement.

The first case concerns the epiphoric referential given in (19) -- the cross-reference is indicated as above:

(19) Dougherty and White seem to have produced FURTHER EVIDENCE IN FAVOUR OF THE LAST-MENTIONED OPINION. (By injection of corticotropic pituitary extract or extract of suprarenal cortex) they achieved (a disintegration of lymphocytes in blood and tissues and a simultaneous rise in antibody titer). [Fagraeus 1.1.3-4]

The initial sentence of (19) is at first reading odd: what is the import of seem? Does the author question whether

the subsequent sentence states evidence for the opinion, whether Dougherty and White produced it, or whether it is evidence? Neither of the latter two appear to be possible inasmuch as whatever is evidence is asserted. The classifier-status of evidence and the remark above lead us to rewrite the initial sentence as: Dougherty and White have produced that which seems to be further evidence..., where that is epiphoric to the discontiguous referend indicated. Replacement of that by the referend yields:

(19') Dougherty and White have produced by injection of corticotropic pituitary extract or extract of suprarenal cortex a disintegration of lymphocytes in blood and tissues and a simultaneous rise in antibody titer, which seems to be further evidence in favour of the last-mentioned opinion.

The second case -- presented as (20) -- is exceptional in that two epiphoric referentials occur in the initial sentence (the referend of the first is enclosed in parentheses):

(20) EXPERIMENTAL PROCEDURES WHICH DEplete LYMPHOID TISSUE OF SMALL LYMPHOCYTES have provided CIRCUMSTANTIAL EVIDENCE THAT SMALL LYMPHOCYTES PLAY A PART IN PRIMARY IMMUNE RESPONSE. Thus, the primary antibody response of animals can be depressed or abolished by (agents which damage lymphoid tissue) or by (neonatal thymectomy which prevents its normal development).
[McGregor 303.1.1-2]

The first epiphoric referential is a classifier of the referend, e.g., agents which damage lymphoid tissue and neonatal thymectomy...are experimental procedures which deplete lymphoid tissue of small lymphocytes (the occurrence of thus and or in the second sentence may point to

the relation between referential and referend as one of "exemplification" in both cases, cf. section 4.4). Replacement of this referential is by conjunction of the two referend-components indicated, yielding:

(20') Agents which damage lymphoid tissue and neonatal thymectomy which prevents its normal development have provided circumstantial evidence....

Replacement of the second referential classifier is not clear -- the referend is all of the second sentence in (20) except for thus, i.e., it overlaps the referend of the first referential. If have provided in the first sentence is taken as a classifier-like verb for can depress or abolish in the second, both replacements might be coordinated: for experimental procedures which..., the referend noted is substituted; for have provided -- can depress or abolish is substituted; for the second epiphoric referential the primary antibody response is substituted.¹⁶ The resultant sentence is identical to the second sentence of (20) minus thus after it has been depassivized.

5. Cross-Reference and the Organization of the Article.

The results of the present investigation have bearing upon the organization of the article into various sections and subsections and the separation supposed in FIS between sentences considered part of the immunological sublanguage and those which relate to methods and procedures (chapter 3, section 1 reviews the organization of the article into

various headings; section 3.4 of chapter 2 discusses the division between "Methods" sentences and science-language sentences).

In the section headed "Introduction" there are no cross-references to occurrences of phrases in sentences outside that section. Within the "Experimental" section, there are a few instances of referential relations across the various subsections. For instance, injection (R2) in sentence 200.2.1 in "Histological changes in the Lymph-node" is referential to the first conjunct of 198.2.2 in the preceding subsection. There are a few cases of cross-reference in this section in which the referend of a referential is identified as occurring in sentences of the section "Methods and Materials" (cf. section 5.1). The relative self-containedness or "integrity" of the "Experimental" section is indicated by the first referential phrase in the "Discussion" section (204.1.1) -- the data presented. If the definite article in this phrase is considered anaphoric and not determinative (cf. section 4.1), the referend is loosely identifiable as the various instances of sublanguage sentence-types within the "Experimental" section, each of which is classified by datum, e.g., That in the early days after injection (2 to 4 days) antibodies were found in the right lymphnode against PR8 exclusively, and in the left node only against Lee is a datum (cf. section 200.4.6, see section 6.13 below).

Three of the remaining sections merit special consideration (The one-sentence acknowledgment, containing a

reference to the authors' names, may be disregarded). Section 5.1 examines the "Methods and Materials" portion of the article. Here it was of interest to note whether the sentences within this article-segment displayed any distinctive patterns of cross-reference, e.g., in respect to classifier-relations, as opposed to the remainder of the text. The "Discussion" and "Summary" sections display many instances of cross-reference in which the referend is located in a preceding article-section, e.g., R74 in [204.4.5]. This in itself should occasion no surprise inasmuch as such sections by convention point out the implications of, and encapsulate, the results reported in the article. More noteworthy is the fact that nearly all sentences within these sections appear to be themselves connected to earlier sentences (or: sentence-fragments) of the article. That is, many of these sentences "nearly repeat" these prior sentences or may be considered consequences of certain of these sentences. Referential-relations typically obtain between occurrences of phrases within sentences; the connections noted between sentences in the "Discussion" and "Summary" sections and those in prior sections suggest the possibility of considering particular occurrences of sentences as themselves referential to other sentences. Appraisal of this prospect is difficult as the connections between these sentences are quite involved. Section 5.2 provides a preliminary sketch of them for two sentences of the "Discussion".

5.1. "Methods and Materials". Within the "Methods and Materials" section there are several cross-references in which the referential phrase occurs in one subsection and its referend in a prior subsection. Given the separate enumeration of all referential and referend phrases within this section, these cases may be readily discerned in the analysis (chapter 4, section 2) by comparison of the highest-numbered superscript (i.e., referential-phrase) in the subsection with subscripted referend phrases assigned a larger number than that superscript, i.e., which are referends of referentials occurring in another subsection (cf. section 1 of chapter 4 for the notation provided for indicating referentials and referends in the text). The "Methods and Materials" section itself is self-contained in respect to cross-reference. That is, there are no instances in which a referential phrase within the section has its referend located in a section outside the section.

There are several ways in which this section distinguishes itself from the remainder of the article in respect to cross-reference. One of these ways is the implicit-sentences presumed in order to obtain a referend for a particular referential phrase (cf. chapter 1, section 2.4). Nearly all of these tacit sentences relate to laboratory procedures. For examples, an implicit sentence -- Injections are made with a needle -- is given to resolve the occurrence of the referential the needle in sentence [194.2.3, R27]. With one exception the other tacit sen-

tences assumed pertain to the procedure of centrifugation, e.g., sentences [195.1.5 and 195.2.3]. The exceptional case is the tacit sentence -- Chick-embryos grow in eggs which is assumed in order to resolve the eggs (R4) in sentence [194.2.2]. This case is perhaps comparable to the assumption -- Foot-pads are parts of legs -- made in other sections of the article (see, e.g., sentence 200.4.8).

The "Methods" section also exhibits characteristic classifier-relations between certain referentials and their referends. For instance, in sentence 197.2.1, the phrase the reagents (R156) is epiphoric to the occurrence of cell-extract and the influenzal virus in the succeeding sentence. The subsection "Technic of Antibody-determination" displays a distinctive pattern of referential classifiers: test as well as technic occur as classifiers of method; occurrences of test in turn classify occurrences of technic. In (30):

(30) The ratio of titers obtained in
(the pattern-test) to titers obtained
in (the sedimentative test) enable us
to transfer from one system to the other.
[197.1.5]

the referends of one system and the other are taken to be the pattern-test and the sedimentative-test respectively. The occurrence of system here as a referential-classifier should be compared with the occurrence of the same system (R25) in sentence 204.1.6 of the "Discussion" section. In the latter case, the same system is anaphoric to the occurrence of the local lymphatic system (or -- resolving the

zero-referential announced by local -- to the lymphatic system local to the foot-pad).

Within the subsection "Technic of Antibody-determination", test occurs both as a classifier of method and of phrases which name the material to be tested. An example of the former is provided in sentence 196.1.6 where the pattern-test (R92) is considered referential to the preceding occurrence of the pattern-method (itself a referential phrase, R87) within that sentence. In (31):

(31) After 10 minutes of incubation at room-temperature (0.2 ml of a 1 per-cent suspension of cells was added to IT) and THE TEST was incubated at 4 C. until the red cells had settled to the bottom of the test-tubes. [sentence 197.1.2]

the test as subject of was incubated evidently is not referential to occurrences of, e.g., the pattern-method. The referend is indicated in brackets and is taken to include the zero-referential announced by added. Resolution of the test (143) here requires prior resolution of the zero-referential whose referend occurs in the immediately prior sentence. Replacement yields the prolix yet comprehensible:

(31') ...and the produce of adding 0.2 ml of a 1 per-cent suspension of cells to the product of adding 0.4 ml of antigen in suitable dilution to 0.4 ml of serial dilutions of lymph was incubated at 4 C. until the red cells had settled to the bottom of the test-tubes.

(See the Notes to R142 and R143 of the "Methods" section for details).

Aside from these distinctive referential-classifiers, the "Methods" section shares a number of referential classifiers with the rest of the article, e.g., the cells

in sentence 195.2.3 (cf. the antigen in (31)) as well as several "sublanguage-announcers", e.g., collected, specimens (chapter 3, section 3.23). In the subsection noted before, zero-referentials the cells and the virus (or: the antigen) are established for various occurrences of the operator agglutinate (cf. the occurrence of the operator with both of its arguments present in Both methods utilize the phenomenon of agglutination of chicken-erythrocytes by allantoic fluids infected with influenzal virus,... in sentence 196.1.2).¹⁷

As noted above, there are several cases in which the referend of a referential phrase occurring in the "Experimental" section itself occurs in "Methods and Materials". For example, the popliteal lymphnodes (R2) and the zero-referential the animals (R3) in sentence 197.3.3 are taken to have as their referends occurrences of the popliteal lymphnodes and rabbits in sentences of the "Methods" section. Alternatively, given the passim occurrence of these phrases, the referends can be taken to occur in the "Introduction", e.g., sentence 194.1.3. In sentence 204.1.5 of the "Discussion", these serological tests is referential to the occurrence (passim) of the pattern-test and the sedimentation-test in paragraph 196.1 in "Methods". The question may be posed whether resolution of these referentials (and others with referends in "Methods") yields sentences which are not instances of science-language sentence-types (see chapter 2, section 4.3). The matter is compli-

cated by the inclusion of sentences which pertain to procedures within other sections of the article.¹⁸ For example, resolution of the lymphocytes (R27) in sentence 193.1.9 of the "Introduction" yields -- ...the lymphocytes into which lymph was separated by centrifugation contained antibody in higher concentration than the supernate. The relative clause adjunct on lymphocytes is not representable in terms of the sublanguage word-classes (unless, e.g., was separated by centrifugation is considered an intransitive W-operator with lymph as its T-subject). Resolution of these referential phrases, i.e. referentials whose referends occur in sentences concerning methods¹⁹, yield sentences in which the phrases pertaining to methods generally appear as secondary sentences (adjuncts) on phrases which are members of sublanguage word-classes. In cases such as the popliteal lymphnodes, the animals noted above, resolution of the referential phrase yields a sentence of a sublanguage-sentence type. Secondary sentences which relate to methods were not assigned to a sublanguage word-class in the analyses of FIS as there was insufficient recurrence of these phrases to establish well-entrenched word-classes. In this respect resolution of these referentials does not result in sentences which are not instances of science-language sentence types in line with the hypothesis forwarded. However, it may well be the case that upon resolution of cross-references there is sufficient recurrence of phrases such as was centrifuged, so as to establish specific

word-classes. This need not be taken as counter to the supposition that sentences which relate to methods comprise a distinct sublanguage (chapter 2, section 4.1) from the science-language. Rather, it suggests that if methods-sentences form a distinct "sublanguage of procedures", this sublanguage is closely linked to the science-language in ways which merit further study.

5.2. "Repeated" Sentences. Many, though not all, of the sentences which occur under the section headings "Discussion" and "Summary" appear to be "near repetitions" or consequences of previous sentences (or: sentence-fragments) of the article. Though some connection is evident if one compares each of the relevant "Discussion" or "Summary" sentences with particular sentences of the preceding sections, the nature of the connection is not clear. Moreover, the supposition that there is some relation, e.g. consequence which obtains between these sentences is not easy to evaluate.

A preliminary investigation of this conjecture was made for the first five sentences of the "Discussion" section. An attempt was made to "derive" each of these sentences from the sentences to which each was presumed to be related, using such operations as substitution of local synonyms, adjunction of secondary sentences and transformations. In the case of the first three sentences, the path sketched is exceedingly complex: cross-references between occurrences of phrases within these sentences must be resolved

as well as cross-references within the sentences to which they are presumably related. Resolution of the latter cross-references entails in some cases yet other referential phrases requiring replacement, and in many cases, the supposition of tacit sentences. Below I sketch out some connections for the relatively simpler cases. After each sentence -- with particular segments labelled on occasion for ease of reference -- the principal sentence(s) presumed to be related to it are listed. The notes to each sentence attempt to trace a path from the latter sentences to the former, making use of the operations mentioned above.

- I. (32) 204.1.4. The antibodies in these tissues [i.e., the lymphnode and the lymph emerging from that node -- from 204.1.3] are frequently found earlier and, in early days, in higher concentration than in the blood-serum.

[204.1.4] is presumed to be related to:

198.2.13 The serum-titer in the first 4 days almost always lagged behind the antibody-titers of both the lymphnodes and lymphs of the corresponding days.

198.2.14 By the 5th and 7th days the antibody-content of the serum was greater than that of either the respective lymphnode or the lymph.

Notes: In 198.2.13 the anaphoric the corresponding days can be replaced by its referend the first 4 days with a change of the preceding preposition to in (The actual replacements involved are somewhat more complicated than indicated, see Notes to R59-60, 64-67 in chapter 4, section 2). For almost always the synonymous form frequently is substitutable in 198.2.13. The phrase lagged behind can be rewritten was

found later and was lower than. However, simple substitution of this phrase in 198.2.13 poses difficulties: In The serum-titer in the first 4 days was frequently found later than the antibody-titers of both the lymphnodes in the first 4 days, a component sentence of the altered 198.2.13, the first 4 days appears redundant given the presence of later than.

A more acceptable form is obtained if the phrase in the first 4 days simply modifies was lower than upon the rewriting of lagged behind in 198.2.13. This yields:

- (i) The serum-titer was frequently found later and, in the first 4 days, was lower than the antibody-titers of both the lymphnodes and lymphs in the first 4 days.

In (i), the second occurrence of in the first 4 days can be repetitiously zeroed, and both -- taken here as epiphoric -- replaced by its referend the lymphnodes and lymphs (the distributes over and yielding the lymphnodes and the lymphs). The result is given as (ii):

- (ii) The serum-titer was frequently found later and, in the first 4 days, was lower than the antibody-titers of the lymphnodes and the lymphs.

In (ii), the comparative-form lower is connected to the two occurrences of titer (is obtainable from was in a titer lower than, cf. GEMP 9.11); the sentence is thus transformable to (iii):

- (iii) The serum was frequently found later and, in the first 4 days, was lower in titer than the antibodies of the lymphnodes and the lymphs.

(The plural suffix -s of antibody might be considered the effect of the alteration of titers). In (iii), the

locally synonymous concentration is substitutable for titer. The converse of the relation was later and lower than is were earlier and higher than, yielding (iv):

(iv) The antibodies of the lymphnodes and the lymphs were frequently found earlier and, in the first 4 days, in higher concentration than the serum.

In (iv), the lymphs can be considered anaphoric to lymph collected from the efferent lymph-vessels (in sentence 198.2.2). In sentence 194.1.3, it is noted that the lymph is collected from the efferent lymphatic vessel of the popliteal lymphnode. Thus, the lymph collected from the efferent lymph-vessels can be related to the lymph emerging from the node in sentence 204.1.4 (perhaps by means of an implicit definitional sentence). Comparison of sentence 198.2.13 with the succeeding sentence accounts for the early days in sentence 204.1.4: the first 4 days are said to be the early days as opposed to the 5th and 7th days. The residual differences between the two sentences -- ((iv) and sentence 204.1.4 -- are minor: In (iv), there is the preposition of as opposed to in; there is a plural form the lymphnodes in (iv) and the serum as opposed to the blood-serum, and, finally, the tense form in (iv) is the past whereas in sentence [204.1.4] the present-tense is used in reporting facts without respect to time.

II. (33) 204.1.5. No antibodies to influenzal virus were found under the conditions of these serological tests [i.e., the pattern- and sedimentative tests -- from 196.1] in:

- (b1) lymphnodes of legs opposite to the leg injected,
- (b2) lymphnodes of unmanipulated rabbits,
- (b3) lymphnodes derived from rabbits which had received antigens other than influenzal virus, and
- (b4) sera taken prior to injection with influenzal virus.

Sentence 204.1.5 -- (b1-3) -- is presumed to be related to:

198.1.6 Antibodies to influenzal virus appeared in the lymphnode from 2 to 4 days after injection of the virus into the foot-pad, whereas normal lymphnodes or lymphnodes derived from rabbits injected with typhoid or dysentery bacilli showed no reaction with influenzal virus.

Notes: Replacement of reaction with influenzal virus was discussed above (section 1 of this chapter); detaching the sentence following whereas yields (with replacement:

- (i) Normal lymphnodes or lymphnodes...did not contain antibodies to influenzal virus.

Sentence (i) is transformable to:

- (ii) No antibodies to influenzal virus were contained in normal lymphnodes...bacilli.

In (ii) normal lymphnodes may, with the aid of implicit sentences, e.g., foot-pads are parts of legs, and sentence [198.2.2], be rewritten as lymphnodes of legs opposite to the leg injected and lymphnodes of uninjected (= unmanipulated) rabbits. In [198.1.6], typhoid and dysentery bacilli are classifiable as antigens other than influenzal virus and which received is substitutable for injected with (as is found substitutable for contained -- see chapter 2, section 3.3). The resultant form is:

(iii) No antibodies to influenzal virus were found in lymphnodes of legs opposite to the leg injected and lymphnodes of un-manipulated rabbits or lymphnodes derived from rabbits which received antigens other than influenzal virus.

(cf. sentence 204.1.5, b1-3)

The (b4) part of sentence 204.1.5 is presumed to be related to 197.3.11 in much the same manner:

197.3.11 Similarly, the blood collected from the rabbits' hearts contained antibody to influenzal virus whereas serum collected prior to injection showed no reaction.

Notes: By replacement of reaction (and detachment of the second sentence); a transformation of the negative element upon replacement; and substitution of taken for the synonymous collected in 197.3.11, one obtains:

(iv) No antibody to influenzal virus was contained (= found) in serum taken prior to injection. (cf. 204.1.5, b4)

Conjunction of (iii) and (iv) with repetitional zeroing yields a sentence close to that of 204.1.5. Assumption of a sentence, e.g., Antibody-determinations are made under conditions of serological tests, would result in a form "essentially identical" to that of 204.1.5.

The examples presented do not constitute full-fledged derivations of the "Discussion" sentences 204.1.5-6. The sentences of the "Summary" section add yet another complication as they appear to be related both to sentences of the "Discussion" and others in previous sections. Tables III and IV present a listing of the relevant "Discussion" and "Summary" sentences (cited by number); next to each is the citation-numeral for the sentence in previous sections to which it is presumably related.

TABLE III: "Repeated Sentences" -- Discussion Section

<u>Sentence in Discussion</u>	<u>Sentence Presumed Related in Prior Section</u>
204.1.1	200.3.1-2, 193.1.5
204.1.2	200.3.1-2, 200.3.5-6
204.1.3	198.2.6-7, 198.2.10
204.1.4	198.2.13-14 (cf. 200.4.5)
204.1.5	198.1.6, 197.3.11
204.1.6	193.1.4-10
204.1.7	194.1.1-2 (cf. 194.2.4)
204.2.1	193.3.3-5 (and 193.1.2)
204.2.2	193.3.6 (and 193.1.2)
204.3.2	196.1.14
204.3.3-4	196.1.15-16
204.4.1	200.4.1-3
204.4.2	Fig. 2, Fig. 3, 200.4.10-11
204.4.3	Figs. 2 and 3
204.4.5	198.2.6-16 (cf. 200.4.5, 203.1.4)
204.4.8	198.2.6-16 (cf. 200.4.5, 203.1.4)
204.4.9	Fig. 1 and 198.2
204.4.10	198.2.13-14 (cf. discus- sion above of 204.14 above)
205.1.2	Table I: 195 (10th column) and 195.2.1-2
205.1.4-5	Table I: 195 (last column)
205.1.6	193.1.10 (cf. 193.1.8-9)

TABLE IV : "Repeated Sentences" -- Summary Section

<u>Summary Sentence</u>	<u>Sentence Presumed Related in Prior Sections</u>	<u>Sentence Pre- sumed Related in Discussion</u>
205.2.1	198.2.6-15, 193.1.5	204.1.3
205.2.2	198.2.13	204.1.4
205.2.3	198.2.14-15	(204.1.4)
206.1.1	200.3.1-2, 5-6	204.1.1 (204.1.3 <u>at same time</u>)
206.1.2	200.3.1-2, 5-6	204.1.1-2
206.1.3	198.2.3, Table I	204.1.1
206.2.1	200.4.1	204.4.1
206.3.1	195.2.1 203.2.1 Table I	205.1.4
206.3.2		205.1.5
206.4.1	Table I; 205.1.1	205.1.1
206.4.2	193.1.1-10	204.1.6

6. Meta-Scientific Segments and Science-Language Sentences.

Two of the major hypotheses of this work, presented in chapter 2, bear upon the division made in many sentences of the article between segments of the sentence called "meta-scientific" and those which are science-language sentences. In the first, it was conjectured that referential phrases occurring in science-language sentences only cross-refer to other occurrences of phrases contained in science-language sentences (chapter 2, section 3.5). The second hypothesis, closely related to the first, supposed that resolution of cross-references in the science-language sentences does not yield sentences which are not instances of science-language sentence-types (chapter 2, section 4.3.²⁰ A test of either of these hypotheses presumes confirmation of a prior supposition, namely, that metascientific segments and referentials occurring in science-language sentences are identifiable as such independently of resolution of cross-references. Establishment of this prior thesis presents a number of complications which are themselves instructive as to the status of the division between meta-scientific material and the science-language. These difficulties are considered in detail in section 6.1. Section 6.2 discusses the results of testing the two hypotheses. As will be seen, the first conjecture is not confirmed: there are several instances of cross-reference in which the referend of a referential occurring in a science-language sentence itself occurs in a meta-scientific seg-

ment. The second hypothesis can be maintained with special qualifications. In section 6.3, an attempt is made to "translate" some sample paragraphs of the article into a form where meta-scientific segments occur as "prefixes" to science-language sentences. For example, the text-sentence:

(34) On that day, antibody could generally be found in the extracts of lymphnodes in low titer.
[sentence 198.2.7]

could be translated into (34'):

(34') It could generally be found that/on that day antibody is present in the extracts of lymphnodes in low titer.

In (34'), the "meta-science prefix" is written before the slash-mark; the sentence which follows is a science-language sentence and can be read independently of the prefix.

6.1. Identification of Meta-Science Segments and Referentials in Science-Language Sentences. Delimiting referentials as occurring in science-language sentences and distinguishing meta-scientific segments often proceeds 'hand-in-hand'. Thus, in example (34'), the phrase the extracts of lymphnodes is identifiable as a referential in a science-language sentence as it occurs as an argument of the sub-language operator present. This requires extraction of the meta-scientific phrase could generally be found in (34). Section 6.11 discusses the question of which referential occurrences of phrases are referentials in science-language sentences. The precise identification of meta-scientific segments, i.e., as containing occurrences of

the M, M', and M'' operators noted in chapter 2, section 3.5, presents a number of difficulties; these are reviewed in section 6.12. To establish other referential phrases as meta-scientific, e.g., the immunological findings, in [197.2.1] requires special consideration (6.13).

6.11. Referentials in Science-Language Sentences. Referentials as occurrences in science-language sentences are distinguished under three conditions. Firstly, a referential phrase is a referential in a science-language sentence if it is an argument of a sublanguage operator, i.e., a member of the word-classes, J, U, V, W, etc., or of local operators on members of these word-classes. Thus, the many occurrences of, e.g., the antigen under inject, the lymph-node under present, the antibody under increase, etc. are science-language referentials. Similarly, all occurrences of zero-referentials introduced by sublanguage announcers (chapter 3, section 3.23) are science-language referentials. Since the analysis of the article in chapter 4 was based on the text in its original form and not upon a regularized version in which meta-scientific operators were extracted, there are a number of cases in which a meta-scientific operator, e.g., could not usually be detected in [198.2.6], is marked as an announcer of a zero-referential, e.g., there. These operators were regarded as variant forms of, e.g., is not present (cf. example (34-34') above and section 6.12 for illustration of extracted meta-scientific segments).

In a few instances the referential phrase which is the argument of a sublanguage operator is not composed of the recognized vocabulary of the sublanguage. Thus, in sentence [193.3.1], the referential phrase a similar mechanism (or, more precisely, the referential phrase that mechanism introduced by similar) occurs as subject of might operate in. The latter phrase is a member of the local operator word-class designated 'r' which takes as its first argument members of the word-classes C or T and, as its second, members of the operator subclass v_p .²¹ Included as science-language referentials as well are the occurrences of the phrases of the experiment(s)/this experiment in sentences [193.3.4, 198.2.15, and 204.4.10]. In these sentences (see example (35)), the phrases mentioned occur in positions occupied in similar sentences by after (the) injection (cf., the early days after injection in [200.4.6]):

(35) The greater antibody-titer in lymph and lymphnode-extract than in the serum in the early days of THIS EXPERIMENT has, then, even a greater significance.... [from 204.4.10, R98]

In section 3.23 of chapter 3, phrases such as the first 4 days, the 3d day, the 9th day were noted as instances of the 't' word-class which is a modifier on the conjunctional word-class ':', and so regarded as introducers of the zero-referential -- (after) the injection. The similarity of these sentences to others in which after (the) injection occurs or is reconstructed leads us to consider the occur-

rence of the experiment, etc. within them as science-language referentials.²²

The second condition under which a referential is considered a science-language referential is where the referential phrase is a nominalization of a sublanguage operator. Thus, the frequent occurrences of (the) injection explicitly or as reconstructed are considered to be referentials in science-language sentences. Similarly, the nominalized form the later rise in:

(36) It may well be that THE LATER RISE represents a summation of the declining rate of antibody-production with the node itself plus....
[from 204.4.4]

is a science-language referential (see also, e.g., this peak in sentence 200.2.1 and this percentage in 200.4.11).

Finally, included as science-language referentials are the two interesting cases of referential phrases, not composed of the sublanguage vocabulary, which occur (or, can occur, upon transformation) as parts of intransitive operators which have as their subject an argument word-class of the sublanguage. The first case to be noted is the occurrence of this property in sentence [197.3.9], discussed in section 3.3, example (11). The relevant portion of the sentence is given as (37):

(37) ...the toxic effect on the local lymphatic tissue was due to THIS PROPERTY of the particular viral agent employed.

(37) is transformable to: ...the toxic effect...was due to the particular viral agent employed having this property in

which this property (or -- having this property) is a sort of 'pro-adjectival' operator with a member of the word-class G as its subject (see the section cited above for further remarks).

The second case occurs in a sentence presented earlier in paragraph 197.3:

(38) THE SAME GROSS PICTURE characterized the popliteal lymphnodes excised on the 5th day following injection of the vaccine. [197.3.4]

(38) can be transformed to:

(39) The popliteal lymphnodes excised...were characterized by THE SAME GROSS PICTURE.

In (39) were characterized by is semantically close to have (cf. the transformation of (37)); the same gross picture, similarly to this property, is a sort of 'pro-operator' having here as subject a member of the word-class T.²³

6.12. Demarcation of M-Segments.²⁴ The status of meta-scientific segments was briefly addressed in section 3.5 of chapter 2. These segments are identifiable, roughly, as the residue of particular text-sentences after regularization.²⁵ The analysis presented in chapter 4 is performed on the text as it appears (modulo reconstruction of zero-referentials and of a few instances of repetitional or appropriate zeroings).²⁶ Consequently, meta-scientific segments are not marked in the analysis; their identification in many instances presumes transformation of a given text-sentence. In the discussion which follows, instances of meta-scientific segments are presented in respect to the

various categories of operators distinguished previously (in chapter 2, section 3.5, cf. FIS chapter 2, section 1); these are "M", "M'", and "M'". In section 6.3 below, some sample paragraphs of the article are presented in a partially regularized form, i.e., so as to explicitly delimit meta-scientific segments in the text-sentence.

M-operators. M-operators are distinguished as operators whose second argument (object) is a science-language sentence and whose first argument (subject) is not identical to the subject of the science-language sentence. A clear case of an M-operator is presented in [193.1.2] where indicated that has as its subject Early investigations (1-3) and as its object a science-language sentence. In many instances the science-language sentence appears in nominalized form, e.g., the object of to investigate in:

(40) In the present study it was felt desirable
to investigate the development of antibodies...
[from 194.1.1]

(cf. had demonstrated in 193.3.3). The class of M-operators for the sublanguage includes: find, study, recognize, conclude, determine, see, etc. Recognition of particular phrases in text-sentences of the article as instances of M-operators often requires transformation of the text-sentence. For some of these transformations, precise criteria for their application are available. Thus, could barely be discerned in:

(41) Outlines of the follicular architecture
could barely be discerned. [197.3.8]

is extractable, and outlines of the follicular architecture can be altered to the follicular architecture has outlines (= "appears with outlines"). This yields:

(41') It could barely be discerned that
the follicular architecture has outlines.

In (41) the occurrence of the modal could as well as the privative adverb barely (cf. GEMP, sections 2.65 and 6.64) can serve as criteria for extraction (I do not consider the epiphoric it in (41') nor other pro-forms introduced by extraction, e.g., we in (43), further). Similarly, in (42), may be observed can be extracted, and the reciprocal a difference denominalized:

(42) A difference in the properties of the antigen may be observed in that the rise of titers in all the tissues examined is earlier in one experiment than in the other. [203.1.4]

yielding (42'):

(42') It may be observed that the properties
of the preparation differ in that....²⁷

(cf. sentence 204.1.5). Sentence [203.1.2] can be altered to:

(43) We traced the development of antibodies to the homologous and heterologous virus in the lymphnodes and the serum.

The occurrences of seen (cf. see in the listing of M-operators above) in sentences 200.3.2-4 can be extracted; in 200.3.3-4, however, reconstruction of the operator are present is not a standard transformation and requires the agreement of the informant, e.g.,

(44) Mitotic figures were often seen...[from 200.3.3]

(44') It was often seen that mitotic figures
are present.

(cf. examples 34-34' at the opening of this section).²⁸

In 200.3.6, these areas were clearly recognizable as secondary nodules is transformed to: It was clearly recognizable (or: clearly possible to recognize) that these areas are secondary nodules.²⁹

There are a few 'difficult' cases which are here considered as involving M-operators. In sentences [197.3.9] and [204.4.8], there is no explicit subject for the operators following, gathered with; however, these operators have as their object a science-language sentence (see example 11 in section 3.3 for the latter case).³⁰

In (45):

(45) ...the fate of particulate antigens was
traced from the time of injection until that
of the appearance of antibodies. [from 193.1.2]

the operator was traced can be extracted as We traced, though the complements introduced by the prepositions from and until, remain in the science-language segment, despite their dependence upon trace. The meta-scientific operator can be considered trace — from — until — with where the "—" are 'filled' by science-language sentences; the operator itself falls outside the classification provided in FIS. Another difficulty is found in:

(46) Burnet and Lush (3) infected mice with
virulent influenzal virus via the intranasal
route.... [from 193.3.6]

The subject of infected in (46) is similar to the subjects of other M-operators (often names of scientists) though the object is not a science-language sentence. A science-

language sentence is obtained as an object if a causative transformation (GEMP 6.8) is applicable to (46), yielding:

(46') Burnet and Lush (3) caused the infection of mice with influenzal virus via the intranasal route.

Alternatively (46) can be regarded as a case of a meta-scientific segment M' (see section 6.2).

Aside from those cases presented in section 6.13 and the "M* cases" noted below, the examples above and others clearly similar to these examples exhaust the instances of M-operators in the article. (The M-operator together with its subject is taken as a meta-scientific segment.)

M'-operators. M'-operators are distinguished as occurring with a subject in the class of subjects established for M-operators and an object which is a member of an argument word-class of the sublanguage. Thus, were made of is an M'-operator in (47):

(47) ...simultaneous studies were made of extracts of the popliteal lymphnode, the lymph of the efferent and efferent lymph-vessels of that node, and the blood-serum. [from 193.1.6]

(cf. sentence 196.1.11).³¹ As before, the recognition of some operators as instances of M' requires that the text-sentence be transformed, e.g., in [198.2.6], When the extracts of lymphnodes were tested,... is transformed to When we tested the extracts of lymphnodes,...

Other meta-scientific segments are more complex. Consider:

(48) Analysis of the lymph collected at the various intervals showed that.... [from 198.2.10]

(49) Simultaneous tests with the blood-serum showed that.... [from 198.2.11]

(50) Analysis of the results obtained from rabbits where lymph, extracts of lymphnode, and serum were obtained showed that....[from 198.2.19]

In (48-50), the object of showed that is a science-language sentence whose subject is not identical with that of the operator; hence, showed that can be considered an instance of an M-operator. The subjects of showed that are, however, complex. In (49), the subject is itself an instance of M': simultaneous tests (made) with the blood-serum. In (48), the object of analysis is a member of the argument word-class T; a secondary sentence which is a science-language sentence is adjoined to the object.

In (51), a secondary sentence is attached to rabbits; the operator of the secondary sentence (were obtained) can be considered a W-operator or itself an M'-operator, i.e., where we obtained lymph,....³² Examples (48-50) involve "chains" of M and M' operators; while analyzable as cases of the former, they are for convenience termed 'M*'.
M'-operators. M'-operators are operators whose first argument is a science-language sentence. In [204.4.5], the two occurrences of the demonstration of can be considered meta-scientific segments inasmuch as, e.g., antibodies occurring in higher titer in the local lymphatic system than in the serum is a demonstration.³³ Other M'-operators in the sublanguage include: may be, result, is possible, significant, a factor, a theory, evidence. In

several cases a modifier on a text-sentence can be regarded as meta-scientific in that it is derivable from a modifier on an M''-operator. For instance, microscopically in [200.3.1] is derivable from That there was marked diffuse hyperplasia...appears microscopically where appears is an M''-operator.

Other instances of modifiers considered as operators on M'' include: In the first series of experiments undertaken [197.3.1]; on other occasions [198.1.8]; had been found to be characteristic of... [198.2.5]; found by Freund (17) [200.4.11]; within each experiment, however, [203.1.5]; are fairly representative of.... [203.3.2]; for two reasons [204.4.5]; under these circumstances [204.4.8]. One might include the occurrences of first and second in [204.4.6-7] in this grouping, though it is perhaps more appropriate to regard them as metalinguistic "reading instructions", i.e., as equivalent to "consider first/second". M''-operators are noted further in section 6.13.³⁴

Finally, included as meta-scientific are a few text-sentences in which no words in the sublanguage vocabulary occur, e.g., sentences [203.1.1 and 203.1.3]. Two sentence (-fragments) occur which are apparently connected to meta-scientific material -- in [200.3.8], the nodular organization of the cortex had begun to lose definition and in [200.3.9] the nodules were increasingly indefinite on succeeding days (cf. 200.3.6); the operators are, however, taken here as instances of the W word-class.

6.13 Referentials in Metascientific Segments. There are a fair number of referential phrases whose status as meta-scientific segments or science-language referentials may not be immediately clear. These include a series of developments [193.1.1, R1], the immunological findings [193.2.1, R34], these quantitative-relations [198.2.16, R75], another series of experiments [200.4.1, R1], the data presented [204.1.1, R1], the set of observations [204.1.6, R24], (further) evidence of specificity [204.4.1, R51], this (rather laborious) demonstration [205.1.6, R136], these findings [206.4.1, R39], and this conclusion [206.4.2, R40].³⁵

Thus, it may be questioned whether the referential phrase the immunological findings in (51):

(51) The immunological findings were correlated with histological changes taking place in the local lymphatic tissue.

is determinable as a meta-scientific or a science-language referential independent of its resolution. In the test of the hypothesis, these referentials are considered meta-scientific segments. Nearly all of these phrases are composed of vocabulary outside of the sublanguage³⁶ and many are nominalizations of M'-operators -- find, evidence, observe, demonstrate and conclude.³⁷ The phrase a series of developments [193.1.1] occurs as subject of has pointed to which in other of its occurrences conjoins science-language sentences; it is included as a meta-scientific segment given the modifier on the operator -- in recent years.

In the phrases further evidence of specificity and the evidence for the lymphocyte itself as a primary source of the antibody, vocabulary from the sublanguage occurs, though as part of the meta-scientific classifier evidence.

Several of these phrases have been discussed previously as classifiers of science-language sentences or sequences thereof (a few of them are epiphoric). As part of meta-scientific segments, these phrases are not considered in testing the hypotheses (section 2). As classifiers of (sequences of) science-language sentences, these referentials do have bearing on the division in text-sentences between meta-scientific material and science-language sentences. For example, the referend in the first paragraph of page 193 of the immunological findings does not include as a component the methods-related sentence [193.1.8] and excludes as well simultaneous studies were made of...serum and other meta-scientific segments (see Notes to R34, 193.2.1].³⁸ The referential classifiers the set of observations and the data presented have as referends all of the science-language sentences within the preceding "Experimental" section. These referentials dubiously include among the many components of their referend segments of sentences or sentences considered above to be meta-scientific, e.g., Figs. 2 and 3 illustrate two of the experiments described above [203.1.1] is not classified by the phrases data (datum) or observation or methods-related sentences, e.g., in the paragraph [203.2]. Referential phrases such as the epiphoric the evidence for the lymphocyte itself as a primary

source of the antibody present a subtlety of some interest; the referend, roughly, comprises the sentences [205.1.2-5]. While meta-scientific segments such as it is considered of additional significance in [205.1.5] are not part of the referend, other phrases, e.g., since the volumes on which calculations...packed cells in [205.1.2], pertaining to the reasoning for the conclusion offered, i.e., that the lymphocyte is a primary source of the antibody, are considered as classified by evidence for the lymphocyte itself....

Further discussion is provided in the notes to these referential phrases. Inasmuch as these referentials "separate off" in their referend-components segments of text-sentences (or: text-sentences themselves) here considered meta-scientific from science-language sentences, they provide evidence for the division between the science-language and meta-scientific material.

6.2. Tests of the Hypotheses; Results. The extensive discussion in section 6.1 was provided to establish the claim that science-language sentences and meta-scientific segments can be delimited independently of the resolution of cross-references. There is the errant occurrence of the pro-sentential this in sentence [194.1.4] which may not be distinguishable as meta-scientific or part of science-language sentence independent of its resolution. It is considered here as meta-scientific inasmuch as it is not composed of sublanguage vocabulary.

To test the hypotheses that (i) referentials in science-language sentences do not have as referends occurrences of phrases in meta-scientific segments and (ii) that their resolution does not lead to sentences outside the sublanguage sentence-types involves a further consideration. Excluded from the tests are sentences in the section "Methods and Materials" and other method-related sentences in the article.³⁹ Cross-references to phrases in these sentences were discussed in section 5.1.

Results of the first hypothesis. To recapitulate, the first hypothesis claims that referentials occurring in science-language sentences do not have as referends occurrences of phrases in meta-scientific segments. It may have been expected that meta-scientific segments as operators on science-language sentences contain referentials to phrases in science-language sentences and, indeed, many of the referentials discussed in the preceding sections of this chapter are examples of this, e.g., a series of developments, (further) evidence of specificity (discussed in sections 3.5-6). Further study of cross-referentials may serve to establish criteria for delimiting particular classes of referential phrases in meta-scientific segments which have as referends other phrases in those segments from those which do not.

An examination of cross-references within the article does not support this thesis. As might have been expected,

the principal counter-instances to the hypothesis arise in two cases: (a) where the science-language referential is composed of material not recognized in the sublanguage vocabulary (cf. section 6.11) and (b) where the science-language referential has as its referend the complement of a M' operator. These are reviewed in turn.

The occurrence of this experiment (R98) in sentence [204.4.10] of the "Discussion" section constitutes the sole instance of the first case. See example (35) above; (related occurrences of the experiment, the experiments have as referends occurrences of injection sentences, i.e., of the sentence-type GJB)⁴⁰. The referend, occurring in the preceding sentence, is: the experiment summarized in Fig. 1. It should be noted that this experiment can indirectly be related to an injection sentence. Example (35) -- The greater antibody-titer...this experiment -- is presumably connected to a previous sentence of the article:

(52) The serum-titer in the first 4 days almost always lagged behind the antibody-titers of both the lymphnodes and lymphs of the corresponding days. [198.2.13]

(cf. the discussion of example (32) in section 5.2). In (53) the first 4 days is referential to 1, 2, 3, 4 days after injection in sentence [198.2.2].

There are quite a few instances falling under case (b). Two examples will be provided. In sentence [193.1.7], the occurrences of the popliteal lymphnode and the efferent lymph are referential to prior occurrences of the popliteal lymphnode and the discontinuous phrase the lymph...of the

efferent lymph-vessels of that node in sentence [193.1.6], (see example (47) above). The occurrence of the lymph (collected at the various internals) is the complement of a nominalized M'-operator occurring as the subject of showed that in sentence [198.2.10]; see example (48) above. The phrase the lymph serves as referend to the zero-referentials (R41, R43) -- (in) the tissue (alternately there) within that sentence.

Several remarks can be made about such cases. Firstly, the referend in nearly all cases is itself a referential phrase (or: part of one -- as in the second example) whose referend occurs in a science-language sentence.⁴¹ In many instances, the complement of the M'-operator is the referend of zero-referentials within the science-language sentence operated upon by that operator (or one linked to that operator, cf. the M* cases discussed in section 6.12). Reconstruction of these referentials would not be necessary if, e.g., sentence [198.2.10] were altered to:

(53) The lymph collected at the various intervals similarly showed no measurable amount of antibody before the 2d day....

by deleting analysis of (which precedes the lymph....).

Finally, a number of M'-operators, e.g., use, examine, excise, test, suggest that these cases be regarded as involving cross-references to methods-related sentences.

Aside from the cases noted, there are two counter-instances to the hypothesis which can be rendered "apparent counter examples" pending acceptance of transformations

noted in section 6.12. In the first, the zero-referential after this introduced by in 4 to 6 days in sentence [194.3.6] cross-refers to the referend given as example (46). If the causative transformation yielding (46') is accepted, the referend of this can be taken as the complement of the operator caused in (46'). In the second, resolution of these clearly defined nodules (R26) in [200.3.6] yields the form the secondary nodules which these areas were clearly recognizable as. If sentence [200.3.6] is transformed so that were clearly recognizable as appears in an extracted meta-scientific segment (as in the discussion in section 6.12), the referend could be taken simply to be secondary nodules.

Results of the Second Hypothesis. The results of the second thesis, i.e., that resolution of cross-references in science-language sentences does not yield sentences which are not instances of science-language sentence-types, follow readily given those of the first. An obvious qualification should be added: the thesis is obviously discredited if meta-scientific segments operating on the science-language sentence in which the referential occurs are considered. The hypothesis is restricted simply to the science-language sentences and asks whether resolution of referentials within that sentence yields other science-language sentences.

Resolution of referentials in science-language sentences which cross-refer to complements of M'-operators

obviously does not count against the thesis inasmuch as these complements are words which are members of argument word-classes of the sublanguage. Thus, resolution of the zero-referential in [the tissue] in (55):

(55) Simultaneous tests with (the blood-serum) showed no measurable amount of antibody was present in [THE tissue] usually before the 3d day. [198.2.11]

yields, substituting the blood-serum for the tissue, a sentence of the sublanguage-type GJB: AVT, i.e., no measurable amount of antibody was present in the blood-serum usually before the 3d day (after the injection). This leaves the cases of this experiment and (after) this noted above. Considerations relevant to the former were mentioned above. The second case can be regarded as compatible with the thesis either by (i) use of the causative transformation or (ii) adjusting the referend given as (46) via strong nominalization and zeroing of the subject Burnet and Lush (3).

The hypotheses forwarded here have a clear bearing on the status of the immunology sublanguage. Confirmation of either or both can be taken as support for the sublanguage as an "independently functioning entity". A positive result to the first hypothesis would establish that cross-references in science-language sentences are resolvable without recourse to meta-scientific segments; that they, as it were, operate "blindly" in respect to these segments. As the results show, this is clearly not the case. Rather

they suggest that the demarcation of the sublanguage be made after resolution of cross-references. A positive result in respect to the second thesis would demonstrate that this task presents no special difficulties: in respect to resolution of cross-references in science-language sentences, the sublanguage is closed. Here, aside from one or two debatable examples, the results are positive.

As noted above the M'-operators which present counter-examples to the first thesis might be more appropriately construed as pertaining to procedures. These include such words as: use, test, analyze, excise. In the immunology sublanguage, semantically similar (or: identical) phrases occur as W operators, e.g., collect, derive from, obtain, extract. Section 5.2 noted several cases in which cross-references are made to phrases occurring in the sentences of "Methods and Materials" or in other methods-related sentences in the rest of the article. These observations suggest that the relation between sentences pertaining to procedures and those which report results is quite close and involved.

6.3. Translation of Sample Paragraphs. Two portions of the "Influenzal Antibodies" article are presented below in which meta-scientific segments are explicitly indicated and, where possible, extracted from the science-language sentences in which they occasionally occur. The treatment of conjunctions is left open: those conjunctions which connect two science-language sentences are regarded as occur-

ring under a science-language scope-indicator (see below), although some evidently are meta-scientific in character, e.g., as to indicate clearly in sentence [193.1.7]. After presentation of the "rules of translation", i.e., transformations applied in recasting various sentences, and scope-indicators, the two excerpts are given. The first comprises the "Introduction" section of the article; the second, the subsection "Histological Changes in the Lymph-node". Notes to particular sentences follow the excerpts (the convention for citation of sentences follows that presented for the analysis; see chapter 4, section 1).

Rules of "Translation". The following rules of translation are applied in transforming the text-sentences:

(1) Tense -- the main verb in a science-language sentence, which has often been tensed in respect to a higher meta-scientific operator (see GEMP 6.1 on tense-forms due to higher-order operators), is translated from a non-present tense form into the present tense as befits the assertion of facts (cf. the "Discussion" section in which present tense forms predominate in science-language sentences). The forms which are altered are underlined. In cases where an operator has been extracted from a science-language sentence to serve as a meta-scientific operator (hereafter these are called 'M'), the operator carries the tense-form it had in the science-language sentence, e.g., Mitotic figures were often seen is altered to It was seen that.

(2) Movement of M-adjuncts. In [194.1.2], the adjunct utilizing conditions...antigens is moved into the position of a M-segment (cf. section 6.12 on M' operators).

(3) Causative. In [193.3.6], infected is moved into the science-language segment via a causative transformation (cf. example (46) and (46') above and GEMP 6.8).

(4) Extrapositing M-operators. Many instances in which M-operators were extracted from science-language sentences by extraposition were presented in section 6.12. A number of these are reproduced in the excerpts given. The status of was found as in, e.g., [193.3.4] The neutralizing principle was found in higher concentration... is unclear. Is it comparable to the occurrence of found, e.g., Stars are found in the sky? Other occurrences of found are perhaps meta-scientific, e.g., found with the modal could in [193.1.2]. Occurrences of found are generally regarded here as M and, so extraposed with a concomitant change of the science-language operator to is present, unless there is already a M-operator on the sentence (the extraposed operator and is present are underlined in the excerpts). In such cases, e.g., in [193.1.2], was found is considered a variant of is present; could might be regarded as equivalent to "sometimes".

(5) Denominalization. In [193.3.5], was found is extracted from the science-language sentence along with its argument-indicator that (evidence was found that) and the

science-language sentence denominalized, yielding the virus introduced multiplies in the lymphnodes.... Denominalization with restoration of the argument-indicator that is seen in [193.3.3] where one can reconstruct an appropriate operator the presence of.

(6) Change of Wording. In [193.3.4], of the experiment is reworded as after the injection (this is licensed given the referend established for R55). In [194.1.1], the discontinuous phrase employing...as antigen is rewritten as injecting (cf. section 2 on use). All rewordings are underlined.

Scope-Indicators. Two markers of scope are employed. A sentence is presumed to start off with a meta-scientific segment until a single stroke '|', indicating the start of a science-language sentence appears. The stroke '|' has scope over the remainder of the sentence unless interrupted by '||' indicating resumption of M. The single stroke is provided with a diacritic: a "roof" -- ']' means that the following material can be read independently of any M-material in the text-sentence. In "translating" other sections of the article, other diacritics could be employed, e.g., to indicate that the science-language sentence is missing a complement contained in an M-segment (see the section 6.2 discussion of such cases).

Excerpt I. Introduction.

193.1.1. In recent years, a series of developments has pointed to | the role of the lymphatic system in the formation of antibodies. 1.2. Early investigations (1-3) indicated that T following introduction of an antigen into the tissues of an animal, antibodies are sometimes present in the regional lymphnode, often appearing there earlier than in the blood-serum. 1.3. More recently, two series of studies have been concerned with | the relation of the lymphatic system to the production of antibodies. 1.4. In one of these, that of White and Dougherty (4,5), it was shown that T preparations of the spleen and lymphnodes rich in lymphocytes contain antibodies following subcutaneous injections of antigen into mice. 1.5. In the other series of studies, Ehrlich and Harris made use of the fact that T the popliteal lymphnode is the sole node draining all tissue distal to it. 1.6. T Cellular antigens are injected into the pad of the rabbit's hind foot, || and simultaneous studies are made of extracts of the popliteal lymphnode, the lymph of the afferent and efferent lymph-vessels of that node and the blood-serum. 1.7. These investigations (6) showed that T the lymphnode and efferent lymph contain antibody in such concentration and so soon after the injection of antigen, as to indicate clearly some role of the lymphnodes in the formation of antibodies. 1.8. On further analysis, T lymph is separated by centrifugation into lymph-plasma and lymphocytes. 1.9. Examination of each of these sepa-

rately showed that T the lymphocytes contain antibody in higher concentration than the lymph-supernate. 1.10 Cross-absorption studies further pointed to the fact that T the lymphocytes do not absorb antibodies from the lymph-plasma but are the primary site of these substances.

2.1. The immunological findings are correlated with | histological changes taking place in the local lymphatic tissue. 2.2. In other studies of this series it was shown (8) that T macrophages do not, on contact with antigens in vivo, produce antibodies, || and the fate of particulate antigens is traced from the time of injection until that of the appearance of antibodies (9).

3.1. Since the studies referred to above involved | the injection of bacterial or cellular antigens and whole cells || interest was aroused as to whether it may be that | a similar mechanism operates in the production of antibodies to other antigens such as viral proteins. 3.2. Two of the earlier studies mentioned had been concerned with | the sequence of events following injection of active virus. 3.3. McMaster and Kidd (2) had demonstrated that T an antiviral principle is present in extracts of regional lymphnodes following the endermal injection of active vaccine-virus into the ears of rabbits. 3.4. It was found that T the neutralizing principle is present in higher concentration in the lymphnode than in the serum in the first week after the injection. 3.5. Evidence was found that T the virus introduced multiplies in the lymphnodes

until the appearance of antibody. 3.6. Burnet and Lush (6) effected | the infection of mice via the intranasal route || , and Burnet and Lush found that | antibody to influenzal virus is present in the mediastinal lymphnodes in 4 to 6 days.

194.1.1. In the present study, it was felt desirable to investigate | the development of antibodies to a viral agent, injecting the agent, with no possibility of multiplication of the virus in the tissues. 1.2. Accordingly, a study, utilizing conditions similar to those prevailing in the experiments quoted above with bacterial and particulate antigens (6-9) was undertaken of | the immunological response in the rabbit to the injection of preparations of influenzal virus, inactivated by exposure to ultraviolet rays. 1.3. | The preparations of inactivated influenzal virus are injected into the foot-pad of the rabbit and at various intervals thereafter the following materials are collected: lymph from the efferent lymphatic vessel of the popliteal lymphnode, the node itself and heart-blood. 1.4. In one series of experiments, | one type of influenzal virus is injected into one foot-pad, and a heterologous type is injected into the other foot-pad. 1.5. This provides a further control on | the specificity of the reaction.

Excerpt II. Histological Changes in the Lymphnode.

200.2.1. T The weight of the popliteal lymphnodes increases progressively with time after injection, from a normal of 0.2 g in the uninjected leg, to weights of 0.7 to 0.8 g. 2.2. T This peak is attained at the 5th to 7th day, and after 10 days, the weight of the lymphnodes begins to decline. 2.3. T At about the 4th or 5th day, the entire surface of the lymphnode has very fine irregularities, || which is the external evidence of follicular structure within.

3.1. Microscopically T there is marked diffuse hyperplasia reaching a maximum two days after the injection. 3.2. It was seen that T the enlargement of the node is due to swelling of the cortex with great numbers of large and medium lymphocytes, which are not fitted into any units of organization. 3.3. It was seen that T mitotic figures and transitional forms between reticulum-cells and the young lymphocytes mentioned above are often present. 3.4. On the third day there is further increase in size || and it was seen that T on the third day a number of small lymphocytes are present. 3.5. T On this day there are beginnings of groupings of small lymphocytes into circular areas. 3.6. It can be clearly recognized that | on the fourth day these areas are secondary nodules, and by the fifth day, the larger part of the cortex consists of these clearly defined nodules and many of the lymphocytes were of the small type. 3.7. It was seen that T at this time

large lymphocytes, some reticulum cells and transitional forms are present at the centers of the nodules. 3.8. T Thereafter the histological picture remains fairly constant for a few days. 3.9. T On the ninth day, the nodular organization of the cortex begins to lose definition. 3.10. T The nodules are increasingly indefinite on succeeding days, and the size of the node diminishes.

Notes to Excerpt I (Introduction). Sentence [193.1.8] can be considered a methods-related sentence. In [193.2.1] the immunological findings is part of M (see section 6.13); are correlated need not be taken as derived from, e.g., We correlated and so might be considered a conjunction in the sublanguage. The scope-indicators are inadequate to render the properties of trace in [193.2.2]; the entire segment is indicated as M, though depassivizing is traced yields We traced | the fate of particulate antigens || from | the time of injection || until | that of the appearance of antibodies. In [193.3.1] the segment after M is readable as a separate sentence though it is clearly dependent upon the preceding M-operator. In [193.3.6], Burnet and Lush is reconstructed on the basis of repetition to serve as the subject of found that.

Notes to Excerpt II (Histological Changes in the Lymphnode). In sentence 200.2.3, showed has been rewritten as has; which is reconstructed to indicate the M-status of evidence as a classifier, though the modifier external on evidence

points to a connection with the science-language in [3.2], great and units of organization are considered part of the sublanguage. In [3.3], the phrase and transitional... above is permuted to after figures to obtain an independently 'readable' science-language sentence; mentioned above is metalinguistic. In [3.4] it was seen that might be assigned scope over the entire science-language segments given to prevent "interruption" by M and reconstruction of on the third day. Clearly defined as a modifier on nodules is considered part of the sublanguage sentence, cf., the operators loses definition in [3.9] and we indefinite in [3.10]. The original text-sentence in [3.9] contains had begun (had may be considered a tense-referential) so that has begun is perhaps more appropriate.

1. This case is discussed in the notes to R41-42 -- sentence [204.4.10]. A similar case of coordinated replacement is presented by R46-47 of sentence [204.4.12].
2. Cf. sentence [194.1.1], where in the tissue is not reconstructed; the sublanguage sentence: the development of antibodies to a viral agent is not asserted under the meta-scientific operator it was felt desirable to investigate (see section 6.12 on meta-scientific operators).
3. Occurrences of similarly can also be related to the pro-form so in line with the analysis of GEMP 9.63. Thus, considering only the following fragments of [195.1.5-6]: The supernate was stored at -10 C. until tested. Serum was...similarly stored at -10 C., it may be noted that the fragment can be 'paraphrased' with So was the serum in place of the second sentence.
4. Other articles in the corpus of FIS, e.g., those involving electron-microscopic investigations, contain many occurrences of phrases not in the word-classes considered here, e.g., in the 'ultrastructure' word-class designated "S".
5. The cross-referential relation noted here is not recorded in the analysis of chapter 4.
6. In terms of operator-grammar, the appearance of before as a conjunction between sentences is due to a reduction see Ryckman and Gottfried (1981).
7. The four articles surveyed from the corpus of FIS are: Philip D. McMaster and Stephen S. Hudack, "The Formation of Agglutinins within Lymphnodes", Journal of Experimental Medicine, vol. 61 (1935), pp. 783-805; Astrid Fagraeus, "The Plasma Cellular Reaction and Its Relation to the Formation of Antibodies in vitro", Journal of Immunology, vol. 58 (1948), pp. 1-13; D. D. McGregor and J. L. Gowans, "The Antibody-response of Rats Depleted of Lymphocytes by Chronic Drainage of the Thoracic Duct", Journal of Experimental Medicine, vol. 117 (1963), pp. 303-320; T. N. Harris and Klaus Hummeler and Susanna Harris, "Electron Microscopic Observations on Antibody-Producing Lymph-node Cells", Journal of Experimental Medicine, vol. 123 (1966), pp. 161-172. The other article is: Charles G. Craddock, Jr., "The Lymphocyte: Studies on its Relationship to Immunological Processes in the Cat", Journal of Laboratory and Clinical Medicine, vol. 34 (1949), pp. 158-177. These articles are

cited below in respect to the name of the first author and the page, paragraph, and sentence number of the example provided. Citations of the "Influenza1" article do not mention the authors and follow the convention noted in chapter 4, section 1.

8. The notes to R84.5 of the "Methods and Materials" discussion cite similar cases. Another case, in which it is not considered epiphoric, is given in example (11) above: here the inability to replace it is presumably connected to the conjunctive verb was due to appearing within the complement of it was felt.

9. Similar cases are presented in, e.g., expansion of several occurrences of the local lymphatic system to: [the lymphatic system local to [the site of injection]].

10. The relation of exemplification is a "strong semantical" one (see chapter 1, section 3). For some related discussion, see Goodman (1976), pp. 52-67.

11. A complication is presented in example (22) by the occurrence of frequently which modifies recognized.

12. First and second are regarded as metalinguistic inasmuch as they pertain to a counting of the sentences.

13. Cf. the referential Two methods, R74, in [196.1.1] where the second-component of the referend contains a referential, this method, to the first component.

14. Cf. a sharp rise... in replacing a burst of activity in the local lymphatic system, discussed at the close of section 3.2 above.

15. The weak verb was done could also be taken as part of the referential phrase, cf. examples (21) and (21').

16. Deletion of the remainder of the second sentence in the referend might be said to be based on repetition.

17. See footnote 31 in chapter 3.

18. The relevant sentences (or: sentence-fragments) are identifiable as: 193.1.8; 197.3.2; 198.1.9; and the first sentence-part of 198.1.10; 198.2.2 (as judged by...cells); 200.4.3; sentences in paragraphs 203.2 and 204.3, and in 206.3.1 on separation...content. This listing was checked against judgment of the informant.

19. Another instance of a referential whose referend occurs in a methods-related sentence is that announced by further in further evidence of specificity; see R50 in sentence [204.4.1].

20. Sentence-types of the science-language are surveyed in chapter 2, section 3.2.

21. Other members of the 'r' word-class include: play a role in, may be responsible for, participate in. An extensive listing is provided in FIS, chapter 2, section 3; particular features of the 'r' operator are discussed in chapter 4, section 7 of that work.

22. Several remarks are in order here. (1) These phrases -- of the experiment, etc. -- are not taken as "equivalent to" after the injection; such a claim requires further argument. As will be seen in section 6.3, the occurrence of this experiment in (35) presents difficulties for that claim. (2) If these phrases are not accepted as science-language referentials, they do not fall within the domain of the test for the hypotheses examined in section 6.3. Consequently, the difficulties presented by this experiment for the hypotheses do not arise. (3) Phrases similar to those occurring as the 't' modifier on the conjunction (':') occur elsewhere in some of the sentences of the article, e.g., 1 or 2 days in sentence [198.1.8]. Generally, these occurrences are transformable into the position of modifiers on the colon conjunction though the transformations involved and their justification are rather complex (details are given in chapter 5, section 4.4 of FIS). Such transformations of the text are not presented here. (4) The phrases (in) one experiment and (in) the other in sentence [203.1.4] are not considered science-language referentials. After the injection cannot be substituted in the case of the latter phrase. Consequently, earlier is taken, as in other occurrences, as an announcer of (after) the injection -- cf. sentence [204.1.4] and in one experiment, in the other are considered modifiers on meta-scientific operators (see the discussion of M' operators in section 6.12).

23. For the referend of the same gross picture and the replacement, see the Note to R10 in sentence [197.3.4]. In (41) one might extract were characterized by as a discontinuous meta-scientific operator (cf. section 6.12): We characterized...as..., though the active form of the operator in (40), as well as the semantic relation between were characterized by and have, suggests that characterize is not meta-scientific.

24. The reader can follow the ensuing discussion more readily by consulting the article as reprinted in the Appendix.

25. See section 2.2 of chapter 2 for a discussion of regularizing operations.
26. Portions of this article in its regularized form are given in FIS (article 5 of the Appendix).
27. In (42) examined is part of the anaphoric referential phrase all the tissues examined (cf. section 4.1 above) and so is not considered.
28. As noted above, in the analysis seen is taken as equivalent to present, thus serving to introduce a zero-referential.
29. Cf. section 6.3. Extraction of were clearly recognizable as leaves as the science-language sentence the form TWT, which may not be appropriate.
30. Subjects for these operators are reconstructible -- for the former case, see GEMP 3.44; a "depassive" transformation may be applied in the latter, cf. sentence [193.3.5] presented in section 6.3.
31. In sentence [204.1.2], used can be taken as a M'-operator on grounds of its parallelism to employed which follows. If used is considered equivalent to inject (cf. section 2 above), a causative transformation may be applied as in example (46) yielding made (or: caused) as a M-operator: McMaster and Kidd made an injection of active vaccine-virus.
32. Obtained is considered here a W-operator akin to collected, excised. See section 6.2 for a reconsideration of the status of these operators in the science-language.
33. Alternatively, the demonstration of can be considered akin to X's demonstration of (where 'X' is an indefinite subject) and demonstration of is an M-operator.
34. To be included in this listing are the occurrences of in one experiment, in the other in [203.1.4]; see footnote 22 above.
35. Related meta-scientific referentials (other) occasions, two reasons, these circumstances, were noted above.
36. The range of individual variation...animals [200.1.1, R110] might also be included in this list though variation occurs as a local operator on the word-class V in the sub-language. An "aberrant" case -- this in [194.1.4] -- is included as meta-scientific, cf. section 6.2.

37. Those referentials in the listing above which involve such nominalized M-operators might be said to be decomposable into a referential phrase belonging to M, e.g., we, and a "pro-science-sentence" referential, e.g., that. For example, this rather laborious demonstration might be re-written We rather laboriously demonstrated that. Alternatively, as nominalizations of M-operators, they might be considered science-language referentials, i.e., they cross-refer to complements of M-operators. Insofar as these referentials, in any case, cross-refer to science-language sentences (or: sequences of such sentences under various conjunctions) their status as meta-scientific segments or as science-language referentials does not affect the results of the hypotheses.

38. The referend could be taken as inclusive of some meta-scientific segments, e.g., examination of these separately showed and cross-absorption studies further pointed, e.g., That cross-absorption studies pointed to the fact that the lymphocytes...lymph-plasma is an immunological finding. It is not clear whether the referend includes but were the primary site of these substances in [193.1.10]; see the discussion of the evidence for the lymphocyte as a primary source of the antibody below.

39. See footnote 18; the discussion of these hypotheses below suggests a closer link between "methods" sentences and those of the science-language.

40. See R55 of [193.3.4] and R73 in [198.2.15] and footnote 22, remark (2).

41. In the full listing of these cases, i.e. referentials whose referend occurs as the complement of a M'-operator, which follows, those instances in which the referend is itself a referential phrase are noted by the referential number of the referend and an asterisk. The subscripts attached to these referentials indicate the referentials which refer to it.

Introduction	R18, R19 in [193.1.7]
Preliminary Observations	R17* in [197.3.6]
The Optimal Concentration of Antigens	R2* in [198.1.1]

(cont.)

Sequence of Events
Following Injection
of the Viral Antigens

R22* in [198.2.6]; R29 which cross-refers to R22 is itself part of the referend for R31-32 and is the referend of R35; R31-32, R35 are thus linked to R22 via a chain of referentials R41, R43 in [198.2.10]; increasing titer in 198.2.10 can announce yet another zero-referential, not recorded in the analysis, whose referend would be the occurrence of the lymph in 198.2.10. The referend is itself part of the referential phrase R39.

R48* in [198.2.11]

Experiments Involving
Different Serological
Types of the Virus

R89 in [198.2.20]

R10 in [200.4.4].

various noxious stimuli considered. A consequence of (21') is: Dougherty and co-workers have reported...by exposure of the animals to roentgen radiation in which the epiphoric classifier has been replaced by its referend. Replacement of considerable evidence in (21) by the referend indicated yields:

(23) In spite of the lack of conclusive data..., an appreciable augmentation of serum antibody titer in mice by injections...suggests that alterations in availability of adrenal cortical hormone are of importance in the immunologic response.

which is a consequence of (21) -- (on the deletion of the weak verb exist in the replacement, see the discussion of replacements in section 4.6).

A possible case of "exemplification" within the "Influenzal Antibodies" article is the relation between the epiphoric the range of individual variation among the experimental animals in 200.1.1 and its referend in the succeeding two sentences (cf. text). The referend-sentences do not exhaust the data, i.e., sentences, obtainable from Table II (see page for Table II) but provide a sampling (replacement of the referential classifier is discussed in the notes to sentence 200.1.1, R110).

4.5. Patterns of Epiphoric Cross-Reference. A number of epiphoric cross-references, particularly those in which the referential phrase contains a numerical determiner (see (c) in section 4.3), are variously associated with anaphoric referential relations. In example (15), noted in section 4.2, the epiphoric referential two of the earlier studies