A Reanalysis of So-Called Pied Piping in Relative Clauses

Debbie Linett Nanni

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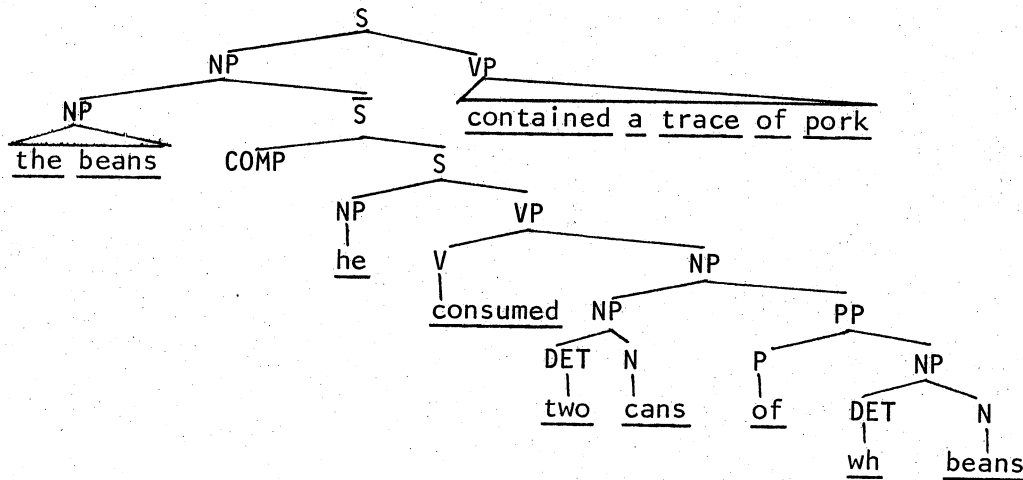
in

relative clauses

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0.   Introduction.

John Ross (1967) observes that when the Relative Clause transfor-
mation applies, it can, in certain instances, front either the NP marked
wh or any number of NP's that dominate this NP.[1] Thus the output of the
Relative Clause rule applying to the structure shown in (1) may be either
(2a) or (2b).

136

1.

```
                              S
                  NP                    VP
          NP            S̄         contained a trace of pork
       the beans    COMP      S
                          NP       VP
                          he    V           NP
                            consumed  NP              PP
                                    DET   N       P          NP
                                    two  cans     of     DET      N
                                                          wh     beans
```

2. a. The beans which he consumed two cans of Ø contained a trace of pork.

   b. The beans two cans of which he consumed Ø contained a trace of pork.

Ross also notes that cases such as (2a) are in direct violation of Chomsky's A-over-A principle as it was originally formulated. This principle would permit the rule to front only the dominating NP -- in this case, $[_{NP}$ two cans of beans$]_{NP}$.

In order to permit the grammar to generate sentences such as (2a), Ross therefore proposes that the Pied Piping Convention be added to the theory. Provided that certain conditions are met, this convention permits a "dominating" NP optionally to be reordered along with a "dominated" NP which is reordered by the application of some transformation. To derive (2b), the Relative Clause rule applies and fronts the NP wh-beans and the dominating NP is "pied piped" along with it.

Unfortunately, there are several problems with this analysis. For example, in many instances NP's vary in their ability to pied pipe. The Pied Piping Convention fails to account for these differences in pied pipe-ability. In addition, not all rules that permute NP's behave identically with respect to pied piping -- a fact which Ross himself notes (1969) but which cannot be explained by the Pied Piping Convention as it has been formulated.

The purpose of this study is to provide a reanalysis of pied piping in relative clauses. The first section is a review of the facts that motivated Ross's Pied Piping Convention. In addition, I will present some counterexamples to the convention and will argue that because pied piping is not consistent across rules, this type of universal convention is inappropriate as a device to explain the pied piping facts. From this point on, discussion will essentially be limited to pied piping in relative clauses.

Before a detailed reanalysis of pied piping can be presented, however, it will be necessary to reexamine certain facts concerning the structure of NP's and PP's, and the conditions under which they may pied pipe. In Section 2, such facts are discussed.

When Ross first introduced the Pied Piping Convention, he claimed that without such a convention it would be necessary to add some new abbreviatory notation to the theory. However, it will be shown that pied piping facts can be accounted for by constraining the theory -- first by limiting the operation of substitution, and second by restricting the manner in which a certain abbreviatory notation is interpreted. The first task can be accomplished by utilizing the work done by Peters and Ritchie (1974). A redefinition of their substitution elementary appears in Section 3.

In Section 4, a formulation of the Relative Clause Fronting rule is presented. A restriction on the interpretation of parentheses notation is included in the discussion of how this rule operates. Finally, it will be shown that pied piping in relative clauses is a consequence of the manner in which the Relative Clause Fronting rule analyzes and applies to a given structure.

1.   The Pied Piping Convention.

Ross formulates the Pied Piping Convention to account for the following set of facts.

Ross claims that an NP or PP that dominates an NP that is specified in a transformation can optionally be reordered with the specified NP. For the present we can assume that a term is _specified_ if it is analyzed and operated on by a given application of some transformation.[2] (The notion _specified term_ will be made more precise in Section 3.) Hence in the following structure, any of the circled NP's may be reordered along with $[_{NP}$wh-reports$]_{NP}$ by an application of the Relative Clause Fronting rule:

3.   [See   next   page].

It should be noted that there are certain discrepancies between Ross's figure 4.162 and our figure (3). Ross assumes that sequences consisting of P + NP are constituents of type NP. There exists evidence, however, that sequences of this sort are not NP's but rather of some other constituent type that I am calling PP.

First, NP's can freely occur in the subject position of a sentence while PP's may not.

4.   a.   Harry left yesterday.
          b.* On her shoe left yesterday.

138

3.　　　(approximately Ross's 4.162)
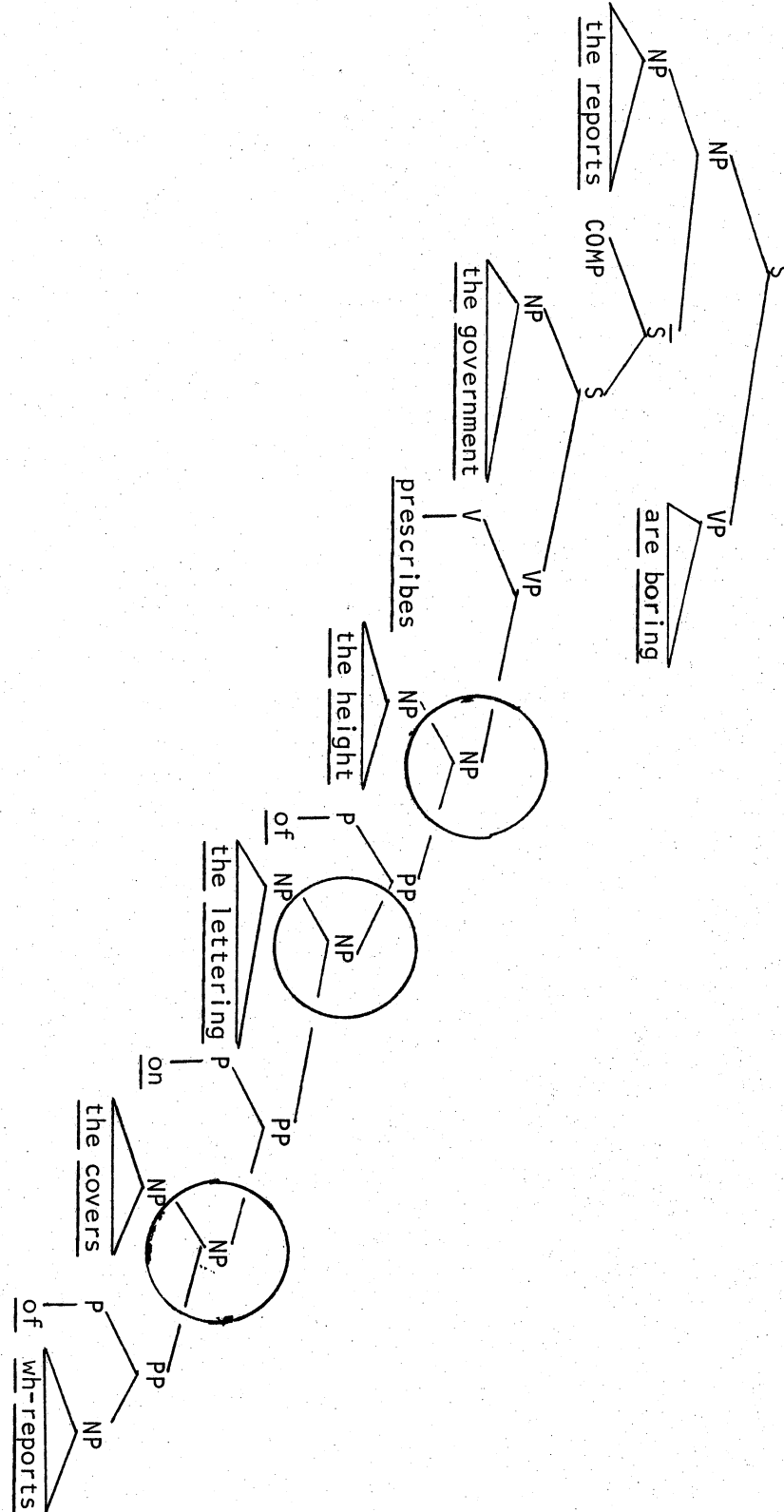
Certain types of PP's can occur in sentence initial, non-subject position without altering the normal sentence intonation pattern. NP's cannot.

5.   a.   For dinner we ate spaghétti.
             b.* Spaghetti we áte.

Certain verbs are subcategorized to take PP's and not NP's.

6.   a.   We glanced at the book.
             b.* We glanced the door.

Additional tests can be found which support the distinction between constituents of the type NP and those of the type PP.

Because a distinction is being made between NP constituents and PP constituents, it is necessary to make certain changes in Ross's presentation of the pied piping facts. However, all such modifications are, I believe, consistent with his representation of the data. Thus, while Ross described pied piping as the reordering of NP's we extend this reordering to include PP's as well.

An application of the Relative Clause Fronting rule to (3), then, will yield any one of the following sentences, (cf Ross, 4.163).

7.   a.   The reports which the government prescribes the height
               of the lettering on the covers of are boring.
             b.   The reports the covers of which the government prescribes
               the height of the lettering on are boring.
             c.   The reports the lettering on the covers of which the
               government prescribes the height of are boring.
             d.   The reports the height of the lettering on the covers of
               which the government prescribes are boring.

It will be shown in Section 2 that this particular representation of the facts is not entirely accurate.

Ross also notes that the PP's in (3) cannot be reordered. Hence there are no sentences like

8.   * The reports of which the government prescribes the height
          of the lettering on the covers are boring.

He accounts for this fact by positing a constraint which blocks PP's from being relativized or questioned when they immediately follow the NP that they modify.

A third fact Ross notes is that if the NP dominating a specified NP is coordinate, neither the dominating nor the dominated NP can be moved. The circled NP in the following structure dominates an NP that would be specified by the Wh-Fronting rule. If the rule applies and reorders either the specified or the dominating NP, the resulting

140

sentence is ungrammatical.

9.
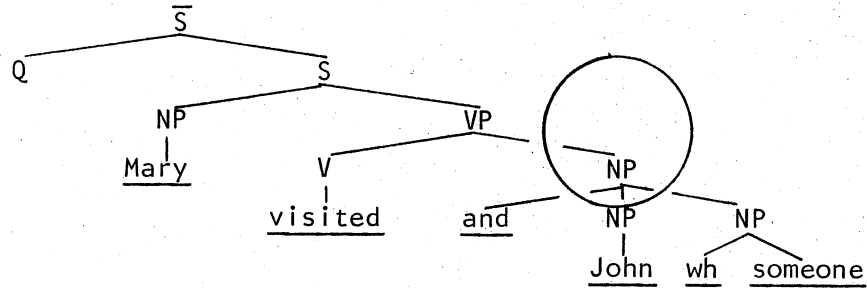
10. a.* Who did Mary visit John and ?
     b.* John and who did Mary visit ?

Finally, Ross notes that if an S-node intervenes between the dominating NP and the specified NP, the higher NP node may not be reordered.

11.
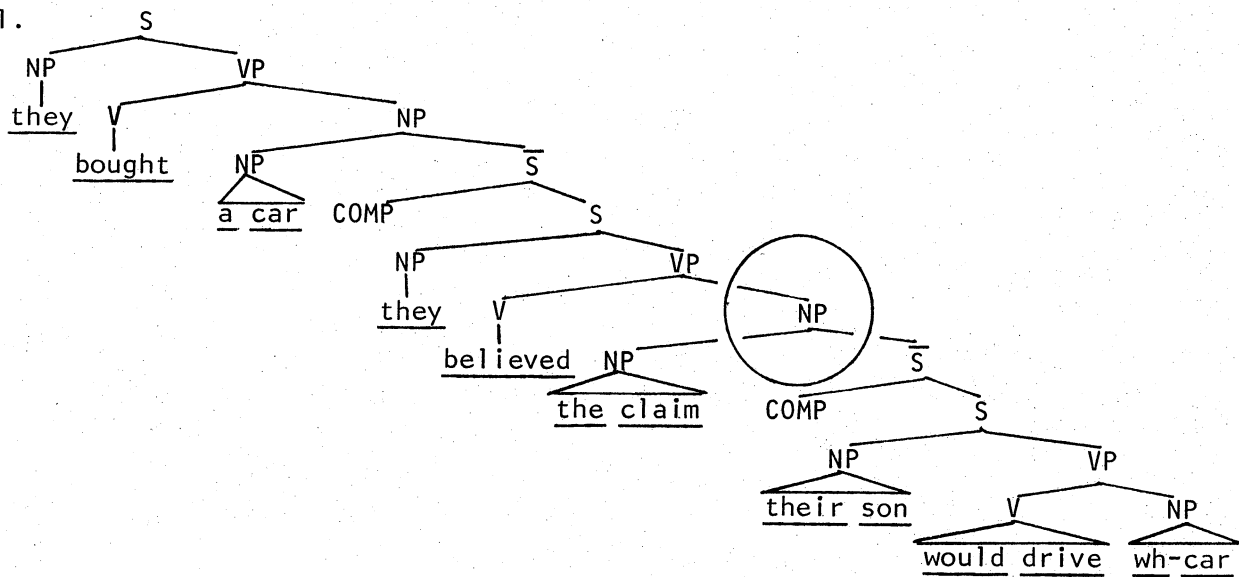
12. *   They bought a car the claim that their son would drive which they believed.

Based on these facts, Ross formulates the Pied Piping Convention:

Any transformation which is stated in such a way as to affect the reordering of some specified node NP, where this node is preceded and followed by variables in the structural index of the rule, may apply to this NP or to any non-coordinate NP (or PP -- DLN) which dominates it, as long as there are no occurrences

of any coordinate node nor of the node S on the branch
connecting the higher node and the specified node.

There are several problems with this approach to pied piping.
First, it should be apparent that such a convention is purely a descriptive
device which does nothing to explain pied piping. Ross attempts to justify
his use of a convention to account for the pied piping facts. He notes
that the process of pied piping can potentially affect an infinite number
of nodes. He therefore claims that in order to account for the data it is
necessary either to add some new abbreviatory notation to the theory to
permit finite formulation of rules involving this process, or to add some
special convention to the theory. However, it will be shown that pied
piping can be explained, in part, by constraining the theory through
restricting certain existing abbreviatory notations.

Second, the purpose of this convention is not to constrain the
application of rules. Rather, this convention gives rules greater freedom
in how they may apply. Therefore, certain absolute constraints that
would ordinarily block a particular rule application are inoperative. As
a result, it is necessary for Ross to build the Coordinate Structure
Constraint (CSC) into the formulation of the Pied Piping Convention. Thus
the CSC must operate at two points in a given grammar -- once as an
absolute constraint on rules, and once as a sub-part of the Pied Piping
Convention. If Pied Piping followed from the application of a particular
rule, it would be unnecessary to incorporate the CSC into the theory at
two distinct points.

Third, it is not clear that all rules that reorder an NP flanked
by variables in the structural index actually involve pied piping.
Consider, for example, the following set of sentences.

13.   a. It's aluminum that the chair was made from an alloy of.
         b. It's an alloy of aluminum that the chair was made from.
         c. It's from an alloy of aluminum that the chair was made.

In each of these sentences, an NP has been fronted by an application of
the rule of Clefting. Clearly, the structural index for this rule must be
formulated with the specified NP flanked by variables. Although we might
claim that in cases (13b) and (13c) the higher NP has been fronted as a
result of pied piping, there is a problem involved in such a claim.

Unlike an NP that has been permuted by an application of
Wh-Fronting or Relative Clause Fronting, an NP that is fronted by an
application of Clefting has no marker like wh- associated with it. There-
fore, in a sentence like (13b), there is no way to precisely determine
what the specified NP is. That is, if the specified NP is aluminum, then
the fronting of the higher NP is the result of pied piping. Alternatively,
the rule might analyze and apply to move the entire sequence an alloy of
aluminum. Although the Pied Piping Convention is applicable in cases such
as these, it is also unnecessary. The rule can simple analyze and apply
to the higher NP. [3]

142

Finally, Ross claims that the Pied Piping Convention is universal. A weak interpretation of this claim would entail that any rule in a grammar which reorders an NP flanked by variables in the structural index would involve pied piping. The discussion of sentences (13a) - (13c) above indicates that this is not necessarily the case. A still weaker interpretation of the claim would entail that only certain rules in a given grammar would be subject to the Pied Piping Convention. If we adopt this interpretation, then it would be expected that the pied pipe-ability of a given NP or PP will be consistent for all rules subject to pied piping. This is not the case however. Two rules in a single grammar may exhibit different pied piping behavior. For example, an NP that can be pied piped by one rule cannot necessarily be pied piped by another.

Ross (1969) himself notes that certain NP's cannot pied pipe when Wh-Fronting applies, but that those same NP's may pied pipe when the Relative Clause Fronting rule applies.

14. * A picture of whom do you have on your piano ?
15. The president, a picture of whom you have on your piano, is certain to veto that bill.

In fact no "dominating" NP can be pied piped along with an NP fronted by the Wh-Fronting rule. Only a preposition that is a sister to the specified sequence can be pied piped in questions.

16. Which bank did he steal the money from ?
17. From which bank did he steal the money ?
18. * The money in which bank did he steal ?
19. * In a bag of what did he find the missing ring ?

However, these same nodes can be pied piped by an application of the Relative Clause Fronting rule.

20. The bank, the money in which you stole, has installed hidden cameras.
21. The flour, in a bag of which he found the missing ring, was mealy.

In order to account for such facts and still retain the Pied Piping Convention, it would be necessary to state a different version of the convention for each individual rule.

In the same paper Ross also notes (p 263):

Exactly what types of constituents may pied pipe varies from language to language, from rule to rule, and even from dialect to dialect.

If this is the case, and I believe that Ross's observation is correct, then

the claim that pied piping can be explained by a universal convention of the type proposed is reduced to near vacuity.

The facts indicate that pied piping in relative clauses and pied piping in questions are distinct, although similar phenomena. For the remainder of this paper it will therefore be assumed that pied piping is a function of each individual rule. It will be shown that once a rule is formalized precisely, pied piping will be a consequence of that rule applying to a particular factorization.

2.   PP's, NP's, and Pied Piping.

Pied piping ability does not just vary from rule to rule. Whether or not a particular node may pied pipe is dependent on structure as well. In this section I will show that the pied pipe-ability of a given PP or NP node can be predicted from its position in the tree at the time the tree is analyzed by a given transformation.

I will assume that PP's may originate in three base positions. A PP may be generated as a constituent of an NP, a VP or an S. PP's that are dominated by an NP node cannot pied pipe.[4] For example, the PP near the lake in a sentence like (22) is ambiguous between an NP-PP reading and a VP-PP reading. That is, the sentence can be assigned either of the structures shown in (23).

22.   We picnicked in the park near the lake.

23.   a. (NP-PP reading)

b. (VP-PP reading)

144
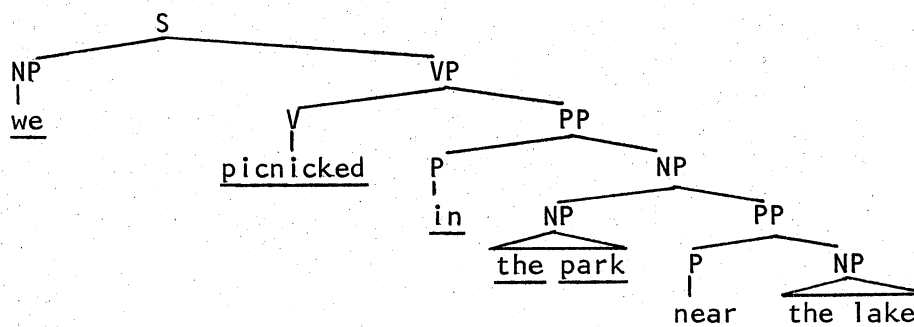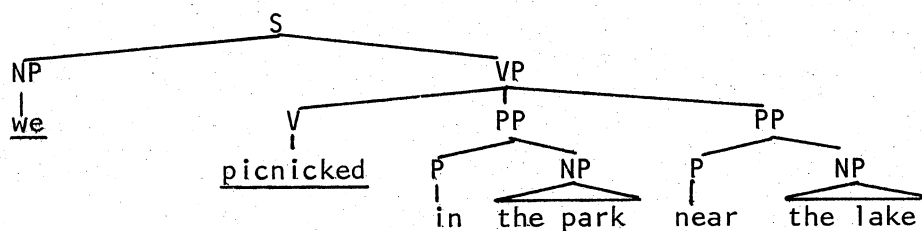
The reading may be roughly paraphrased as follows:

24.   a. We picnicked in the park which was near the lake. (NP-PP)
                b. We picnicked in a particular location in the park --
                     namely, near the lake. (VP-PP)

        If the preposition <u>near</u> is pied piped along with the NP <u>the</u>
<u>lake</u>, only the VP-PP reading is possible.

25.   The lake near which we picnicked in the park was dark and
            still.

In those cases where a VP-PP reading is not possible, such as in (26a),
reordering the preposition along with the NP yields an unacceptable
sentence.

26.   a. We visited the park near the lake.
                b.* The lake near which we visited the park was dark and still.

        Ross (1967) notices this fact about NP-PP's and claims that there
exists a constraint that prohibits PP's that follow and are contiguous to
the NP's that they modify from being relativized or questioned. Actually
neither the PP nor the circled NP in a configuration like (27) can be
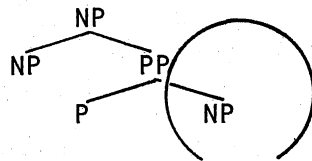relativized or questioned.

27.

If it is correct that this fact should be accounted for by the addition of
a constraint, as Ross suggests, this constraint will have to be extended
to other rules that reorder NP's and PP's.

28.   a.* It was near the lake that we visited the park. (Clefting)
                b.* Near the lake we visited the park. (Y-Movement)
                c. It was near the lake that we picnicked in the park.
                              (Clefting VP-PP reading only)
                d. Near the lake we picnicked in the park.
                              (Y-Movement, VP-PP reading only)

        A preposition that is dominated by a PP node, which, in turn,
is dominated by a VP may optionally be reordered along with a specified
NP node if the NP is also dominated by the same PP. Dresher (1975), in
his paper on prepositional phrases, has formulated some tests to deter-
mine when a PP is a VP-PP.

        When a VP-PP of a certain class is fronted to sentence-initial
position, it triggers verb inversion, provided that the subject of the

sentence is not a pronoun.

29.   a.   John fell into the river.
               b.   Into the river fell John.

A VP-PP will also precede a sentence-modifying adverb or PP.

30.   a.   John fell into the river yesterday.
               b.* John fell yesterday into the river.

Since into the river is a VP-PP, either the NP wh-river alone may be fronted by the Relative Clause Fronting rule, or the entire PP may be fronted.

31.   The river which John fell into was swollen from recent rains.
32.   The river into which John fell was swollen from recent rains.

        The facts regarding S-PP's are not as clear as in the NP-PP and VP-PP cases. The data indicate that a preposition in an S-PP may not be stranded when a rule like Relative Clause Fronting or Wh-Fronting applies to reorder its sister NP. Tests for S-PP's are again provided by Dresher (op cit). S-PP's can freely occur in S-initial position.

33.   During surgery, Harry died.
34.   At six o'clock, John agreed to meet with us at nine o'clock.

S-PP's must follow a VP-PP when the two PP constituents are contiguous and occur after the verb.

35.   John fell into the river during the picnic.
36. *   John fell during the picnic into the river.

        In sentence (37) below, the PP at a particular time is ambiguous between an S-PP and a VP-PP reading.

37.   John agreed to meet us at a particular time.

If the question rule applies and fronts the NP, a particular time, only the VP-PP reading is possible.

38.   What time did John agree to meet us at ?

However, if the preposition is pied piped, the sentence is again ambiguous.

39.   At what time did John agree to meet us ?

        If the PP can only be an S-PP, however, as in example (33) above, stranding the preposition yields an ungrammatical sentence. The preposition

146

in an S-PP must be reordered along with the NP.

40.   a. The surgery during which Harry expired was experimental.
          b.* The surgery which Harry expired during was experimental.
          c.* What did Harry expire during ?

One way to account for these facts about S-PP's would be to claim that pied piping of the preposition is obligatory when an NP is reordered from under an S-PP. Dresher has argued that S-PP's are generated in S-initial position in the base. Assuming that Dresher's claim is correct, such an analysis entails that the reordering of S-PP's to sentence or clause-final position is prior to any application of Relative Clause Fronting or Wh-Fronting. Under such an account it is necessary to add an additional specific constraint to the Pied Piping Convention to guarantee that the preposition in an S-PP is not stranded in sentence-final position.

An alternative analysis is, however, possible. Suppose that Relative Clause Fronting and Wh-Fronting apply while S-PP's are still in S-initial position. This would explain why the preposition in S-PP's is always reordered along with the NP. Stranding a preposition in sentence-initial position as in (41) would be in direct violation of the Clause Non-Final Incomplete Constituent Constraint (cf Kuno, 1973).

41.   * The surgery which during John expired was experimental.

Kuno's constraint prevents extraction of an element from a phrase that is in clause non-final position if what remains constitutes an incomplete phrase or clause. In (41), the NP surgery has been extracted from a clause-initial phrase. The remaining preposition during constitutes an incomplete phrase in non-final position. Hence the sentence is ungrammatical.

There is a problem with this analysis however, because it involves a violation of the Strict Cycle Condition (Chomsky, 1973). Postposing of S-PP's would have to be ordered post-cyclically. Therefore on the topmost cycle, the transformation could potentially apply to affect only material dominated by another cyclic node.

Despite this problem, there is a small amount of evidence in favor of such an analysis. First, such an analysis does not require the addition of a new, extremely limited constraint to the grammar. The non-stranding of the preposition in S-initial PP's is predicted by a more general, independently motivated constraint.

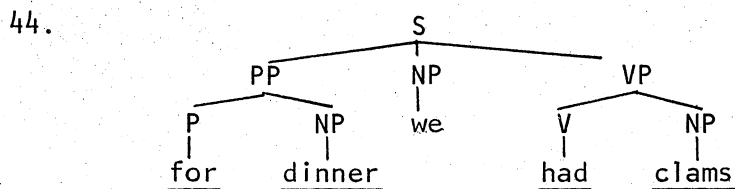Second, Bresnan (1971) noticed that sentences like

42.   We had cláms for dinner.

were apparent counterexamples to the Ordering Hypothesis that she proposed to account for normal sentence stress patterns. Under this hypothesis, the

Nuclear Stress Rule applies at the very end of every cyclic domain, stressing the rightmost element. Hence, contrast the stress in sentence (42) above with that in (43), where for dinner forms a constituent with plans.

43.   We had plans for dínner.

If, however, S-PP's are still in clause-initial position at the end of the S cycle (as in (44)), the fact that primary stress falls on clams would be explained.

44.

```
                          S
          ┌───────────┬─────────────┐
          PP          NP            VP
       ┌──────┐       │         ┌────────┐
       P      NP      we        V        NP
       │      │                 │        │
      for   dinner             had     clams
```

        Although there is not, at present, an abundance of evidence to support this latter analysis of S-PP's, I feel it is somewhat better motivated than the former, and will henceforth assume that it is correct in this paper.

        Ross appears to assume that generally, the pied piping of NP's is optional. The facts indicate, however, that only in one specific instance is pied piping of NP's optional. In all other cases, pied piping of a dominating NP is obligatory.

        Chomsky (1970) presents syntactic and semantic arguments that derived nominals like proof of the theorem, destruction of the city, murder of John, have the internal structure of a complex NP like a picture of John. He proposes that such NP's be generated in the base and have the underlying structure in (45).

45.

```
                      N̄̄
          ┌───────────────┬──────────┐
         SPEC             N̄
          │         ┌──────────┬────────┐
         DET        N          N̄̄
          │         │     ┌─────────┬──────┐
         the      proof  SPEC       N̄
                          │         │
                         DET        N
                          │         │
                         the      theorem
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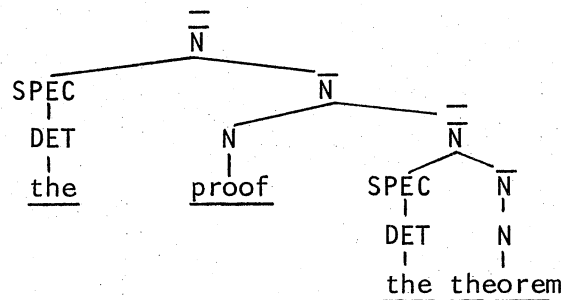
The pied piping facts are consistent with this analysis.

        Both derived nominals and complex NP's like a picture of John, a sack of flour, a nugget of gold, behave identically with respect to pied piping. In these cases the pied piping of the higher NP is optional.

148

46.   a.   The man who John purchased a picture of was seated by the window.

              b.   The man, a picture of whom John purchased, was seated by the window.

47.   a.   The flour which we opened a sack of was freshly ground.

              b.   The flour, a sack of which we opened, was freshly ground.

48.   a.   The theorem which we studied the proof of was confusing.

              b.   The theorem, the proof of which we studied, was confusing.

I will assume that (45) correctly represents the underlying structure of these NP's. [5]

      In other NP constructions, however, pied piping of the higher or "dominating" NP is obligatory. Consider, for example, the following set of sentences.

49.   a.   We counted the money in the sack.

              b.   The sack which we counted the money in was torn.

              c.   The sack in which we counted the money was torn.

              d.   The sack, the money in which we counted, was torn.

In sentence (49a), the PP in the sack is ambiguous between a VP-PP reading (the pragmatically implausible reading) and an NP-PP reading. When the lower NP is fronted as in (49b) or when the PP is fronted as in (49c), only the VP-PP reading is possible. When the higher NP is fronted as in (49d), however, only the NP-PP reading is possible.

      Consider now sentences (50a) - (50d).

50.   a.   We carried inside the chair on the porch.

              b.* The porch which we carried inside the chair on was beginning to sag.

              c.* The porch on which we carried inside the chair was beginning to sag.

              d.   The porch, the chair on which we carried inside, was beginning to sag.

In (50a), on the porch can only have an NP-PP reading. When only the lower NP or PP is fronted, as in (50b) and (50c), the sentence is ungrammatical.

      NP's such as the chair on the porch and the money in the sack behave differently from NP's such as the proof of the theorem, the bag of money. While a lower N may be extracted from an NP of the latter type (eg (46b), (47b), (48b)), nothing can be extracted from an NP of the former type. Only the highest NP can move in these cases.

      I will assume that NP's such as the money in the sack, the chair on the porch have the structure shown in (51).

51.

```
                    =
                    N
         _____
        DET         N         PP
                           _____
                          P        =
                                   N
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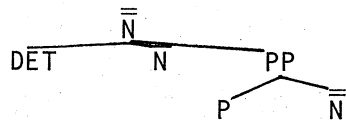
Once again it would be possible to introduce an additional constraint
into the Pied Piping Convention to account for those instances where
pied piping is obligatory. However, this would again be only a descriptive
device.

There is one final problem I wish to bring up regarding the facts
about pied piping. This concerns a particular discrepancy between Ross's
facts and those just presented. Recall sentence (7b).

7.   b. The reports, the covers of which the government prescribes
              the height of the lettering on are boring.

By the analysis just presented, it would be impossible to derive this
sentence from the structure that Ross suggests, since it would entail the
fronting of the lower NP from a structure like (51).

Consider now sentence (52), which is similar in structure to
Ross's original example.

52.   The government describes the lettering on the covers of the
          reports.

This sentence is ambiguous. The phrase the lettering on the covers of the
reports can be either a single constituent or a sequence of two constituents
as evidenced by the two possible passive sentences that can be formed.

53.   a. The lettering on the covers of the reports is described by
              the government.
          b. The lettering is described by the government on the covers
              of the reports.

Thus the sequence on the covers of the reports may occur underlyingly either
as a modifier of the NP the lettering or as a modifier of the VP. Ross
himself asserts that PP's may not be reordered from under the NP's that
they modify. However the PP on the covers of wh-reports can be reordered.

54.   The reports on the covers of which the government prescribes/
   describes the lettering, are invariably boring.

This evidence, along with the facts presented earlier regarding the pied
pipe-ability of certain NP's indicates that sentence (7b) must be derived
from a structure in which the phrase on the covers of the reports is a VP
modifier.

In summary, each of the circled nodes in the following construc-
tions may be reordered by an application of the Relative Clause rule.

150
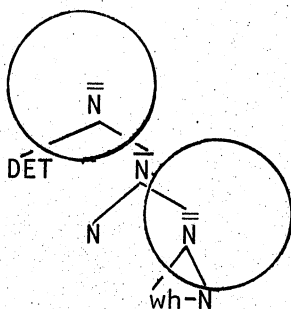
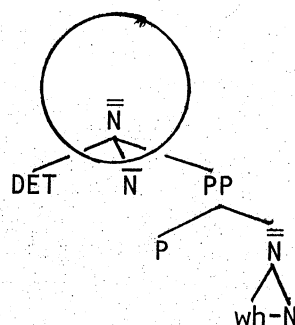55.   a.   b.
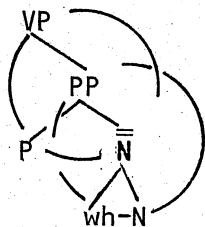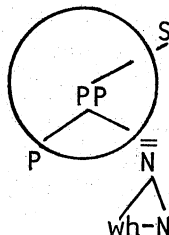

c.   d.

3.   Restriction on Movement.

In Section 1 it was argued that pied piping varies from rule to
rule and therefore cannot be treated as a single phenomenon. It will also
be shown that at least in the case of Relative Clause Fronting, pied piping
follows from the manner in which the rule analyzes and applies to a
given structure. Such a rule will be formulated in Section 4. However,
it is first necessary to constrain the operation of substitution within the
theory.

In the formal system proposed by Peters and Ritchie (1973), all
transformations are defined on strings of labeled bracketings and are
built up from a restricted set of elementary operations. These elementary
operations are adjunction, substitution and deletion. Movement rules
consist of either a combination of substitution and deletion, or a com-
bination of adjunction and deletion. In the case of substitution, a copy
of some substring of labeled bracketing is substituted for another string
and the original occurrence of the copied string is deleted. In the case
of adjunction, a copy of a substring is adjoined to some other string and
the original occurrence of the string is deleted. In addition, every
transformation must have a structural condition -- a specification of the
sequences of terms to which the rule may apply.

One of the assumptions underlying the work of most linguists is
that transformations operate on constituents. Thus, transformations have
consistently been used to test whether or not a particular string of words
is a constituent. For example, the Passive and Pseudo-Cleft rules have
been used as a test for NP's, the Do-So rule as a test for VP's, and
Clefting and Right Node Raising as a test for constituents of various
types. In spite of this there exists nothing in the formalism that would
prohibit movement[6] transformations from operating on arbitrary strings
of constituents.

Although most linguists would claim that a rule like (56) is extremely "unnatural", rules of this sort would be permitted to apply in a system such as the one proposed by Peters and Ritchie.

56.   SD: X - NP - P - NP - Y
                1 -   2 - 3 -   4 - 5
        SC: 1 - $\emptyset$ - $\emptyset$ - 2 - 3 - 5

In this section I will propose two modifications in the formalism. The two modifications will have the effect of prohibiting rules like (56) from applying unless the sequence NP + P forms a single constituent. Both modifications are, I believe, motivated on general grounds.

According to the definition given by Peters and Ritchie, the substitution elementary substitutes the <u>Contents</u> of a string ψ (C(ψ)), for the <u>Interior</u> of a string ϕ (I(ϕ)). [7]

The Interior of a substring of a well-formed labeled bracketing is defined by Peters and Ritchie as follows:

57.   Interior.
        "The Interior of a terminal labeled bracketing ϕ is the longest well-formed labeled bracketing ψ such that
        (i) the debracketization of ϕ = the debracketization of ψ, and
        (ii) there are (possibly null) labelled bracketings σ, τ, such that $\phi = \sigma\psi\tau$."

A labelled bracketing is considered to be well-formed if its brackets are in matched pairs. Hence (58a) and (58b) are both well-formed labeled bracketings, while (58c) is not.

58.   a. $[_X \psi]_X [_Y \phi]_Y$

        b. $[_X [_Y \phi]_Y]_X$

        c. $[_X [_Y \phi]_X]_Y$

Thus, by the definition given in (57), the interior of a substring is either a constituent or a string of sister constituents. In addition, the interior of a substring must be the <u>longest</u> well-formed labeled bracketing that also contains all the terminal symbols in ϕ, the original substring. For example, the interior of the substring in (59) is (60).

59. $\phi = [_S [_{NP} [_{DET} \text{ the }]_{DET} [_N \text{ man }]_N]_{NP} [_{AUX} [_{TNS} \text{ past }]_{TNS}]_{AUX}$

60. $\psi = [_{NP} [_{DET} \text{ the }]_{DET} [_N \text{ man }]_N] [_{AUX} [_{TNS} \text{ past }]_{TNS}]_{AUX}$

Contents is defined to be the concatenation of the Interiors of a substring of a well-formed labeled bracketing. That is, given some substring of a well-formed labeled bracketing and given the grossest factor-

152

ization of the substring in which each term has an Interior, Contents will equal the concatenation of the Interiors of that factorization. The Contents of (59) is (60) also. However, while the sequence in (61) has no Interior, it does have a Contents.

61.
a. $[_{AUX}[_{TNS}$ past $]_{TNS}]_{AUX}$ $[_{VP}[_{V}go]_{V}$

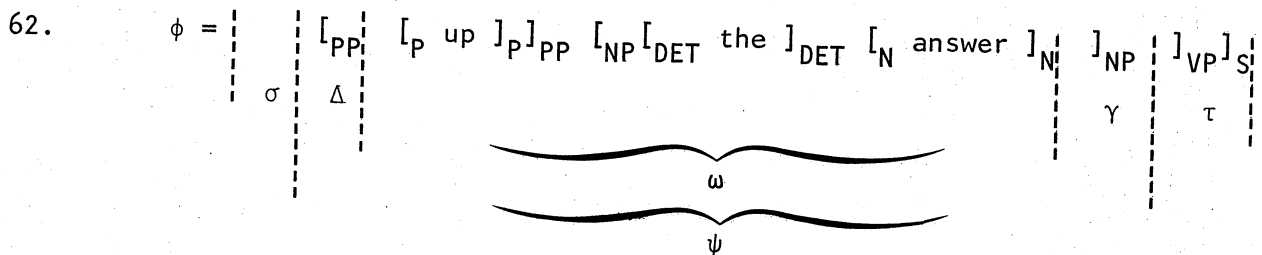b. $C(\phi) = [_{AUX}[_{TNS}$ past $]_{TNS}]_{AUX}$ $[_{V}$ go $]_{V}$

The sequence in (61) has no Interior for the following reason. The longest well-formed labelled bracketing in this substring is $[_{AUX}[_{TNS}$ past $]_{TNS}]_{AUX}$. The debracketization of this longest well-formed labeled bracketing is <u>past</u>. However, the debracketization of the entire string in (61a) is <u>past go</u>. Hence, condition (i) in (57) is not met. The sequence in (61a) does have Contents, however, since it can be factorized into two factors, each having an Interior. The Interiors of these two factors are $[_{AUX}[_{TNS}$ past $]_{TNS}]_{AUX}$ and $[_{V}$ go $]_{V}$. The Contents of (61a) will thus be the concatenation of these Interiors, or (61b).

Since the substitution elementary substitutes the Contents of one substring for the Interior of another substring, this analysis would permit a string of constituents like that in (61b) to be substituted for a string of constituents like that in (60) (provided that the two strings did not overlap).

In order to constrain the substitution elementary so that it will apply only to constituents, it is first necessary to limit those substrings that the elementary may apply to. This can be accomplished by adding a third condition to the definition of Interior. This condition will ensure that only a string that is a constituent may have an Interior.

57.
. . .(iii) There are Δ, γ, ω such that $\Delta \in L$ (the set of left labeled brackets), $\gamma \in R$ (the set of right labeled brackets), ω is a well-formed labeled bracketing, and $\psi = \Delta\omega\gamma$ (where Δ and γ are not null).

By the revised definition, a sequence like (62) has no Interior, since the sequence that is equivalent to ω is itself not a well-formed labeled bracketing.

62. $\phi = $ $[_{PP}$ $[_{P}$ up $]_{P}]_{PP}$ $[_{NP}[_{DET}$ the $]_{DET}$ $[_{N}$ answer $]_{N}$ $]_{NP}$ $]_{VP}]_{S}$

σ Δ γ τ

ω

ψ

A PP like <u>to his sister</u> in (63) will have an Interior since all conditions stated in <u>the definition</u> are met. The ω factor in this case is a well-formed labeled bracketing.

63. $\qquad \phi = \begin{array}{|c|c|c|} \hline & & [_{PP} \ [_{P} \ \text{to} \ ]_{P} \ [_{NP}[_{DET} \ \text{his} \ ]_{DET} \ [_{N} \ \text{sister} \ ]_{N}]_{NP} \ ]_{PP} \\ \hline \sigma & \Delta & \\ \hline \end{array} \quad \gamma \quad \tau$

$$\omega$$

$$\psi$$
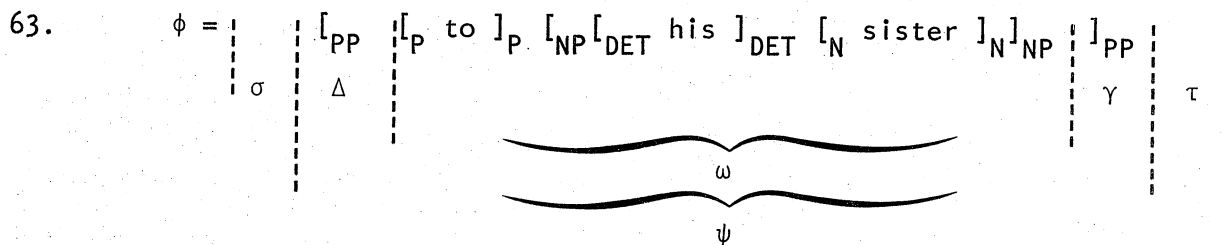
By the revised definition, the Interior of any substring is a constituent.

It is now possible to modify the substitution elementary.

64. Definition.
The substitution elementary is the function T_s from pairs

(ϕ,ψ) of substrings of well-formed labeled bracketings to labeled bracketings defined if and only if ϕ has an Interior by setting $T_s (\phi,\psi) = E_l (\phi) \ I(\psi) \ E_r (\phi)$. ($E_l$ is the σ factor in the definition of Interior; E_r is the τ factor.)

Thus, as in the Peters and Ritchie system, the substitution elementary, T_s (h,i)(j,k) will operate on a factorization of a string. It will substitute a copy of the sequence of the $j^{th} - k^{th}$ terms of a factorization for the sequence of the $h^{th} - i^{th}$ terms. However, the effect of the proposed modifications will be to constrain the grammar so that the substitution elementary will apply only to constituents. That is, the $j^{th} - k^{th}$ terms which will be substituted must be a constituent, and the $h^{th} - i^{th}$ terms which will be substituted for must also be a constituent.

The notion <u>specified</u> <u>term</u> can now be defined in the following manner:

65. Definition.
A constituent is <u>specified</u> if it is mentioned in the structural condition of some transformation, and if it occurs within the $j^{th} - k^{th}$ terms of an elementary of some transformation.

The notion specified term as here defined will be utilized in the discussion of the Relative Clause Fronting rule in Section 4.

4. The Relative Clause Fronting Rule.

In the previous section it was proposed that grammars be constrained in a particular manner. Specifically, rules that substitute one sequence for another are now restricted to the substitution of constituents. This restriction is achieved by limiting the types of substrings that

154

may be applied to by the substitution elementary. By constraining the grammar in this manner, it now becomes possible to account for a wide range of facts.

In this section, a formulation of the Relative Clause Fronting rule will be presented. The remainder of the section will be devoted to a detailed discussion of how the rule operates. The analysis of PP's and NP's presented in Section 2 will be assumed throughout this discussion. In addition, the interaction of the Relative Clause Fronting rule with the A-over-A Principle (Chomsky, 1973) will be discussed. I will show that one interpretation of this condition is too strong. It will also be demonstrated that a large number of facts can be explained if a particular interpretation of the Relativized A-over-A Principle (Bresnan, 1974) is adopted.

Consider now a formulation of the Relative Clause Fronting rule (henceforth, RCF):[8]

66.   RCF

$$\text{SD:} \quad \bar{\bar{N}} - \text{COMP} - W_1 - \left[{S \atop \bar{N}} \right\} W_2 - (P) \; [\bar{\bar{N}} \; W_3 - \underline{wh} - W_4 \;]\bar{\bar{N}} - W_5 \left\{ {S \atop \bar{N}} \right.$$

$$1 - 2 - 3 - \qquad 4 - 5 \quad 6 - 7 - 8 \qquad - 9$$

$$\text{SC:} \quad 1 - 5 - 6 - 7 - 8 - 3 - 4 - \emptyset - \emptyset - \emptyset - \emptyset - 9$$

When this rule applies to a given proper analysis, it will substitute terms 5 - 8 for the Complementizer (term 2) and will then delete the original occurrence of terms 5 - 8.

The brace notation enclosing the non-terminal symbols $\bar{N}$ and S in the rule indicates that either terms 4 - 8 "are an" S or terms 4 - 8 "are an" $\bar{N}$, (see Peters and Ritchie, op cit, for a definition of the formal notion "is a").That is, these brackets allow us to delimit the domain in which the 5th - 8th terms are analyzed. The reason for including this bracketing will be made clear below.

Certain empirical consequences of the modifications made in the previous section should now become apparent. For example, consider a structure like (67) which contains a sentence-modifying prepositional phrase.

67.   (See next page).

RCF can analyze this structure in two ways. In one proper analysis, term 5 is null. In another proper analysis term 5 will be the preposition during. The output of the rule applying to the former proper analysis would be (68).

68.   * The surgery which during John expired was experimental.

However, because the prepositional phrase in (67) is in clause non-final

67.

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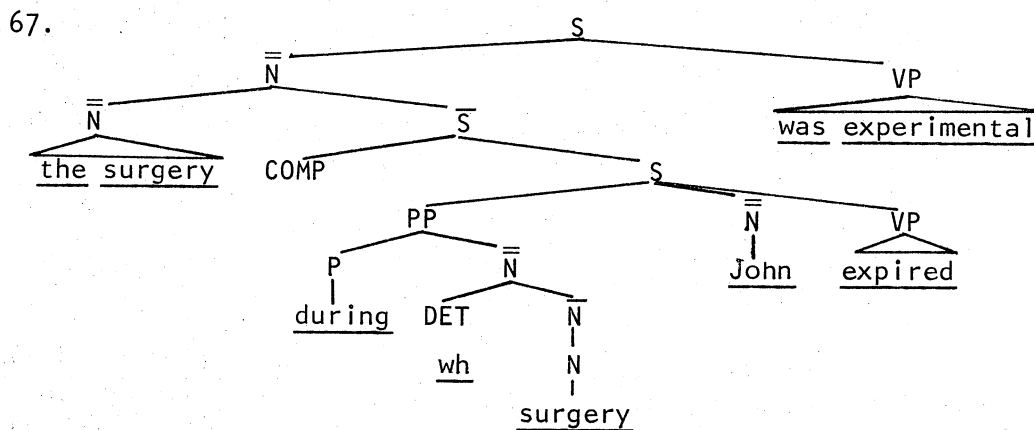
position, the Clause Non-Final Incomplete Constituent Constraint will block the rule from extracting only the N double bar, <u>wh-surgery</u>. If this $\overline{\overline{N}}$ were extracted from the prepositional phrase, the remaining constituent would constitute an incomplete phrase. However, the Constraint will not block the rule from applying to the proper analysis in which term 5 is not null.

69.   The surgery during which John expired was experimental.

        Second, RCF will only analyze and apply to a tree if the sequence in the tree that corresponds to terms 5 - 8 in the rule is a constituent (ie, has an interior). In particular, notice that it is not necessary to "mention" a PP node in the structural index of the rule. Nevertheless, the rule can apply to substitute a sequence P + NP for the COMP only provided that this sequence is a constituent. Consider for example, cases in which the sequence P + NP does not form a constituent.

        Emonds (1972) has argued that particles in constructions like (70a) - (70d) should be reanalyzed as intransitive prepositions.

70.   a.   look up
           b.   send off
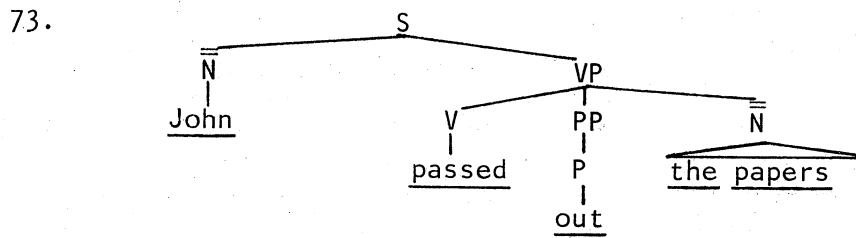   c.   pass out
           d.   pay back

He proposes that they be generated in the base by the following phrase structure rule.

71.   PP → P (NP)

Thus a sentence like (72) would be associated with the phrase marker (73).

156

72.   John passed out the papers.

73.

```
                               S
         ‗                              
         N                            VP
         |                              
       John              V      PP         N̄
                         |       |          
                      passed     P      the papers
                                 |
                                out
```

       The restriction placed on the substitution elementary would block a rule like RCF from applying to a proper analysis in which <u>out the papers</u> is the 5th - 8th terms. Hence, we would predict that sequences of this sort will not be fronted by RCF. The facts bear out the prediction.

74.   a.* The number up which I was looking was unlisted.
        b.* The letters off which we sent last Tuesday never arrived.
        c.* The papers out which John passed had been graded on a curve.
        d.* The loan back which they paid was for $ 500.

RCF can, however, apply to structures which contain an intransitive preposition followed by an NP provided that the 5th term is analyzed as null.

75.

```
                                    S
              N̄                                      VP
         N̄         S̄                          was unlisted
    the number  COMP        S
                        N̄            VP
                        |     V      PP              N̄
                        |  was looking P         DET      N
                        |             |          wh       N
                        |            up                   N
                        |                              number
     1       2            4          5 6         7        8    9
             3
```
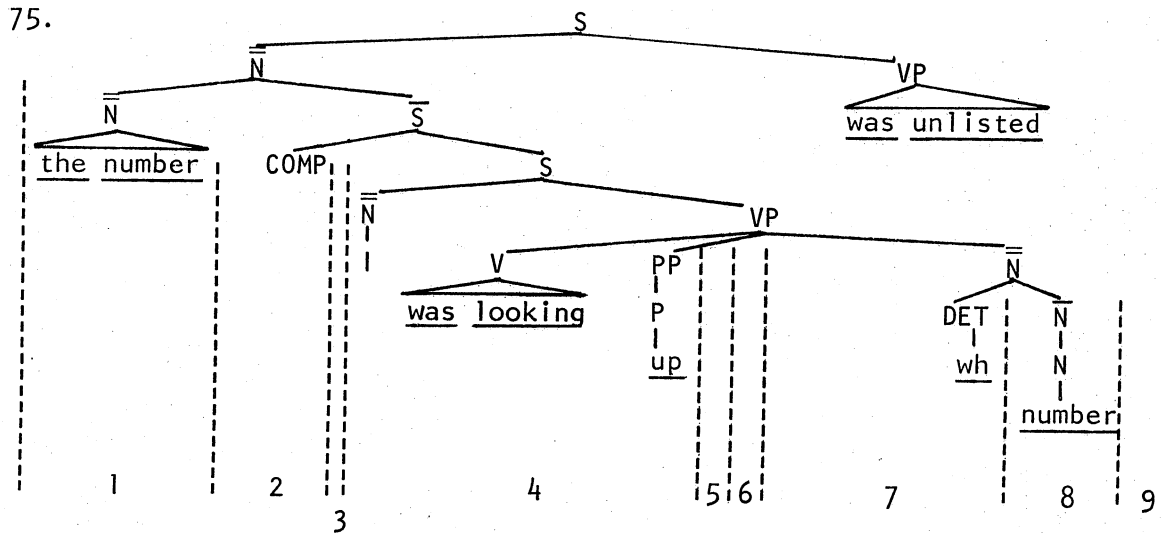
Since, in this case, the substring corresponding to terms 5 - 8 is a constituent, the rule will analyze the tree and apply, yielding:

76.   The number which I was looking up was unlisted.

In those cases in which a sequence P + NP forms a constituent or in which an NP is dominated at some point by an NP, the rule may analyze and apply to the structure in a variety of ways. Since the applicability of this rule in such cases crucially involves the A-over-A Principle, it is useful to first make precise how this condition may be interpreted.

Chomsky (1973) claims that if a transformation may apply to two constituents of the same type, then it must apply to the maximal constituent of that type. Thus we can interpret this condition as blocking any rule from applying to the node circled in the configuration,

$$A$$
$$|$$
$$A$$
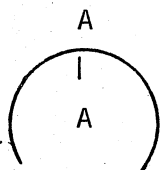
An application of RCF involves movement of a noun phrase into the COMP position. Since noun phrases can be embedded in noun phrases, the A-over-A Principle would prohibit any noun phrase embedded in a noun phrase from being fronted by an application of this rule.

Further, we can interpret the notion "apply to" to mean that the constituent must be <u>specified</u> in the rule. That is, only a specified term is subject to this maximality condition. Hence, this condition would <u>not</u> extend to constituents that are mentioned in the rule but that do not occur within the j-k terms of some elementary transformation in the rule. In RCF, for example, the terms $\bar{N}$ and COMP which appear in the structural index will not be subject to the maximality condition.

In addition, we might assume that RCF abbreviated four distinct transformations which all have a particular operation in common.

77. $\bar{\bar{N}} - COMP - W_1 - [_S W_2 - P - [_{\bar{N}} W_3 - \underline{wh} - W_4]_{\bar{N}} - W_5]_S$

78. $\bar{\bar{N}} - COMP - W_1 - [_S W_2 - [_{\bar{N}} W_3 - \underline{wh} - W_4]_{\bar{N}} - W_5]_S$

79. $\bar{\bar{N}} - COMP - W_1 - [_{\bar{N}} W_2 - P - [_{\bar{N}} W_3 - \underline{wh} - W_4]_{\bar{N}} - W_5]_{\bar{N}}$

80. $\bar{\bar{N}} - COMP - W_1 - [_{\bar{N}} W_2 - [_{\bar{N}} W_3 - \underline{wh} - W_4]_{\bar{N}} - W_5]_{\bar{N}}$

In each rule it is the term $\bar{\bar{N}}$ that is specified. Thus, A-over-A would predict that in no case will a node of the type $\bar{N}$ be removed from a node of the same type, but rather that only the maximal node of the type $\bar{\bar{N}}$ may be reordered by the application of any rule abbreviated by RCF.

Consider in the light of this discussion, how RCF and the A-over-A Principle interact with respect to the following structure.

158

81.

$\overline{\overline{N}}$ tree:

the porch — COMP — $\overline{N}$ / $\overline{\overline{S}}$ ... we / carried inside ... the chair / on wh porch ... was beginning to sag
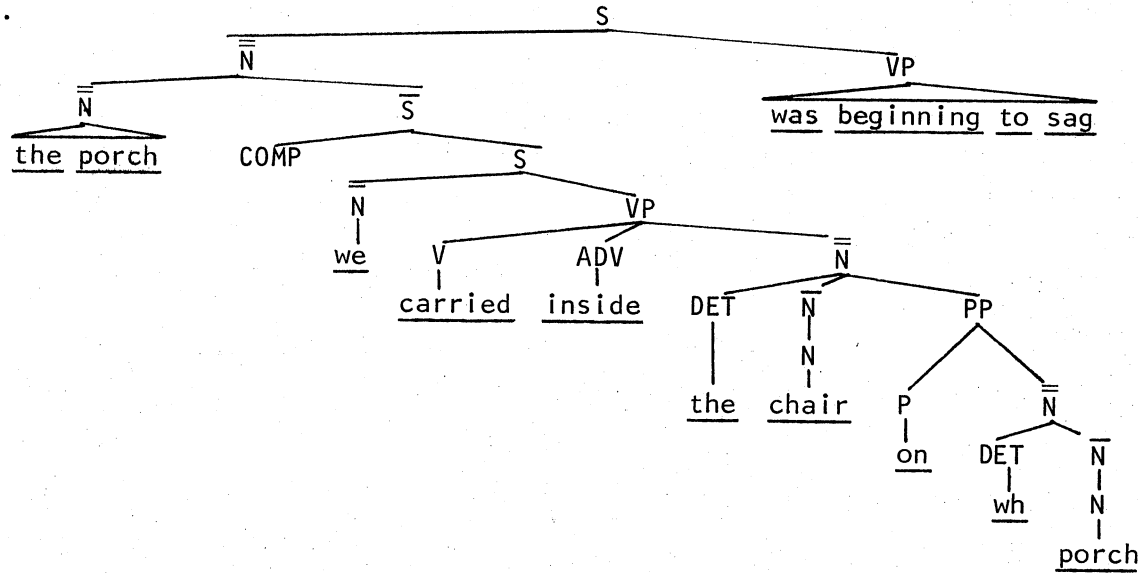
Rules (79) and (80) cannot analyze (81) since the sequence [$_{\overline{\overline{N}}}$ the chair on wh-porch]$_{\overline{\overline{N}}}$ is not dominated by $\overline{N}$. Rule (77) may analyze this tree as follows:

82.   the porch — COMP — $\emptyset$ — [$_S$ we carried inside [$_{\overline{\overline{N}}}$ the chair —
           1   —   2   — 3 —   4

       on — [$_{\overline{\overline{N}}}$ $\emptyset$ — wh — porch]$_{\overline{\overline{N}}}$]$_{\overline{\overline{N}}}$ — $\emptyset$]$_S$
       5   —   6   —   7   —   8   —   9

Notice, however, that reordering the sequence 5 - 8 in (82) will involve moving a non-maximal occurrence of an N double bar constituent, [$_{\overline{\overline{N}}}$ $\emptyset$ - wh - porch]$_{\overline{\overline{N}}}$, out of a maximal N double bar, [$_{\overline{\overline{N}}}$ the chair - on - [$_{\overline{\overline{N}}}$ wh - porch]$_{\overline{\overline{N}}}$]$_{\overline{\overline{N}}}$. Therefore, A-over-A blocks the rule from applying. This would appear to be precisely the result we wish to obtain. Hence, A-over-A blocks such ungrammatical sentences as (83) from being generated.

83.   * The porch on which we carried inside the chair was beginning to sag.

       Rule (78) may analyze (81) in two ways.

84.   the porch — COMP — $\emptyset$ — [$_S$ we carried inside [$_{\overline{\overline{N}}}$ the chair on —
           1   —   2   — 3 —   4   —

       $\emptyset$ - [$_{\overline{\overline{N}}}$ $\emptyset$ — wh — porch]$_{\overline{\overline{N}}}$]$_{\overline{\overline{N}}}$ — $\emptyset$]$_S$
       5 -   6   —   7   —   8   —   9

85.   the porch - COMP - Ø - [$_S$ we carried inside - Ø -
          1   -   2   - 3 -   4   - 5 -

     [$_{\overline{\overline{N}}}$ the chair on - wh - porch]$_{\overline{\overline{N}}}$ - Ø]$_S$
         6   - 7 -   8   - 9

Once again, A-over-A correctly blocks the rule from applying to the proper analysis in (84) but permits the rule to apply to the analysis in (85).

There is a problem with this analysis, however. The original assumption that RCF is, in fact, four rules, forces us to make a very strong and incorrect claim -- namely, that the A-over-A Principle prevents moving a non-maximal node whether or not the maximal node meets the structural description of a given rule (cf (82) above). Consider now the phrase marker (86):

86.[10]
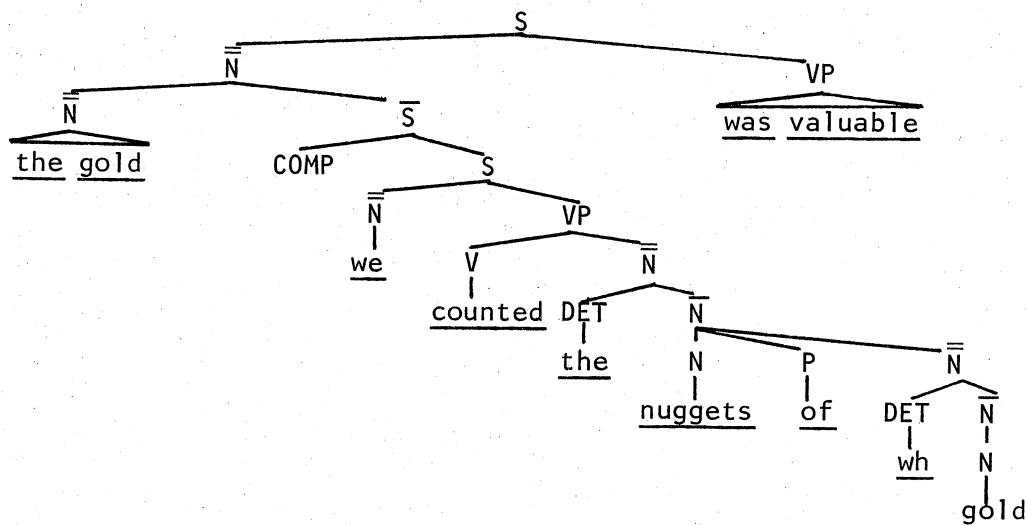
Rules (77) and (79) cannot analyze this tree since the sequence of wh-gold has no Interior. Rules (78) and (80) can. Rule (78) can analyze the structure in two ways.

87.   the gold - COMP - Ø - [$_S$ we counted [$_{\overline{\overline{N}}}$ the nuggets of -
          1   -   2   - 3 -   4

     Ø - [$_{\overline{\overline{N}}}$ Ø - wh - gold]$_{\overline{\overline{N}}}$]$_{\overline{\overline{N}}}$ - Ø]$_S$
     5 - 6   - 7 -   8   - 9

88.   the gold - COMP - Ø - [$_S$ we counted - Ø -
          1   -   2   - 3 -   4   - 5 -

     [$_{\overline{\overline{N}}}$ the nuggets of - wh - gold]$_{\overline{\overline{N}}}$ - Ø]$_S$
         6   - 7 -   8   - 9

160

The A-over-A Principle will block the rule from applying to the proper analysis in (87) while permitting it to apply to (88). In this latter analysis, the N double bar being reordered is maximal.

89.   The gold, the nuggets of which we counted, was valuable.

         Consider next how rule (80) will analyze this same structure. Only one proper analysis is possible.

90.   the gold - COMP - we counted $[_{\overline{\overline{N}}}$ the - $[_{\overline{N}}$ nuggets of -

         1   -   2   -   3   -   4   -

         $\emptyset$ - $[_{\overline{\overline{N}}} \emptyset$ - <u>wh</u> - gold $]_{\overline{\overline{N}}}$ - $\emptyset$ $]_{\overline{N}}]_{\overline{\overline{N}}}$
         5 -   6 - 7 -   8   -   9

In this case the A-over-A Principle will <u>incorrectly</u> block the removal of the 5th - 8th terms since these include a non-maximal occurrence of a constituent of the type $\overline{\overline{N}}$. Hence, a grammatical sentence like (91) will not be generable.

91.   The gold which we counted the nuggets of was valuable.

Notice also that the maximal $\overline{\overline{N}}$ constituent in (86) cannot be analyzed by (80) since it is not dominated by $\overline{N}$.

         Bresnan (1974) presents additional evidence that this interpretation of A-over-A is incorrect. In her analysis of Comparative Deletion, Bresnan argues convincingly that non-maximal constituents of the type $\overline{\overline{X}}$ may be deleted from within other constituents of the type $\overline{\overline{X}}$ provided that the maximal constituent does not meet the structural description of the rule. Hence, sentences (92) and (93) are grammatical since, in each case, the maximal constituent of type $\overline{\overline{X}}$ meeting the structural description of <u>Wh</u>-Fronting has been moved. Sentence (94), however, is ungrammatical, since there the maximal constituent that can be analyzed by the rule has <u>not</u> been moved.

92. $[_{\overline{\overline{X}}}$ How tall $]_{\overline{\overline{X}}}$ is he ?
93. $[_{\overline{\overline{X}}}$ How tall a man $]_{\overline{\overline{X}}}$ is he ?
94. * $[_{\overline{\overline{X}}}$ How tall $]_{\overline{\overline{X}}}$ is he $[_{\overline{\overline{X}}}$ ___ a man $]_{\overline{\overline{X}}}$?

In sentence (95), however, a non-maximal constituent of the type $\overline{\overline{X}}$ has been deleted. The maximal constituent of the type $\overline{\overline{X}}$, in this case, cannot be analyzed by the rule. The output is grammatical because the maximal sequence that <u>can be analyzed by the rule</u> has been deleted.

95.   I ate as many apples as you sold $[_{\overline{\overline{X}}}$ ___ oranges $]_{\overline{\overline{X}}}$.

The strong interpretation of A-over-A which would block the deletion or reordering of all non-maximal nodes is clearly incorrect. There is, however, an alternative assumption that we can make about rule (66). RCF can be interpreted as abbreviating two rather than four rules. This interpretation involves making a crucial distinction between brace notation and parentheses in transformational formalism. What I am claiming, then, is that parentheses do not abbreviate rules. The effect of parentheses appearing in a rule is to abbreviate proper analyses with respect to that single rule. That is, parentheses indicate that a single rule has the option of analyzing a structure in more than one way. Brace notation, on the other hand, does abbreviate or collapse rules. Clearly, this is an empirical claim and it remains to be demonstrated that certain syntactic generalizations follow from making such a claim.

Under the assumption that only brace notation abbreviates rules, we can represent the two rules that are collapsed in RCF as follows:

96. $\overline{\overline{N}}$ - COMP - W_1 - $[_{\overline{N}} W_2$ - (P) - $[_{\overline{\overline{N}}} W_3$ - $\underline{wh}$ - W_4 - $]_{\overline{\overline{N}}} W_5]_{\overline{N}}$

    1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9

97. $\overline{\overline{N}}$ - COMP - W_1 - $[_S W_2$ - (P) - $[_{\overline{\overline{N}}} W_3$ - $\underline{wh}$ - W_4 - $]_{\overline{N}} W_5]_S$

    1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9

Now consider again the structure (86) (repeated for convenience below).

86.
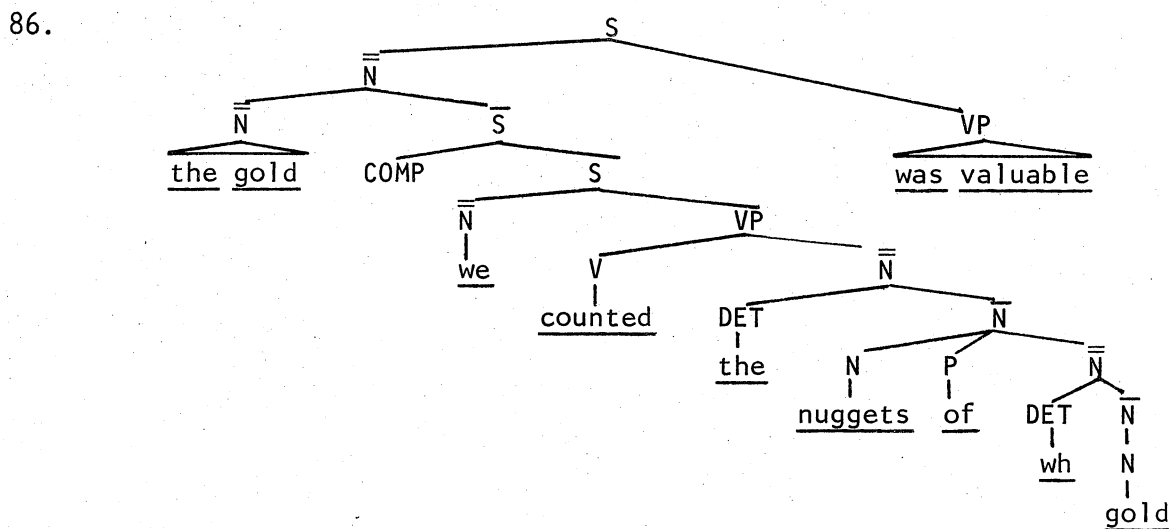
Rules (96) and (97) can both analyze this structure. Two proper analyses are possible by rule (97).

98. the gold - COMP - $\emptyset$ - $[_S$ we counted $[_{\overline{\overline{N}}}$ the nuggets of -

    1 - 2 - 3 - 4 -

$\emptyset$ - $[_{\overline{\overline{N}}} \emptyset$ - $\underline{wh}$ - gold $]_{\overline{N}}]_{\overline{\overline{N}}}$ - $\emptyset$ $]_S$

    5 - 6 - 7 - 8 - 9

162

99.   the gold - COMP - $\emptyset$ - [$_S$ we counted - $\emptyset$ -

            1   -   2   - 3 -   4   - 5 -

            [$_{\overline{\overline{N}}}$ the nuggets of - <u>wh</u> - gold]$_{\overline{\overline{N}}}$ - $\emptyset$]$_S$

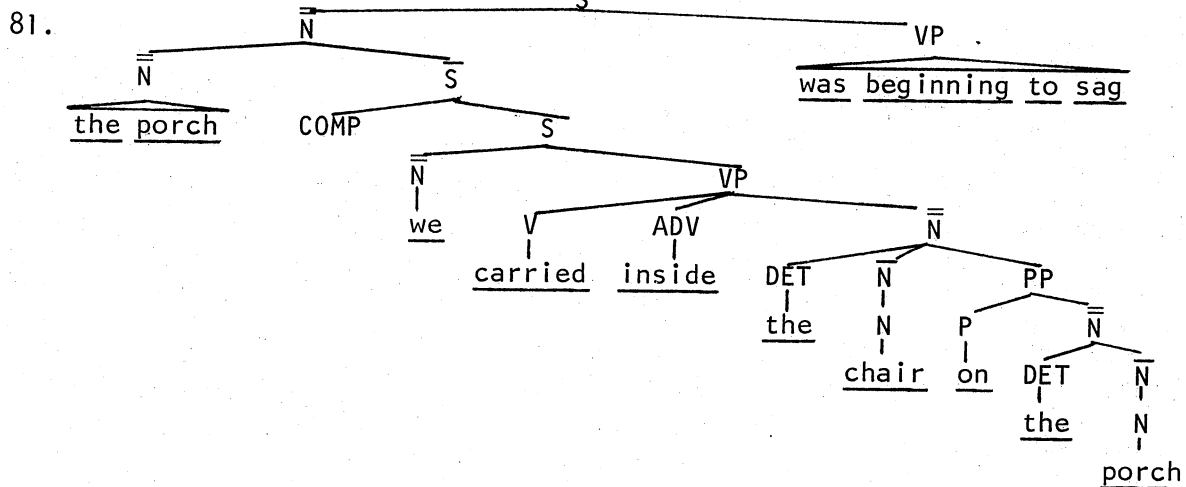   6   - 7 - 8   - 9

Once again, the strong version of A-over-A will block the rule from applying to the analysis in (98). There is, however, a weaker interpretation of this principle which will also have the desired effect. Bresnan (1974) proposes that the A-over-A Principle be relativized to the structural conditions of transformations. This Relativized A-over-A Principle permits only the maximal constituent meeting the structural description of a rule to be moved or deleted. By this weaker interpretation, the A-over-A Principle is invoked only if the maximal as well as the non-maximal constituent that is specified by a single rule may be analyzed by that rule. Thus, rule (97) can apply to the structure in (99), yielding, <u>the gold</u>, <u>the nuggets of which we counted</u>.

Now consider how rule (96) will analyze (86).

100.   the gold - COMP - we counted [$_{\overline{\overline{N}}}$ the - [$_{\overline{N}}$ nuggets of -

            1   -   2   -   3   -   4   -

      $\emptyset$ - [$_{\overline{\overline{N}}}$ $\emptyset$ - <u>wh</u> - gold]$_{\overline{\overline{N}}}$ - $\emptyset$]$_{\overline{N}}$]$_{\overline{\overline{N}}}$

      5 - 6 - 7 -   8   -   9

The strong A-over-A Principle would block the removal of the 5th - 8th terms. The Relativized A-over-A, however, correctly predicts that this sequence may be reordered, yielding, <u>the gold which we counted the nuggets of was valuable</u>. <u>Wh-gold</u> is the maximal constituent of the type N double bar that may be analyzed by rule (96).

We can now predict that in a structure like (81) (repeated below), which can only be analyzed by rule (97), the rule will only apply to reorder the maximal N double bar that can be analyzed by the rule.

81.

Rule (97) can analyze (81) in three ways.

101. the porch - COMP - $\emptyset$ - $[_S$ we carried inside $[_{\overline{\overline{N}}}$ the chair on -
         1   -   2   - 3 -   4

$\emptyset$ - $[_{\overline{\overline{N}}} \emptyset$ - wh - porch $]_{\overline{\overline{N}}}]_{\overline{\overline{N}}}$ - $\emptyset$ $]_S$
5 -   6   - 7 -   8   - 9

102. the porch - COMP - $\emptyset$ - $[_S$ we carried inside $[_{\overline{\overline{N}}}$ the chair   -
         1   -   2   - 3 -   4

on - $[_{\overline{\overline{N}}} \emptyset$ - wh - porch $]_{\overline{\overline{N}}}]_{\overline{\overline{N}}}$ - $\emptyset$ $]_S$
5 -   6   - 7 -   8   - 9

103. the porch - COMP - $\emptyset$ - $[_S$ we carried inside - $\emptyset$ -
         1   -   2   - 3 -   4   - 5 -

$[_{\overline{\overline{N}}}$ the chair on - wh - porch $]_{\overline{\overline{N}}}$ - $\emptyset$ $]_S$

Once again, the stronger version of the A-over-A will block the rule from applying to (101) and (102). However, since we are now assuming that the proper analyses in (101), (102) and (103) represent the results of a single rule analyzing (81), the strong version of A-over-A is unnecessary. The Relativized or weaker A-over-A will also block movement in these cases. This version only requires that rule (97) apply to the maximal $\overline{\overline{N}}$ that it can analyze -- namely terms 5 - 8 in (103), yielding in the process the porch, the chair on which we carried inside was beginning to sag.

Thus, one consequence of distinguishing between parentheses notation, which, I believe, indicates optionality, and brace notation, which indicates "collapsability", is that we are no longer forced to assume the strong version of the A-over-A Principle. The weaker or Relativized A-over-A Principle will correctly predict the non-occurrence of sentences like (83) and (104), while permitting the grammar to generate sentences like (95).

104. * The porch which we carried inside the chair on was beginning to sag.

Notice, also, that a structure like that in (105) may be analyzed by (97) in two ways.

105. (see next page)

The rule may apply to front either $[_{\overline{\overline{N}}}$ wh-porch $]_{\overline{\overline{N}}}$ or $[$ on $[_{\overline{\overline{N}}}$ wh-porch$]_{\overline{\overline{N}}}]$. In either case the $\overline{\overline{N}}$ constituent specified by the rule is the maximal $\overline{\overline{N}}$ constituent that can be analyzed. Hence, no violation of the Relativized A-over-A Principle will occur.

164

105.

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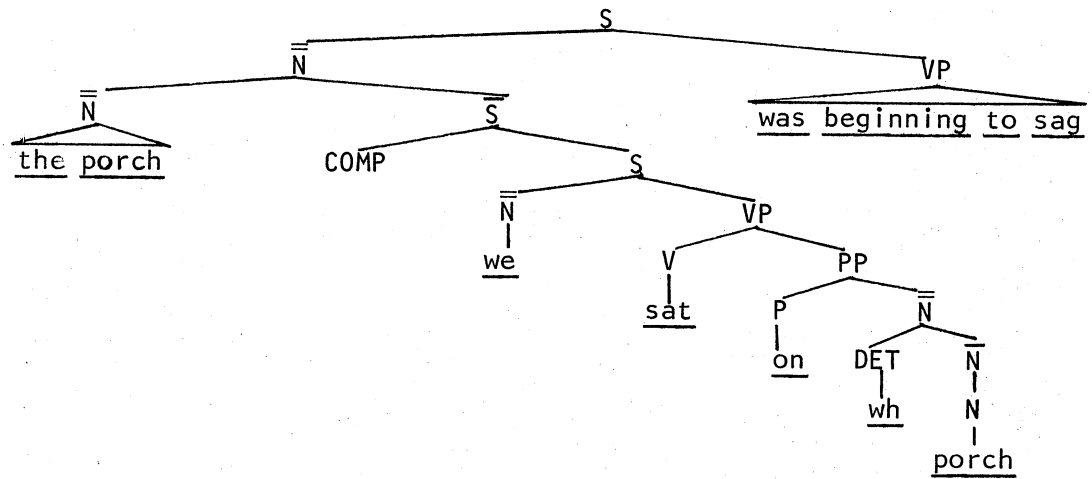
106.   The porch which we sat on was beginning to sag.
107.   The porch on which we sat was beginning to sag.

In summary, the inclusion of the bracketed non-terminals in
RCF along with our interpretation of the notion "apply to" has the following
desired effect. Since the maximality condition must only be met by the
specified sequence, RCF may analyze a structure like (108) so that either
one of the circled nodes in the tree can be analyzed as the domain in which
the 4th - 9th factors are analyzed.

108.
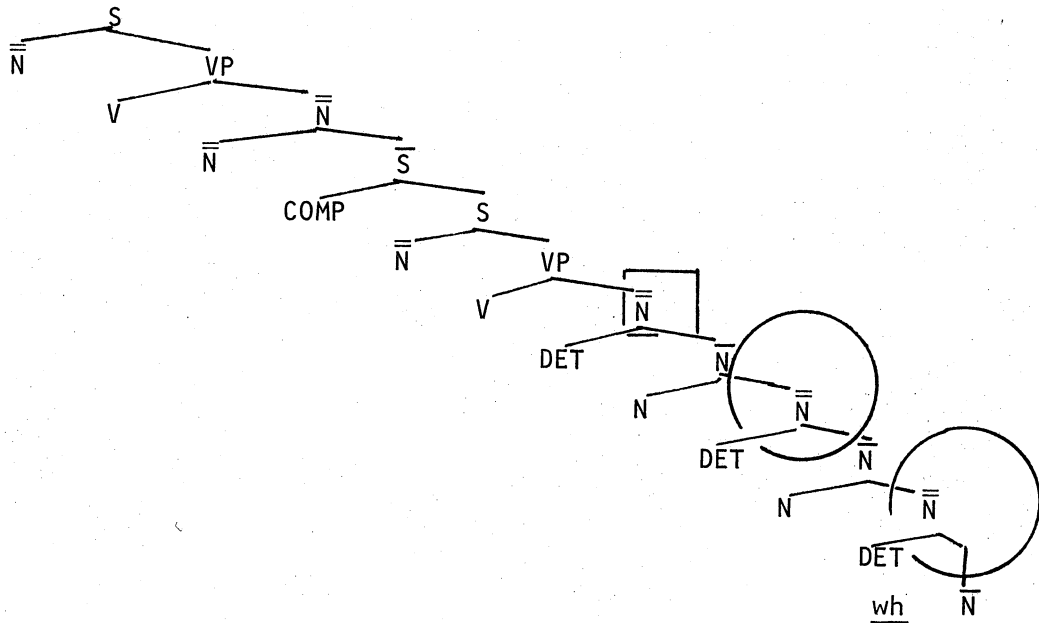
        It would be insufficient only to label these brackets with an $\bar{N}$
since this would require that the 5th - 8th factors analyzed by RCF always

be embedded in an $\overline{N}$. Fronting of the boxed $\overline{\overline{N}}$ in (108) would be impossible. It would also be insufficient only to label these brackets with an S since the Relativized A-over-A Principle as we have interpreted it would then prohibit any $\overline{\overline{N}}$ in (108) except the boxed one from being moved.

If only brace notation abbreviated rules, then RCF abbreviates two rather than four rules. The Relativized A-over-A Principle then ensures that within some fixed domain, the maximal N double bar sequence that may be analyzed by each rule abbreviated by RCF is the sequence to which the rule will apply.

In Section 2 it was argued that a universal convention such as the Pied Piping Convention is inadequate as a device to explain the wide range of pied piping facts. RCF, however, does provide a uniform explanation of pied piping in relative clauses. Pied piping is a direct result of a particular characteristic of transformations in general. Namely, a single transformation may analyze a structure in more than one way. In certain cases, these multiple analyses of a single structure will result in pied piping.

There is a certain problem with this analysis which deserves some mention, although I am unable to suggest any solution. Ross notes that nodes which are pied piped are subject to the Coordinate Structure Constraint. Since pied piping now follows from the application of a particular rule, no new condition must be added to the grammar to account for such facts. However, Ross also observes that the "maximal" node may not itself be coordinate. The Coordinate Structure Constraint will not block movement in these cases, since the reordering would not involve removal of a conjunct, but removal of an entire node that is coordinate. Hence, the problem is to block movement of the "maximal N double bar" from a structure like (109).

109.
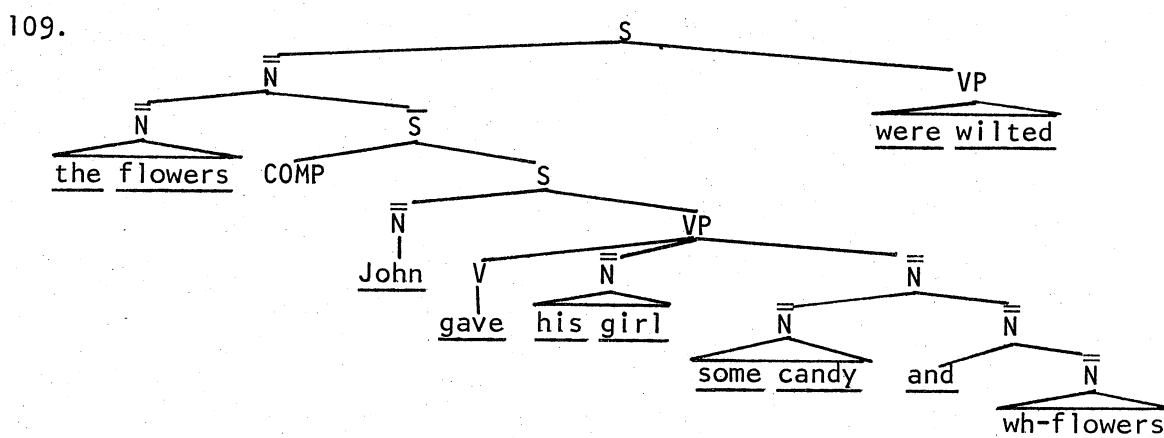
The Coordinate Structure Constraint would block the grammar from generating (110). However, it would not prevent sentences such as (111) from being generated.

166

110. * The flowers which John gave his girl some candy and were wilted.
111. * The flowers some candy and which John gave his girl were wilted.

        Ross accounts for the ungrammaticality of sentences like (111)
by building a condition into the Pied Piping Convention which prohibits
reordering of the maximal N double bar node specifically in cases like
(109). Postal (1972) notes a certain problem with the condition proposed
by Ross. In certain cases, the reordering of a maximal node that is
coordinate is possible.

112.   The manuscript the lettering on the front of which and the
            scribbling on the back of which Harry deciphered was in
            Gwambambam. (Postal's example (4a)).

Postal does not offer a solution to this problem although he does offer
possible alternatives. It might be the case, however, that the element
wh- is constrained in its distribution, and that structures like (109)
are themselves ill-formed. In any event, further research is required
to resolve this question.

        There is an additional problem with the analysis presented
here. Ross, in his original formulation of the Pied Piping Convention,
includes a constraint which blocks pied piping from taking place if an

S node intervenes between the maximal $\overline{\overline{N}}$ to be reordered and the factors
corresponding to the terms wh-W$_4$ in the rule. In Section 1 it was argued
that since pied piping does not result from a particular rule applying,
in Ross's analysis, constraints that would ordinarily block a particular
rule application are inoperative. In the analysis presented here, pied
piping results from the application of RCF. However, some additional
mechanism is still necessary to block sentences like (113) in which a

maximal $\overline{\overline{N}}$ which is separated from a non-maximal $\overline{\overline{N}}$ by an S node has been
fronted.

113. * The man our wish that she meet whom Shirley respected left
         yesterday.

Since pied piping results from the application of a rule, a constraint
on rules can be utilized to prevent the grammar from generating sentences
such as (113). A detailed analysis of such a constraint would be
inappropriate at this time, but is the subject of a separate study
(Nanni, in preparation).

5.   Conclusion.

        The Pied Piping Convention has been shown to be inadequate as a
device to explain the pied piping facts. It has also been shown that these
same facts can be explained in terms of how a transformation may analyze

a given structure and how these proper analyses interact with the Relativized A-over-A Principle.

Further research will have to be done to determine whether all elementary transformations can be constrained to operate only on constituents. Further research will also determine whether the assumption that parentheses are not an abbreviatory notation (ie, do not abbreviate rules) is a correct one.

Footnotes.

[1] I would like to express my appreciation to Ellen Broselow and Elan Dresher for several valuable discussions which contributed to the development of this paper. I would also like to thank Lisa Selkirk for her helpful comments and criticisms. I am extremely grateful to Emmon Bach and Joan Bresnan who provided many valuable comments and criticisms at all stages of the development of the paper.

[2] I am using the term "operated on" loosely to mean that the term is moved or deleted when the transformation applies.

[3] Ellen Broselow has pointed out to me that Paul Postal (1968) has formulated a similar argument regarding pied piping and the rule of Y Movement. Postal argues that Cross Over phenomena provide evidence that no pied piping occurs when the rule of Y Movement applies to front a "dominating NP".

[4] Sentences such as

a.   Who did you buy a picture of ?
b.   What did he drink three bottles of ?

would appear to be counterexamples to this claim. Such cases will be discussed at a later point in this section of the paper.

[5] There is some question regarding the point in the derivation at which the preposition of is inserted into these NP's. In Chomsky's analysis, the of is inserted transformationally. Alternatively, of may be base generated. In either case, there is evidence that the sequence of the theorem is not a PP in a phrase like the proof of the theorem. Hence, all of the following sentences are ungrammatical.

a.   * Of what did he present the proof ?
b.   * It's of the theorem that he presented his proof.
c.   * The theorem of which he presented his proof was difficult to
           grasp.
d.   * Of the theorem he presented his proof.

168

Also, it is clear that the preposition of must be present in the NP prior to any application of Wh-Fronting or Relative Clause Fronting, since such rules can destroy the structure into which the preposition is inserted -- assuming an analysis in which of is inserted transformationally. (This fact was pointed out to me by Emmon Bach.) Therefore, I will assume that the structure of these complex NP's, at the point at which Wh-Fronting or Relative Clause Fronting applies, is as follows:
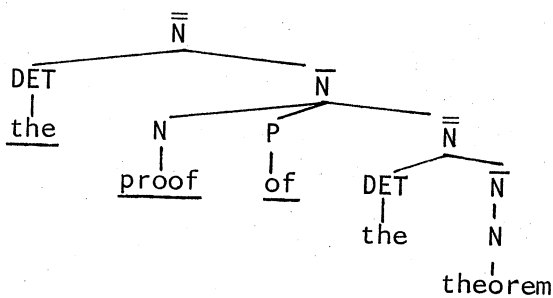
6 But cf Schwartz (1972)

7 I am assuming that rules that involve pied piping (Wh-Fronting and Relative Clause Fronting) are rules that substitute a sequence for the Complementizer. Therefore, the modifications proposed in this section will essentially be limited to the substitution elementary. (See also fn 8).

8 I am assuming that relative clauses are formed by the operation of a cyclic transformation that either deletes a constituent over a variable on identity to a head noun phrase, or substitutes a constituent marked with wh- for the Complementizer. Whether the process of relative clause formation should be represented by two rules or by one will not concern me here.

9 Notice that PP's are not specified in RCF. They might occur within the jth - kth terms in a given proper analysis, but the PP node itself is not mentioned in the rule's structural index.

10 See fn 4, above.

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