

Symmetry and Polarization in the European International System, 1870 - 1879:

A Methodological Study

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An attempt will be made here to apply some graph theoretical methods to the analysis of cooperation and conflict among international actors in the 1870's in Europe. This kind of application of graph theory requires the notion of a *cooperation-conflict continuum* which represents the degree of hostility or friendship directed by one international actor toward another. Such a continuum has been used previously by those interested in the analysis of *event-interactions*.¹

The basic unit of interaction is an act made by one actor and directed toward some other actor. The unit is the smallest discriminable segment of international verbal and nonverbal behavior to which the observer, using some set of categories of behavior can assign a classification and identify the actor and the object of this segment of behavior. (Harle 1971, p. 204)

This smallest discriminable segment of behavior is given a score on a scale of cooperation-conflict based on the coder's perception of the inherent hostility or friendliness of the act. These scores can then be aggregated over a period of time, making possible both cross-sectional and time-series studies. This methodology has proven its utility and flexibility as a tool for studying international relations, but event-interaction analysis has often been plagued by an inability to make itself relevant to historians and theorists of international politics.²

The Corkeley Scale

During my work with Richard Rosecrance on the Situational Analysis Project, a project de-

signed to use diplomatic histories as a source of event-interaction data, I helped to devise and test a method of scaling event-interactions on the degree of cooperation or conflict they represented. The result of this was the Corkeley Scale, so named because it was a joint product of work at Cornell and Berkeley. The scale is displayed in Table I. It consists of a set of categories or types of actions with a number following each type of action. The numbers were obtained by having a number of experts familiar with nineteenth - and twentieth - century international politics estimate the degree of cooperation or conflict of each type of act. The instructions given to the experts were adapted from those used in psychophysics to obtain ratio or internal levels of measurement with subjective data. To put it simply, the scores which resulted from the application of the Corkeley Scale were designed to do more than rank-order event-interactions. They were designed to represent the relative distances between more and less conflictual or cooperative events. Very high intercoder agreement was obtained in reliability tests of the scale conducted on nineteenth century events data. A very complete explanation of the testing of the scale is available elsewhere (Rosecrance, Goodman, Hart 1974), so no more needs to be said here on that subjects.

The Corkeley Scale may be applied to *any set of historical events* in the following way:

(1) A set of events is selected from some reliable historical or journalistic source. All events which are primarily domestic or which do not refer to specific initiating actors (called *initiators*) or to specific objects (called *targets*) of the action are eliminated.

(2) The events are disaggregated so that they

Table I. The Corkel^{ky} Scale

Category	Scale Score
Unlimited Use of Nuclear Weapons	1.01
Limited Use of Nuclear Weapons	3.27
Military Occupation	4.51
Major Attack on/Invasion of	7.99
Blockade/Siege	10.60
Declaration of War	11.70
Full Mobilization against X	16.00
Ultimatum to X	16.30
Sign Military Alliance with Other Power against X	24.70
Warning to X - Military	25.20
Trade Ban	27.60
Withdrawal from Military Alliance with X	28.60
Warning to X - Diplomatic	32.50
Rejection/Refusal of Proposal Made by X - Military	34.90
Statement of Policy Unfavorable to X	42.10
General Observation that Relations with X are Deteriorating	44.50
Comment Unfavorably on Statement of X	45.80
Inquiry for Information from X - Favorable	52.00
Request Positive toward X	54.00
Pledge to Improve Relations with X	58.20
Start Negotiations between A and X	60.30
Acceptance of Proposal by X - Diplomatic	64.80
Arms Reduction or Reduction of Military Budget Previously Thought to be Directed against X	65.50
Increase Trade with X	65.80
Informal Agreement with X - Diplomatic	69.10
Assurance to X - Military	73.70
Agreement with X - Formal Diplomatic	76.30
Supply Military Aid to X	81.20
Arms Contro. Agreement with X	82.90
Military Alliance with X	88.00
Establish Economic Community with X	94.00
Establish Political Federation with X	99.60

represent the simplest possible version of the event such that it reflects an action directed by a single initiator to a specific target which has a relatively precise data connected with it. Such a disaggregated event is called an *event-interaction*. Each event-interaction refers to a specific *directed dyad*, or pair of actors in the initiator-target format.

(3) The cooperation-conflict scale (the Corkeley Scale is one of several possible scales) is applied to the list of event-interactions. Each coder gives the event-interaction a score based upon his judgment of which type of event in the scale most closely resembles the event-in-

teraction in question. If there is more than one coder, intercoder agreement may be tested and scores may be averaged to provide a consensual score.

(4) The scores for event-interactions may then be aggregated over different time-periods or over different sets of actors and targets. Further analysis generally proceeds on the basis of this final stage of aggregation.

The result of this process is usually a set of cooperation-conflict scores of the form c_{ij} (the degree of cooperation-conflict directed by actor i toward actor j) with respect to a specific time period.

A sample of event-interaction coding for events in the 1870's is given in Table II. An *indirect target* is an actor which is not the direct object of the event-interaction but which is clearly the indicated object of the act when seen in the context of previous events. Thus, in the second event in the coding sample, the direct target is Russia since the action involved direct communication between Austria and Russia. The indirect targets are Serbia and Turkey since they are explicitly mentioned in the text of the communication.

Disadvantages and advantages of the approach

Let us take a closer look at this idea of a continuum of cooperation-conflict. Cooperation is defined in the *International Encyclopedia for the Social Sciences* as 'joint or collaborative behavior that is directed toward some goal and in which there is common interest or hope of reward.'³ Conflict is defined as follows:

A conflict emerges whenever two or more persons (or groups) seek to possess the same object, occupy the same space or the same exclusive position, play incompatible roles, or undertake mutually incompatible means for achieving their purposes.⁴

Thus, cooperative and conflictual behavior can take place when (1) there is interaction between two or more actors and (2) there is a cognized conflict or compatibility of goals.⁵ ~~The links between these notions and the no-~~

Table II. An example of SAP cooperation-conflict coding (FM=Foreign Minister; AMB=Ambassador; EMP=Emperor; CHANC=Chancellor)

September 6, 1872

06091872 002

Russian FM expresses concern over Austrian intrigues in Bosnia and Herzegovina.

Initiator	Target	Type of Target	Cooperation – Conflict Score
Russia	Austria	Direct	45.79

September 6, 1872

06091872 003

Austrian FM tells Russian FM that 1) Austrian policies in Bos-Herz are defensive, 2) Austria wishes good relations with Serbia, 3) Austria will not allow extension of Serbian territory, and 4) Austria desires status quo in Turkey.

Initiator	Target	Type of Target	Cooperation – Conflict Score
Austria	Russia	Direct	48.72
Austria	Serbia	Indirect	44.04
Austria	Turkey	Indirect	55.28

September 6, 1872

06091872 004

Russian FM tells Austrian FM that Russia is not connected with Serbian agitation and that Russia is satisfied with the status quo in the Near East.

Initiator	Target	Type of Target	Cooperation – Conflict Score
Russia	Austria	Direct	57.03
Russia	Serbia	Indirect	45.12
Russia	Turkey	Indirect	56.55

~~tions of compatibility and incompatibility of goals in Chapter 4 should be evident.~~

If there is no interaction, then there can be no communication and no attempts to influence the actions of the other actor – both of which are characteristic of cooperation *and* conflict. Thus, cooperation and conflict may arise from attempts to influence. Cognitions about the compatibility or incompatibility of goals help to distinguish between interactions which are instrumental or purposive and those which are primarily expressive. If perceptions about the compatibility of goals are not involved in an interaction, then the interaction is being pursued only for the purpose of interacting. That

is, the actors do not perceive any *need* to interact; they simply do so. It may be that nonpurposive interactions are very rare in international politics. But there are a number of acts (such as state visits) which can not be considered instrumental except in a very limited sense.

There may be no interaction between actors whose goals are perceived to be compatible or incompatible. If the goals are perceived to be incompatible then the actors may not interact in order to minimize the possibility of violence. If the goals are perceived to be compatible then the two parties may operate under a *laissez faire* or 'invisible hand' assumption. That is, they may assume that collaboration is unnecessary for the successful attainment of their goals. Both of these situations can be lumped at the midpoint of a cooperation-conflict continuum, since neither are overtly cooperative or conflictual. Nevertheless, those concerned with the perceptions of underlying interests and the intentions of actors, rather than the overt behavioral manifestations of these perceptions, may wish to maintain the distinction between these two types of non-interaction.

A related point is Coser's distinction (1956, p. 49) between 'realistic' and 'nonrealistic' conflicts. Nonrealistic conflictual behavior involves perceptions of incompatible goals where goals are *not* in actuality incompatible. It is behavior which arises out of a *misperception* of the compatibility of goals. This sort of distinction places a heavy burden of objectivity on the observer. Who is to say whether goals are compatible or incompatible? Nevertheless, there are clearly cases in which more accurate cognition of the compatibility or incompatibility of goals would have influenced the behavior of the actors. In event-interaction analysis, it is generally assumed that the perceived impact of event-interaction: is the same for all relevant actors. Thus the questions of misperception cannot be addressed.

By assuming that cooperative and conflictual behavior are directed between pairs of actors, event-interaction analysis rules out a distinction between bilateral cooperation and conflict, on one hand, and multilateral or uni-

lateral behavior. For example, a gesture of good will toward all mankind would not get translated into a cooperation-conflict score for a directed dyad. Multilateral actions are coded by breaking them down into dyads. For example, if France and Russia jointly condemn the policies of Germany, the event is coded as two event-interactions: between France and Germany and between Russia and Germany. To some observers, it may matter that France and Russia decided to act together. But in event-interaction analysis such questions are generally not addressed.

Using a continuum of cooperation-conflict with event-interaction data has a number of advantages which may outweigh the disadvantages of the simplifying assumptions involved in the method. Rather than concentrating on extreme forms of behavior, like wars, crises, military alliances or political federations, one can study a wide range of behaviors which include the low intensity but high frequency interactions of everyday diplomacy. In this way, the roots of the more extreme forms of behavior may be detected in fluctuations of less extreme forms of behavior, providing a sort of early warning system. The use of cooperation-conflict continuum with event-interaction data also has the advantage of providing a basis for studying international politics of many different historical eras and on multiple levels of analysis. One could, for example, study the cooperative or conflictual behavior initiated by a single individual (a representative of an international actor of some sort) or compare different individuals to test for behavioral differences which might be explained by differences in skill, rank, or personality. On the national level one could investigate the way in which different nations distribute their attention to others or find out whether certain nations were generally 'aggressive' towards others. One could explain differences in dyadic behaviors by comparing the dyads on the basis of the 'distance' between the two actors, either in physical or political terms. One could look at overall levels of cooperation-conflict and sets of dyadic relationships, as will be done below, in international systems. Event data may be

easily obtained from historical sources and from contemporary journalistic sources. A great range of historical periods can be explored with basically the same methods, broadening the universe of the student of international politics like the telescope broadened the universe of the astronomer. Another advantage of the use of cooperation-conflict data is that a variety of important hypotheses about international politics may be credibly operationalized and tested. Some of these hypotheses will be discussed under the headings of 'polarization' and 'symmetry' below. But almost any aspect of international politics which is concerned with the amity or enmity between states can be redefined and tested in terms of dyadic cooperation-conflict data.

Polarization

In a group of actors (whether individuals or aggregates), the degree of polarization of the group is the degree to which antipathetic, non-overlapping subgroups are formed. These subgroups are formed on the basis of amity among members of each subgroup and enmity between members of different subgroups. The student of international politics is not simply interested in the degree of polarization, per se, but also in the number of subgroups which may be distinguished, their composition and their relative power *vis à vis* other subgroups and actors. One major hypothesis which has emerged is that bipolarized systems – polarized groups of nations with two subgroups – are more conducive to international cooperation and stability than multipolar systems – polarized groups with more than two subgroups (Waltz 1964). Some sophisticated mathematical techniques for dealing with these concepts have recently been devised and applied in other fields. But before these techniques are introduced, it might be interesting to review some of the theoretical arguments about polarization in international relations.

First, it is important to note that the debate on polarization in international politics is partly a result of an ambiguity of language. Some theorists talk about polarization in terms of

the distribution of power among actors or subgroups, others in terms of the patterns of cooperation and conflict among actors, and some combine the two viewpoints. For example, for Kenneth Waltz (1964) a bipolar system is an international system with two competing and highly cohesive blocs, with leaders who are much stronger than other members of the blocs, and which maintains itself over a period of years. For Karl Deutsch and J. David Singer (1964) a multipolar system is one in which three or more major actors of roughly equivalent power exist and in which there is a constant shifting of alliance and opposition between actors. In order to avoid some of these ambiguities, the emphasis here will be on polarization which results from polarized patterns of cooperation and conflict rather than from power distributions. Nevertheless, the analysis of international polarization – to truly test the major hypotheses of polarization theory – should be based on both patterns of cooperation-conflict and distributions of power in the international system.

The question of the comparison of bipolar and multipolar international systems was raised by Morton Kaplan (1957) and the elaboration of it continued in articles by Arthur Burns (1961), Kenneth Waltz (1964), Karl Deutsch and J. David Singer (1964) and Richard Rosecrance (1969). Waltz argued that bipolarity was more conducive to 'stability' (meaning the absence of international conflict) because it increased the competition between the two blocs while it decreased the uncertainty of the blocs about the power of their opponent, about their capacity to retaliate, and reduced the amount of calculation needed to preserve order in the system. Bipolarity increased the stakes of the two bloc leaders – making them more cautious and more inclined to preserve the status quo. Waltz suggested that bipolarity would tend to reduce the number of neutral states in the system on the assumption that a sudden switch from neutrality by a given actor could destabilize the system (1964, pp. 881–5). Rosecrance later noted that Waltz was assuming bipolarity would be *tight* bipolarity, since his bipolarity precluded a

détente between bloc leaders or members of opposing blocs (1969, pp. 326–7). Finally, Waltz argued that the dynamics of the bipolar system would include crisis diplomacy without wars, serial confrontations and competitions (e.g., space races, economic competition), and minor shifts of power and alignment, none of which would have major consequences.

Deutsch and Singer argued that multipolarity was more conducive to peace than bipolarity. They argued that although multipolarity did increase the amount of calculation needed to preserve order in the system and therefore increased the probability of conflict by error, it also decreased the intensity of conflict between actors when conflict occurred. Since multipolarity made it possible to form a variety of coalitions to deter any given aggressor, there would be less need for crisis diplomacy or deterrent threats. Deutsch and Singer assumed that multipolar systems would be loosely polarized – that there was a 'long-run tendency' for multipolar systems to break down, especially when technological change or radical alterations of the distribution of power required the pooling of resources on the part of blocs to preserve international order.

Aside from the inconsistencies of these two arguments and their dependence on idealized versions of contemporary bipolarity and eighteenth and nineteenth century multipolarity, then provided an excellent starting point for distinguishing between types of international systems on the basis of the degree of polarization and the number of blocs which resulted from polarization. Richard Rosecrance (1969, pp. 332–5), for example, later suggested that a bipolar system in which the bloc leaders were involved in a *détente* (a specific type of loose bipolarity) would increase the probability of conflict between minor powers and major powers but would decrease the intensity of systemic conflict. Morton Kaplan (1969) refined his typology of international systems first described in *Systems and Process in International Politics* suggesting that loose multipolar and bipolar systems can be conducive to peace and that tight bipolar systems are generally unstable. But as logical and valuable as this

theorizing may seem, there was a rather desperate need for some testing of the hypotheses which had been generated. Michael Haas was able to do this with some success in his 'International Subsystems: Stability and Polarity' (1970). But he admitted that the 'key independent variable – polarity – is less precisely measured than the most significant dependent variables'. (p. 121).

A technique for observing and measuring the degree of polarization and distinguishing between types of international polarization – borrowed from sociology and psychology – will be used here to test the hypothesized relations between polarization and systemic conflict in a number of international systems.

Types and degrees of polarization.

Assuming that a high cooperation-conflict score reflects a substantial amount of cooperative behavior, let an international structure of cooperation-conflict be represented by a signed digraph (Harary et al. 1965, Ch. 13) in the following manner: if the level of cooperation-conflict exceeds a certain threshold value for a given directed dyad, a positive line is drawn from the initiator to the target; if the level is approximately neutral or reflects only moderate levels of cooperation or conflict, no line is drawn; if the level is below a threshold level for conflict, a negative line is drawn. If a signed digraph formed in this way is *blanced* (i.e. if the digraph's points can be partitioned into two sets such that every point is joined to other points in the same set by positive lines and to points in the other set by negative lines; or, equivalently, if there are no negative semicycles in the digraph) then it can be said that the structure is *bipolarized* with respect to the threshold values. If the signed digraph is *clusterable* (its points can be partitioned into a number of *plus-sets* in which each point is joined to others in the same set by positive lines and to points in different sets by negative lines) but *not* balanced, then the structure may be considered *multipolarized*.⁶ The number of *blocs* may be equated to the number of plus-sets.

Several important questions remain to be answered, however. It is important to know whether neutral actors should be excluded from the analysis, grouped with one of the blocs, or considered to constitute blocs by themselves. A related question is the 'connectivity' or cohesiveness of the plus-sets. If the members of a given plus-set are antipathetic toward an opposing plus-set but relatively cool toward one another, should the plus-set be considered a single bloc or several? (See Figure 1 for an illustration of this problem.) It is also desirable from the point of view of international relations theory to know how many blocs exist and which actors belong to them even when the signed digraph is neither balanced nor clusterable. Finally, one would like to know how unbalanced or unclusterable a system is, especially since there may be some connection between the degree of polarization and the level of systemic conflict.

It will be assumed here that unless a neutral actor is a dominant power (or hegemonic power), the neutral actor should not count as a separate bloc. If a plus-set contains disconnected blocs, however, and these blocs contain major powers, the number of blocs in the system will not equal the number of plus-sets. Thus, the international system in Figure 1 would have four blocs if actor X is a major power even though there are only three plus-sets. The question of the degree of polarization and the composition of blocs when systems are not balanced or clusterable is somewhat more complex.

Harary, Cartwright and Norman (1965) discuss several indices for the degree of balance including:

β = the number of positive semicycles in the digraph divided by the total number of semicycles.

λ = the minimal number of lines which must be changed (removed or sign changed) before the digraph is balanced.

In the example in Figure 2, there are four semicycles (A-E-D-A, A-B-C-A, A-C-B-A, and B-C-B). All but one are positive, so $\beta = .75$. Only one line must be changed or removed in order to make the digraph balanced, the line

from A to D, so $\lambda = 1$. Analogous indices for the degree of clusterability would be:

γ = the number of semicycles without a single negative line divided by the total number of semicycles,

and

μ = the minimal number of lines which must be changed before the digraph is clusterable.

Clearly γ must be greater than or equal to β and μ must be less than or equal to λ for any signed digraph. $\beta = \gamma$ if and only if there are no negative semicycles with more than one negative line.

Peter Abell (1968) suggests that it is not necessary to consider all the semicycles in a directed graph for the purpose of measuring imbalance for the following reasons: (1) the sociological justification for the use of semicycles of length greater than three is much weaker than that for semicycles of length two and three,

$\beta_{2,3}$ = The number of positive semicycles of length two or three divided by the total number of semicycles of length two or three,

is much easier to compute than β , and (3) β and $\beta_{2,3}$ increase monotonically with one another (and are, therefore, perfectly correlated).⁷ Thus, in the analysis below, $\beta_{2,3}$ and $\gamma_{2,3}$ will be used to measure the degree of polarization. They will also be used to identify types of international systems using the criteria in Table III.

It is not difficult to identify the number and composition of blocs when then signed digraph is balanced or clusterable (as is obvious from Fig. 1). It is somewhat more difficult to do this for unbalanced or unclusterable digraphs. One of the reasons for this difficulty is that for any given unbalanced or unclusterable digraph there may be a number of ways of balancing or clustering the points according to various criteria (Flament 1963). For example, in Fig. 2 above, only one line must be changed to balance the digraph – but it makes a great difference in estimating the membership of blocs which line is changed. If line AD is removed or changed the digraph would be

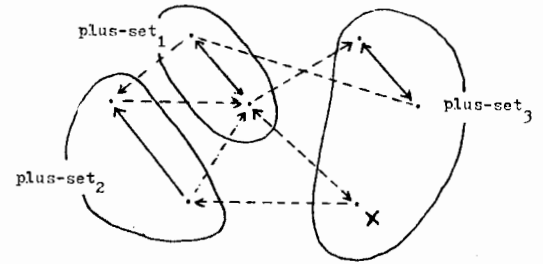


Fig. 1. Example of a clusterable digraph with a disconnected plus-set. Note: Unless otherwise specified, solid lines will represent cooperation and dotted lines will represent conflict between pairs of actors. Cooperative lines are 'positive' while conflictual lines are 'negative'.

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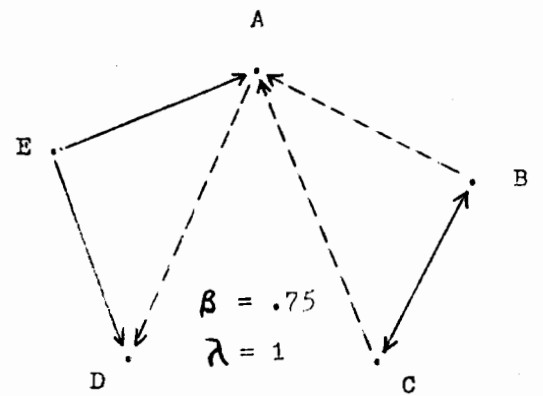


Fig. 2. An example of a signed digraph.

balanced, the system would be bipolar and the poles would be (A, E, and D) versus (B and C). If line EA is removed or changed, the digraph would be balanced, the system would be tripolar and the poles would be (E and D) versus (A) versus (B and C). One might, in such a case, refer back to the strength of the relationships between A and D and between E and A in order to decide which would be most likely to change.

The probability that cooperation-conflict structures will be perfectly polarized is quite low if it is assumed that cooperative and conflictual relations are randomly distributed and if the structure is assumed to be highly interconnected.⁸ Nevertheless, it may be hypothe-

Table III. Criteria for types of polarization

Type of system	$\beta_{2,3}$	$\gamma_{2,3}$	additional criteria
strict unipolar	equal to 1	equal to 1	all lines are positive, no disconnected blocs number of negative lines less than or equal to λ at least one negative line and no disconnected blocs or no negative line and two disconnected blocs
loose unipolar	less than 1	equal to $\beta_{2,3}$	
strict bipolar	equal to 1	equal to 1	
loose bipolar	less than 1	equal to $\beta_{2,3}$	number of negative lines greater than λ
strict multipolar	less than 1	equal to 1	none
loose multipolar	less than 1	greater than or equal to $\beta_{2,3}$	if $\gamma_{2,3} = \beta_{2,3}$, then there must be at least two disconnected cliques in one of the subsets

zed that such structures do, in fact, tend toward polarization – and bipolarization, in particular. Furthermore, it may be hypothesized that the degree of peacefulness or cooperation in an international system is a function of the degree of polarization. Following Waltz, one could say that an international system becomes more stable or peaceful as it becomes more polarized. Interbloc rivalries may be moderated while intrabloc cohesion is increased in highly polarized structures. Alternatively following Deutsch and Singer, one could say that an international system becomes more peaceful as a result of a decrease in the degree of polarization.

The analysis of symmetry in international cooperation-conflict

A number of previous studies (Boulding 1969, Klingberg 1961) have assumed implicitly or explicitly that cooperation-conflict is *symmetrical*: that is, if actor *i* is friendly to actor *j* then actor *j* will be friendly to actor *i* and if actor *i* is hostile toward *j*, actor *j* will be hostile toward actor *i*. This is a natural assumption, since it greatly simplifies analysis of dyadic data, reducing the number of effective observations from $n(n-1)$ – the number of directed dyads – to $n(n-1)/2$ – the number of regular dyads – where *n* is the number of actors in the system. There is evidence that these assumptions valid for interpersonal interaction and liking – disliking relationships (Galtung 1968, p. 288). But there is not much evidence for the validity of these assumptions about international interaction and cooperation.⁹

The existence or nonexistence of symmetry in international cooperation-conflict is indirectly related to several central concerns of international relations theory. Perhaps the most important relationships are those dealing with power balance and deterrence theories. Some deterrence theories assert that in a given dyad a certain type of highly conflictual behavior, 'credible' threats to be specific, may help to prevent higher levels of conflictual behavior. Even though this argument is typically applied to threats of unclear retaliation, it is often expressed in terms of more general threats. Thus, deterrence theory relies on an assumption that some forms of conflict will not be reciprocated – i.e., that dyadic cooperation-conflict will sometimes be highly asymmetrical. Kenneth Boulding has vehemently argued against this point of view, asserting that threats inevitably lead to counterthreats – and that symmetry is thus eventually preserved. Boulding argues, in addition, that threat-counterthreat systems generally break down into systems of mutual hostility (e.g., in war) or, less frequently, into systems of mutual accommodation (Boulding 1962, 1972).

Since power balance theories are more numerous, and some would say more ambiguously worded (E. Haas 1953), than deterrence theories, the connections between them and cooperation-conflict symmetry are somewhat more complex. Some theories of power balancing assert that low levels of conflict are preserved if the international system consists of nonoverlapping alliances of relatively equal power. The international system, therefore, may be bipolar or multipolar as long as the

various blocs are unambiguously defined and have roughly equivalent power (Zinnes 1967, pp. 270-288). *Strict* bipolarity or *strict* multipolarity (another way of stating that alliances do not overlap) requires a substantial degree of symmetry. That is, you cannot have dyadic asymmetries either within or between blocs without undermining strict polarization. Of course, some theories of power balancing assert that the ability of nations to form new alliances or coalitions to counter threats of aggression is conducive to international cooperation (or at least not conducive to conflict) (Deutsch & Singer 1964). These theories prescribe a loose or shifting polarization and would therefore associate the prospects of peace with the existence of relatively asymmetrical patterns of cooperation-conflict. Another aspect of balance of power theory which is related to symmetry is the hypothesis that nations will fight to preserve their existence and even (in some cases) to preserve or enhance their present status in the international system. If some actor, or group of actors, becomes so powerful that the status or continued existence of another actor is threatened, the threatened actor will direct a substantial amount of conflict toward the threatener (Kaplan 1969, pp. 292-4). This hypothesis involves an assumption of dyadic symmetry (not unlike Boulding's theory) for high levels of conflict. Finally, the existence of asymmetry is posited in the theory of the hegemonic power balancer. The hegemonic power, because of its great power or diplomatic skill is able to involve itself in certain types of conflictual activity without fear of retribution. On the other hand, the hegemonic power may ignore strict rules of alliance and extend cooperation toward members of an opposing bloc of actors (Hartmann 1962, p. 386). Those who assert that hegemonic power balancing is conducive to international cooperation or the absence of conflict are also asserting that asymmetry (of a special sort) is conducive to cooperation.

In conclusion, the symmetry of dyadic cooperation-conflict is linked to a number of important theories of international relations. It should be clear, however, that the observation

of symmetry or asymmetry will not lead to verification or falsification of any single theory discussed above. But it may help to provide some telling counterexamples or qualifications to a number of them.

Cooperation-conflict structures in the 1870's

One of the first systematic applications of a cooperation-conflict scale to interaction data was done by members of the Situational Analysis Project, the creators of the Corkeley Scale. The choice of this period for investigation was governed by a desire to test conventional notions about the nineteenth century's 'balance of power' systems. Due to the desire of diplomatic historians to find the roots of World War I in the diplomacy of the period, an unusually rich selection of historical works are available for comparative study. Thus, the Situational Analysis Project compiled a list of events for the entire decade based upon six major works.¹⁰ These events were then disaggregated into event-interactions and scored for the level of cooperation or conflict they represented. The actors upon which the study focused were the five great powers: Austria-Hungary, England, France, Germany, and Russia. Other actors, such as Italy, Bosnia, Montenegro, and Turkey, were included in the study, but analysis of structures of cooperation-conflict was confined to the five major powers. The decade was divided into various periods, depending upon the interests of the different investigators. One periodization, to be discussed in detail here, was based upon equal time periods: calendar years and five-year periods. The number of event-interactions in the major power subsystem for each of these periods is given in Table IV.

Cooperation-conflict structures for each of the thirteen periods listed in Table IV are displayed in Figure 3. In the first column of Figure 3, structures represent cooperation-conflict scores above and below the neutral score of 50. In the second column, structures represent more intense cooperation and conflict. In the second column, a negative line represents a

Table IV. Number of event-interactions in the major power subsystem of the European international system, 1870–1879

Periods	Number of event-interactions
Calendar years	
1870	92
1871	29
1872	45
1873	42
1874	29
1875	150
1876	150
1877	104
1878	240
1879	187
Five-year periods	
1870-4	237
1875-9	831
Total	
1870-9	1068

score of less than 45 and a positive line represents a score of greater than 55.

The index of imbalance $\beta_{2,3}$, was computed for every signed digraph in Figure 3 and is given in columns (2) and (3) of Table V. The index of clusterability, $\gamma_{2,3}$, was not computed since there was only one time period in which a negative semicycle of length three with three negative lines appeared – 1877. Thus, even though the 1870's was a period of multipolarity in terms of relative power, it was a period of bipolarity or unipolarity in terms of patterns of cooperation-conflict (see column (4) in Table V).¹¹ The level of systemic cooperation-conflict was operationalized as the mean of the cells in the matrix (c_{ij}) for the time period – these means are listed in column (6) or Table V.

Unipolar systems are, as one might expect, associated with general systemic cooperation in the 1870's. It is surprising to observe, however, that maximal systematic cooperation (a dyadic average) occurred in 1873 in a strict bipolar system in which all the other powers ganged up on France! There appears to be nothing necessary in this result, however, because the year following witnessed the nadir of systemic

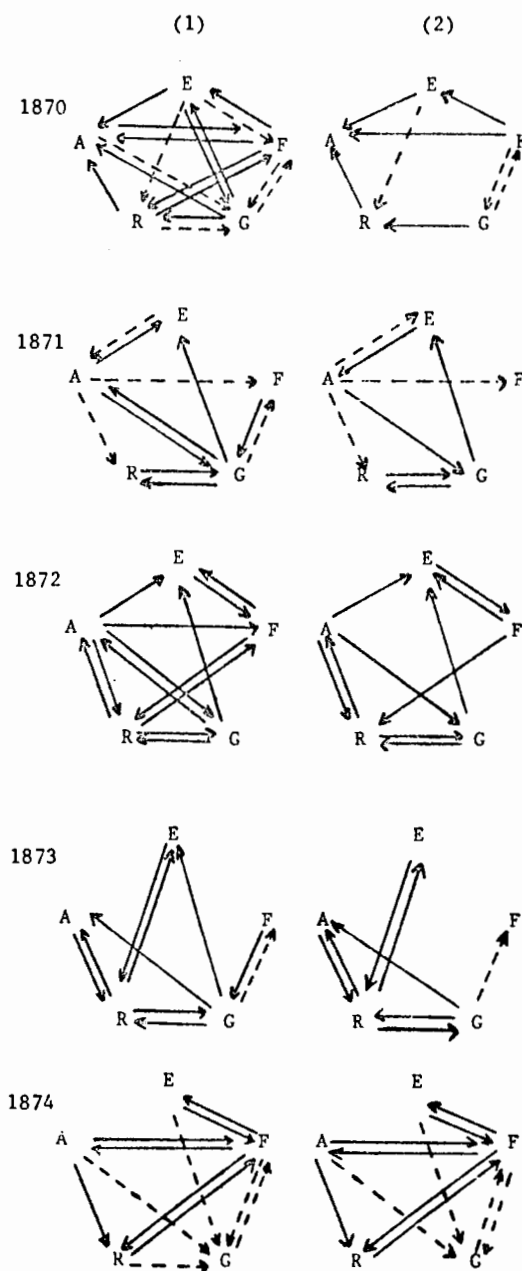


Fig. 3. Patterns of polarization in the 1870s.

cooperation and also evinced a system of strict bipolarity! In the data, loose bipolar systems are associated with intermediate levels of systemic cooperation while loose multipolar systems are associated with lower levels of cooperation. No strict multipolar system existed in

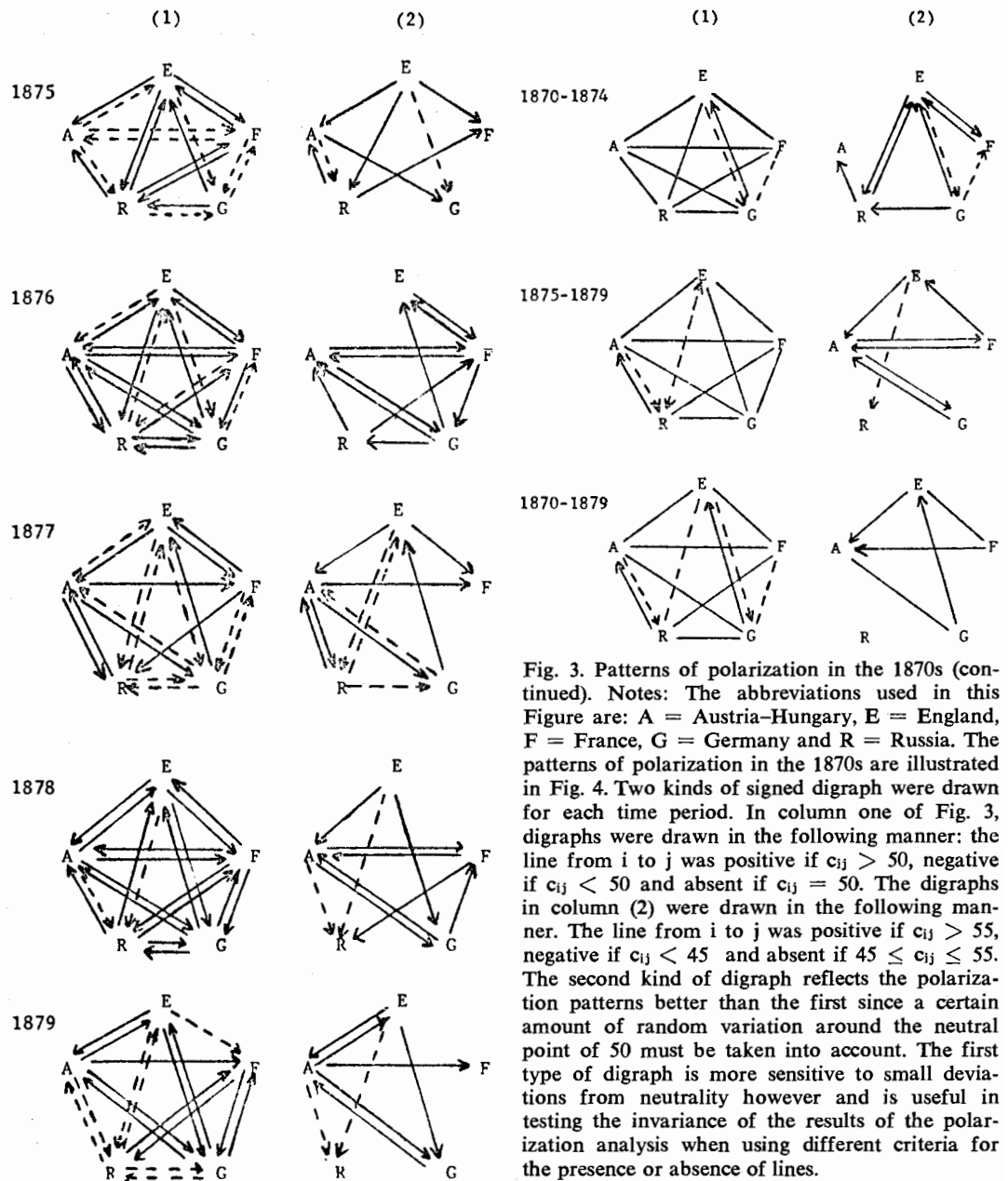


Fig. 3. Patterns of polarization in the 1870s (continued).

the major power subsystem of the 1870's. One should of course remember that the definition a separate node of attraction and repulsion. Given this definition, systemic cooperation is to be found in descending order of the following polarities: first and most cooperative, strict

Fig. 3. Patterns of polarization in the 1870s (continued). Notes: The abbreviations used in this Figure are: A = Austria-Hungary, E = England, F = France, G = Germany and R = Russia. The patterns of polarization in the 1870s are illustrated in Fig. 4. Two kinds of signed digraph were drawn for each time period. In column one of Fig. 3, digraphs were drawn in the following manner: the line from i to j was positive if $c_{ij} > 50$, negative if $c_{ij} < 50$ and absent if $c_{ij} = 50$. The digraphs in column (2) were drawn in the following manner. The line from i to j was positive if $c_{ij} > 55$, negative if $c_{ij} < 45$ and absent if $45 \leq c_{ij} \leq 55$. The second kind of digraph reflects the polarization patterns better than the first since a certain amount of random variation around the neutral point of 50 must be taken into account. The first type of digraph is more sensitive to small deviations from neutrality however and is useful in testing the invariance of the results of the polarization analysis when using different criteria for the presence or absence of lines.

of polarity entertained here does not select out a 'pole' for inclusion in the system unless it is unipolar; second, strict bipolar; third, loose bipolar; fourth, loose multipolar - with the caveat that strict bipolar systems are highly variable in their relation to systemic cooperation. These results form an interesting contrast to the recent empirical findings of M. Haas

Table V. Degree of polarization, type of polarization and relative peacefulness of periods during the 1870s

Time period	(1) Most active initiator	(2) $\beta_{2,3}^a$	(3) $\beta_{2,3}^b$	(4) Type of polarization	(5) Composition of blocs	(6) Mean sub-systemic cooperation-conflict
1870	Prussia	.54	.40	loose bipolar	RG/AEF?	51.1
1871	Germany	.38	.71	loose bipolar	EFGR/A?	53.4
1872	Russia	1.00	1.00	strict unipolar	AEFGR	56.9
1873	Germany	.92	1.00	strict bipolar	AEGR/F	57.8
1874	England	1.00	1.00	strict bipolar	AEFR/G	49.9
1875	Russia	.60	.40	loose bipolar?	AEFR/G? AEFGR?	52.0
1876	Russia	.54	1.00	strict unipolar	AEFGR	55.2
1877	England	.46	.43	loose multipolar	E/G/AFR	50.5
1878	England	.76	.82	loose bipolar	AEFG/R	53.4
1879	Germany	.68	1.00	strict bipolar	AEFG/R	51.5
1870-1874	Germany	.68	.62	loose bipolar?	AERG/F? AEFR/G? AEFGR?	53.2
1875-1879	Germany	.68	1.00	strict bipolar	AEFG/R	53.2
1870-1879	Germany	.39	1.00	strict bipolar	AEFG/R	52.7

Notes: ^a) This is the degree of balance of the signed digraph formed in the following manner: the line between *i* and *j* is positive if $c_{ij} > 50$, negative if $c_{ij} < 50$ and absent if $c_{ij} = 50$. See Fig. 3, column (1).

^b) This is the degree of balance of the signed digraph formed in the following manner: the line between *i* and *j* is positive if $c_{ij} > 55$, negative if $c_{ij} < 45$ and absent if $45 \leq c_{ij} \leq 55$. See Fig. 3, column (2).

(1970) in whose data bipolar systems gave rise to the most severe forms of conflict.

Further, this study of the 1870's suggests that the terms bipolarity, multipolarity, and unipolarity should be subdivided into distinctive aspects. Bipolarization with respect to patterns of cooperation does not require bipolarity with respect to relative power.¹² In the 1870s we find multipolarity with respect to relative power coexisting with bipolarity and even unipolarity in cooperative patterns. Indeed, the typical pattern of cooperative polarity for the 1870s surprisingly is some form of bipolarity.

Finally, one of the most significant findings concerning the 1870s is the constant establishment of more than minimal winning coalitions among nations. Rikerian notions of minimum winning coalitions simply do not apply.¹³ In all but one of the ten systems, coalitions are either maximal or greater than minimum. The typical coalition pattern for the ten-year period involved Austria, England, France and Germany aligned against Russia. To be sure, international politics only imperfectly resembles the game of zero-sum which Riker posited. But

calculations in terms of relative power (chronic in international politics) can be accurately represented in terms of zero-sum games. It is possible to hypothesize that because of the rapid shift of coalitions, the 4 v. 1 coalition appears to give greater security than the 3 v. 2 coalition (which might immediately be transformed into a 2 v. 3 losing coalition).

This effect has interesting results, too, for balance of power calculations. Organski (1968) speculates that exact balances of power are not likely to prevent war because they do not adequately deter powers seeking to improve their positions. We know that World War I ultimately emerged in a balance of power context, with Triple Entente balancing Triple Alliance. Warfare in the 1870s was apparently prevented by a different mechanism. Indeed, the only major war in the period (the Franco-Prussian War) occurs in a context in which alignments are 3 v. 2. With 4 v. 1 alignments characteristic, a possible aggressive power was much more overwhelmingly deterred than it could have been under political alignments of 1907-1914. Successful deterrence may therefore require an overbalance of power, lending sup-

port to Organski's crucial notions and offering evidence against those of Hinsley (1963).

Finally, these results tend to support the need to distinguish between strict polarities and balance of power phenomena. When many analysts have used the term 'bipolarity' they have implicitly assumed that there would be a rough balance between the two 'poles'. In all but one of the systems of the 1870s bipolarity is reflected in imbalance. Germany is overbalanced in the period 1874-75 and Russia is overbalanced in the period 1878-79. Deterrence may work best under these circumstances. These findings may even have some relevance to our interpretations of bipolarity from 1945-65. Relative peace may then have been due, not to bipolar stability but to the imbalance in the forces of the two opposing camps, an imbalance which is now rapidly being redressed. At the same time, however, new major powers are entering the system: Western Europe, China and Japan; perhaps transforming international politics into a multipolar power complex. Whether peace will be assured in the longer run, however, may still depend upon those mechanisms which helped to keep peace in the 1870s: imperfect polarization and the presence of overbalancing combinations.

The estimate of the degree of cooperation symmetry for each time period is given in Table VI. There appears to be a greater degree of symmetry for the half-decade periods and the decade than there was for the single-year period. Even though there may be a high level of symmetry in the long run, this does not necessarily hold for the short-run. Thus, the length of time periods chosen for the testing of the symmetry hypothesis may have a major effect upon the results.

Column (1) of Figure 3 represents degrees of cooperation and conflict which range from the most mild to the most extreme. Twenty-three instances are here found of the most extreme form cooperative asymmetry: cases in which one state returns cooperation while receiving conflict from another state. In column (2) in

Table VI. The degree of symmetry in cooperation - conflict scores

Time period	(1) Correlation between c_{ij} and c_{ji}	(2) Average $ c_{ij} - c_{ji} $ ^b	(3) Estimate of cooperation symmetry
1870	.59	7.48	moderate
1871	-.07	8.11	low
1872	-.04	3.22	moderate
1873	.48	4.34	moderate
1874	.99	4.39	high
1875	-.14	6.22	moderate
1876	.05	6.09	low
1877	.13	6.13	low
1878	.49	3.59	moderate
1879	.97	2.96	high
1870-1874	a	3.56	moderate
1875-1879	a	2.40	high
1870-1879	a	2.57	high

Notes:

^a) Correlation not calculated for these time periods.

^b) In computing this average, I assumed that $c_{ij}=0$ if $n_{ij}=0$.

which only relatively severe instances of cooperative and conflictual relations are included, there are three instances where one actor is clearly cooperating while the other is being hostile. One of these applies to relationships between England and Germany for five years! (The cases are Austria and England in 1871, Austria and Russia in 1875, and England and Germany for the period 1870-1874.) Thus, it does not appear that either Boulding's notions or the simpler formulations of deterrence theory can be supported by the 1870s data. Cooperation symmetry is not inexorable, but it does not follow that nations sit idly by, returning cooperation in response to threats made upon them. If deterrence notions are to be applied to this period at all, they would have to involve mild remonstrances or warnings. The greater the expression of conflictual behavior in the 1870s, the more likely it was that it would be reciprocated by the object of that behavior.

While bilateral or direct deterrence of this type is not generally characteristic of the period, there is something to be said for *indirect* or *systemic deterrence*. Systemic deterrence occurs when an actor threatens, or attempts to

influence, a second actor in order to prevent or reduce the conflict of that actor with some third actor, and the second actor complies. In 1875 Russia intervened with Germany to prevent the humiliation of France, and Germany returned mild cooperation to Russia. More importantly, for the first half of the 1870s, England consistently intervened on behalf of France and against Germany while Germany continued to cooperate with England. It is certainly possible that without these interventions, Germany would have dealt even more severely with France. These results are of course not surprising because in a balance of power system, one would expect to witness the operation of indirect or systemic deterrence.

Conclusions

The aim of this study was to investigate the extent to which nations reciprocated the conflict or cooperation directed toward them by other nations and the extent to which nations became polarized in terms of alignments and enmities in the European international system of the 1870's. Several new methods of studying international politics were devised for this purpose and explicated. The overall method was the use of a cooperation-conflict scaling technique on historical events data. Graph theory was used to analyze the resulting scores. It was discovered that, despite a number of notable exceptions, nations in this historical system tended to react with hostility to conflictual acts directed toward them and with amiability toward cooperative acts. This implied that both simple deterrence theories and theories of pure symmetry in cooperation and conflict must be made to take into account this imperfect but pronounced tendency toward symmetry. In addition, it was found that there was a tendency toward bipolarization in the European system of the 1870's, and in some cases, toward unipolarization. That is, the five great powers tended to divide into two blocs or to form a single all-inclusive bloc, judging from the overall pattern of cooperation and conflict. Thus, even though

the system was multipolar on the basis of the relative military capabilities of the powers, the alignment patterns were bipolar or unipolar. There was generally a tendency toward the formation of blocs with an overbalance of power, with four nations opposed to a single trouble-maker. This is counter to Rikerian notions of coalition formation. Single years in which the system was bipolar tended to have the highest and lowest levels of average cooperation-conflict. Finally, the results suggested that polarization and the distribution of power should be considered as distinct, both theoretically and empirically.

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NOTES

1. For other discussions of the events movement, see Azar 1970, Hermann 1971, and McGowan 1973.

2. I am referring here to the difficulty which some events data collectors have in justifying their efforts to theorists and historians. The most telling criticisms concern the absence or paucity of theoretical propositions and the validity or reliability of the data. These criticisms are becoming less applicable to the movement as it reorients its efforts away from the collection of primarily journalistic data and toward the analysis of historical sources. There is an increasing tendency to test important theoretical hypotheses with events data. The events data movement is becoming more self-critical (see Azar and Ben-Dak 1974) while it is also being recognized as one of many possible paradigms for the study of international politics (see Alker 1973).

3. Nisbet 1968, p. 384.

4. North 1968, p. 226.

5. See Mack & Snyder 1957, for a similar but

less concise formulation of the definition of conflict. Axelrod 1970, Ch. 1, distinguishes between 'conflict of interest', conflict inherent in a situation, and conflictual behavior.

6. For a thorough discussion of the notion of clutesability, see Davis 1967. A clusterable, signed digraph which is not balanced must have more than two plus-sets.

7. For a more general, mathematical treatment of this issue, see Norman, Roberts 1972. They prove that any weighting of semicycles of different lengths will satisfy a set of reasonable axioms about a measure of the degree of balance so long as the weight of longer semicycles is less than or equal to the weight of shorter semicycles.

8. See Abell 1970 on this issue. O. Frank 1971 deals with the general problem of randomness and statistical inference in graph theory.

9. See Phillips 1971 for evidence of symmetry, or 'reciprocity' as he calls it, in contemporary cooperation-conflict data. Iniguchi (1972) tested the symmetry of perception of hostility for China, the Soviet Union and North Korea. His results were mixed but he asserted that symmetrical perceptions tended to have a tamping effect on the level of hostility. Harle (1971) suggested that relations between the Soviet Union and the People's Republic of China in the 1960's were asymmetrical, with the Chinese returning conflictual behavior to the Soviet's cooperation (p. 208). On p. 210, Harle reported that interactions between China, Albania, the Soviet Union, Bulgaria, East Germany, Hungary, Cuba, North Vietnam, Poland and Mongolia were quite symmetrical; but nations which were

in conflicts with the United States were less symmetrical in their cooperation-conflict. Harle reported that symmetry increased at higher levels of conflict. Both Harle hostility measures. For a survey of related studies see Munton 1973.

10. The six major works are: Luigi Albertini, *The Orogen of the War of 1914*, Sidney Fay, *The Origins of the World War*, William Langer, *European Alliances and Alignments, 1871-1890*, Bernadotte Schmitt, *Triple Alliance and Triple Entente*, Raymond Sontag, *European Diplomatic History, 1871-1932*, and A. J. P. Taylor, *The Struggle for Mastery in Europe, 1848-1918*. There was a great deal of overlap in the events reported in each of these works, although Langer was by far the most detailed. The master list of events for the 1870s can not be made available but the cooperation-conflict scores used in this section can be found in Hart 1972, Statistical Appendix.

11. Identification of the type of polarization is based upon the digraphs in column (2) of Figure 4 rather than those in column (1). The same is true for the identification of bloc members. The reason for this choice is discussed in the body of the chapter.

12. See Goldman 1972 for a similar formulation. Other attempts to pin down the ambiguities of polarization theory are E. Haas 1953 and Zinnes 1967.

13. A minimal winning coalition is one in which the members of the coalition have just enough power in the aggregate to win, but no more. See Riker 1962 for a game-theoretic argument that winning coalitions will be minimal.