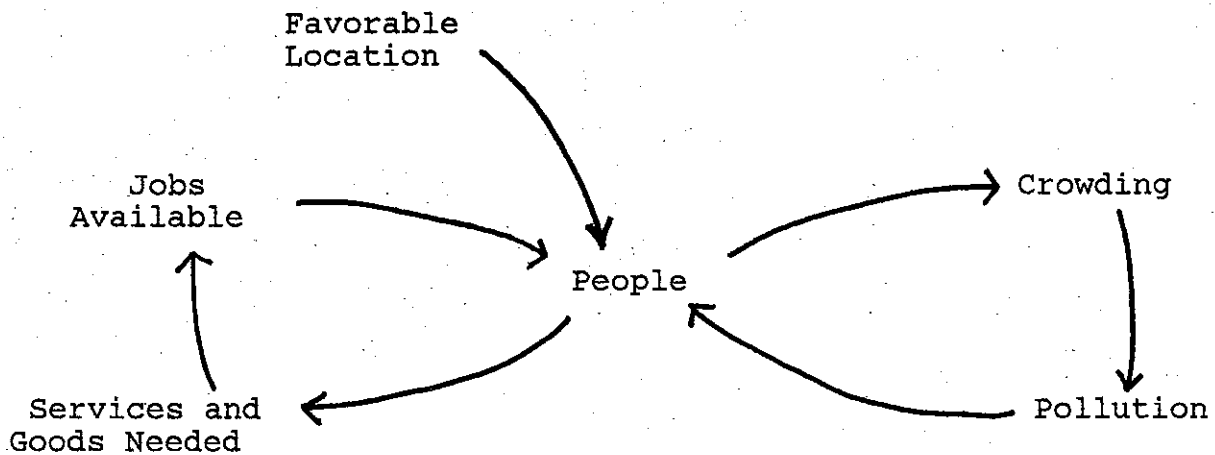# FUNDAMENTALS AND HISTORY OF CYBERNETICS
Exercises

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RISE AND FALL OF A CITY

Favorable
Location

Jobs
Available   Crowding

                        People

Services and   Pollution
Goods Needed
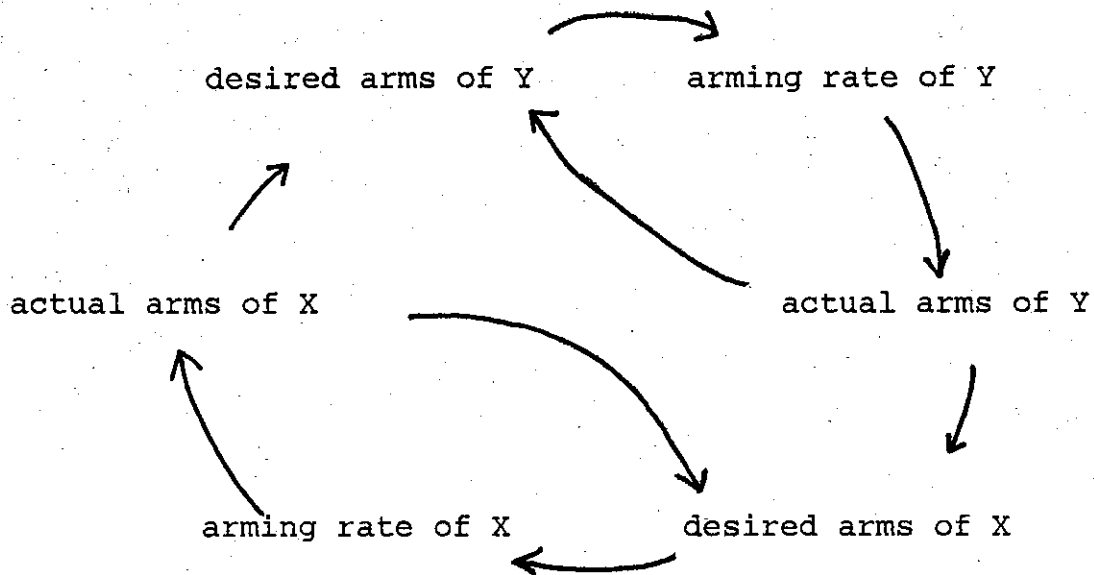

        The above diagram represents a partial possible explanation
of why a city grows and declines.

    1. Label the arrow heads and loops with the appropriate
        symbols.

    2. Write a paragraph explaining what the diagram tells you.
        Notice that there are two closed loops. Explain each one
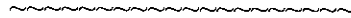   separately.

AN ARMS RACE

desired arms of Y   arming rate of Y

actual arms of X   actual arms of Y

arming rate of X   desired arms of X

1)   You should be able to find three feedback loops -- two negative and one positive.

2)   What are the "rational" and "irrational" aspects of this system? What accounts for the "irrationality"?

THE OIL CRISIS

One aspect of the oil crisis, as explained by an economist, was the starting of a "vicious circle." This vicious circle was begun by agreements made by the Arab oil producing countries in 1971 called the Tehran and Tripoli Agreements (named for the cities in which the meetings were held). Here these countries agreed to raise the price of oil. The rise in oil prices meant that these countries then made more money. They made so much more money that they could not possibly spend it all. Realizing this, these countries decided not to produce as much oil. They knew that eventually their oil supplies would run out so they might as well make them last as long as possible.

Because there was less oil being produced in the world, and more oil was needed every day, a scarcity of oil developed. This scarcity of oil forced the oil prices to go up even higher, continuing the "vicious circle."

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1. Draw a feedback diagram showing the "vicious circle" this economist points out. A vicious circle is an example of a positive feedback loop.

2. Label each arrow with either a + or -.

DYNAMICS OF PERSONALITY

by W. Ross Ashby

HIS personality includes the following traits, foibles, and responses:

1. If startled, his is apt to jump and knock the ash tray to the floor.
2. If asked to take a woman out to a dance, he always says yes.
3. If he feels sorry for a woman, he takes a bunch of flowers to her.
4. Going to a dance makes him feel good-natured and affectionate.
5. If he is given burnt food, he always points out the fault.
6. When he sees a woman in tears, he feels sorry for her.
7. If anyone admits their incompetence to him, he replies that they ought to be ashamed of themselves.
8. He thinks anyone in an irritated state is best cured by being told to control their temper.
9. If anyone should throw things at him, he would hit back.
10. He thinks a wife who could leave her husband is hopelessly bad, and should be told so.

HER personality includes the following traits, foibles, and responses:

1. Going to a dance makes her feel good-natured and affectionate.
2. If a fault in her cooking is pointed out, she admits to being an incompetent cook.
3. The sight of tobacco ash on the floor irritates her.
4. When flowers are given to her, her response is "Let's go out to a dance."
5. To be told that she ought to be ashamed of herself would make her burst into tears.
6. Being told to control her temper makes her really mad.
7. She could never live with a man who thought her hopelessly bad.
8. When she gets really mad, she throws things at whatever annoys her.
9. If her husband were to hit her, she would go back to her mother.
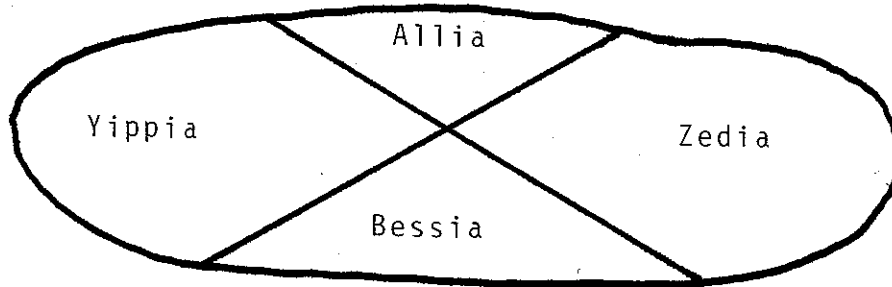
Trace the two sequences of events that follow the two initial Events:

1. She comes in unexpectedly while he is smoking and startles him.

2. The dinner she has prepared proves to be burnt.

A BRIEF HISTORY OF AMASIA
A Study in the Logic of Events

by W. Ross Ashby

Map of the <u>Continent of Amasia</u> and its Four Countries

Words of standardized meaning in Amasian diplomacy:

A Frontier: one of the four lines of contact
A Protest.
Refer to Arbitration.
Declare its Support (of another country).
To Mobilize (on a frontier) against (the other country).
A Defenseless frontier.

* * * * * * * * *

It is with feeling of sadness that I write this History, for I have to record how four countries tried to avoid war, did all they could to avoid it, yet nonetheless fell into it. The reader, I hope, may find it of interest and not entirely uninstructive.

First, I must say something of the geography and basic military ideas of the four countries.

The basic conditions

The continent of Amasia had been divided since the earliest times by two straight lines, giving four Frontiers that divided the continent into four countries: Allia, Bessia, Yippia, and Zedia. Each country, thus, had two neighbors (for the central point was of no practical importance).

None of the countries really trusted the others, but as peace had lasted for some time, all the four national armies were dispersed each about its own country. The countries were sensitive, however, and if a soldier of one country were to enter another country, a Protest was sure to be addressed to the soldier's Government: but no one regarded this as serious, for a Protest was not an invasion.

None of the countries kept a large army. In fact, each army was only large enough, when mobilized, to extend along one of its two Frontiers; and "mobilization" was in fact always directed specifically to one of the two. This left the other frontier "defenseless" (a technical word), and much of Amasia's politico-military problems were concerned with the defenseless frontier. All four were agreed that if a country found its neighbor mobilizing on their common frontier, then, in self-defense, it must also mobilize on the same frontier. Considering what to do if a neighbor should invade on the side that had become defenseless, all four General Staffs agreed that the attempt to turn the army round would lead only to chaos, so all it could do was to attack forwards, invade the country it faced, (and thus, perhaps find room for maneuver).

All four Governments (with public opinion behind them) generally held that, if war broke out, two countries fighting a common enemy would automatically become allies.

The earlier events

In the course of time, with the occurrence of small frontier disputes tending to antagonize neighbors, Allia and Bessia had become somewhat hostile toward Yippia and Zedia, and friendly to each other (having no common source of friction). Yippia and Zedia had similarly tended to draw somewhat closer, but nothing had been arranged officially between either pair.

In 1963, however, a considerable amount of vague political restlessness was evident, though no country wanted war. The government of Allia, under strong pressure from its own Peace Party, decided that it would not reply directly to any Protest addressed to it by its neighbors but would refer it to Bessia for arbitration.

The restlessness continued. Alarmist rumors of mobilizations began to appear in the newspapers. To forestall any such rash act, Zedia announced publicly that if any country mobilized against Yippia, that country would at once be mobilized against by Zedia.

Talk of mobilizations faded somewhat, but threats of Declaration of Support began to be heard. (None had been made before). Bessia tried to suppress these rather provocative threats by announcing that if Yippia declared its support for Zedia, or vice versa, then Bessia would at once declare its support for Allia. To reinforce Bessia's warning, Yippia added that if any country issued a Declaration of Support, Yippia would at once mobilize on its common frontier with that country (if it had one).

These matters were all public, but a private poll taken in Zedia at that time showed that were Bessia to be asked to arbitrate in a matter involving Yippia, public opinion would overwhelmingly demand that the Zedian Government declare its

support for Yippia. This fact, however, was little suspected at the time: it was only the events themselves that converted the potential to the actual.

It was at this uneasy time that the United Nations decided to ensure peace in a really positive way. So was passed Resolution 641, binding upon all parties:

No country should mobilize on its neighbor's defenseless frontier. Should any country so act, its two neighbors will immediately declare war on it and invade it.

So was the danger of war removed for all time, apparently.

What happened

After recording these high and statesman-like activities, I find it almost ridiculous to have to report that the next most significant event of the century was that Private Aldunk, of the Allian army, staggered half-drunk over the Yippian frontier and had to be forcibly ejected by Private Yipsky. But so it was. What followed of course, stands to reason.

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For further reading see Barbara Tuchman, The Guns of August, a history of the start of World War I.

INSTITUTIONAL CHANGES IN CHINA: 1978-1989
Groups in a Social System

The events that took place in Beijing in May and early June, 1989 need to be understood not only in terms of the role of individual political leaders and the power struggle among factions in the party and military establishment, but also, much more importantly, in terms of social tensions and conflicts of interest generated and increasingly intensified by the pattern of institutional change, especially economic reform, in the last decade.

The Chinese economic reform from 1978 to 1989 proceeded from an intention to transform China's traditional command economy to a market-oriented one. It was successful in that it significantly raised the standard of living of the population. It also gave rise to high expectations in regard to both economic opportunities and political freedom. However, special interest groups emerged as a result of the piecemeal nature of the reform. These groups not only obstructed the further progress of reform, but also significantly reduced the ability of the system to meet the rising expectations in the society.

The Chinese reform has proceeded incrementally. While the agricultural success in the early years was remarkable, the reform ran into trouble as it moved into the urban industrial area and began to touch the framework of the social-political arrangement. The reform had been dead-locked before 1989. Various conflicts and tensions had been accumulating and provided rich soil for social unrest.

The process of social development since 1978 has brought about many changes in the social stratification system, leading to readjustments in the relative status, privileges, and expectations of different groups.

Working class. Increased expectations go hand in hand with improvements in living standards. Initial changes in the wage-employment-welfare system generated uncertainty among workers as well as tension between managers and workers.

Intellectuals. Access to Western ideas and reflection on the nightmare of the "Cultural Revolution" gave impetus to their demand for freedom and democracy. Their nominal status has improved, but they have not enjoyed significant economic benefits from the reforms, and this situation has led to frustration and discontent.

Independent businessmen. Emerging after the reform this new group quickly expanded in numbers and acquired a disproportionately large share of wealth. They have little social and political power, so increasing wealth is not matched by higher self-esteem and confidence in the future. The anxieties they face and their sense of uncertainty have

led to reluctance to make additional investments and to a prematurely lavish life style, which, in turn, has reinforced the dissatisfaction of intellectuals and urban workers with the government.

The economic changes have led to conflicting demands from different social groups. However, the ability of the state to resolve these conflicts has not improved because of the constraints of the old political structure. There has been very limited reform of the political system. Moreover, some of the reform measures have actually done more harm than good by establishing a less effective decision-making mechanism. How should the conflicts be dealt with, and what institutions are best for dealing with them?

From a project proposal by Chinese scholars in the U.S. in 1989.

Competitive Exclusion in a Number System

Time	Competing Numbers										Evens	Number of Odds	Zeros
1	1	7	6	4	9	5	3	2	0	8	5	5	1
2	7	2	4	6	5	5	6	0	0	8	7	3	2
3	4	8	4	0	5	0	0	0	0	6	9	1	5
4	2	2	0	0	0	0	0	0	0	4	10	0	7
5	4	0	0	0	0	0	0	0	0	8	10	0	8
6	0	0	0	0	0	0	0	0	0	2	10	0	9
7	0	0	0	0	0	0	0	0	0	0	10	0	10

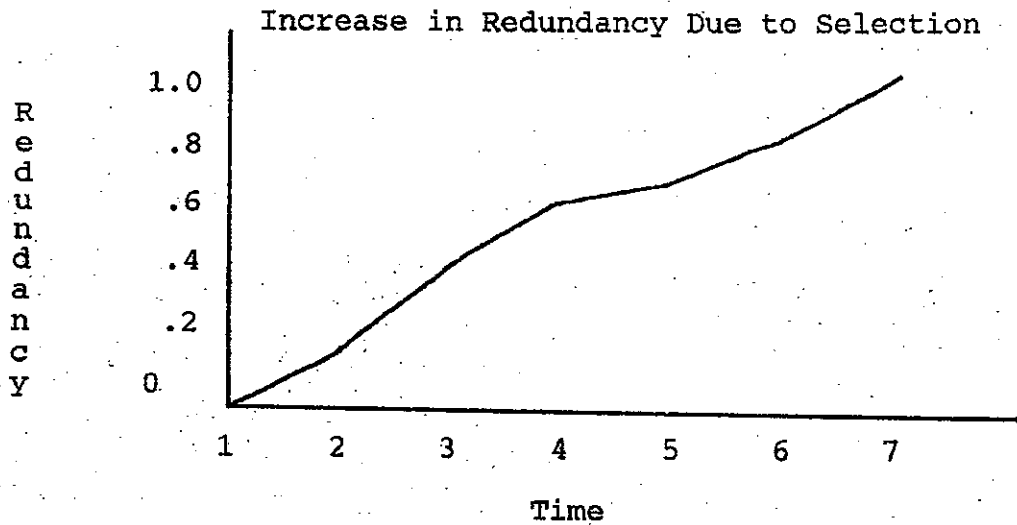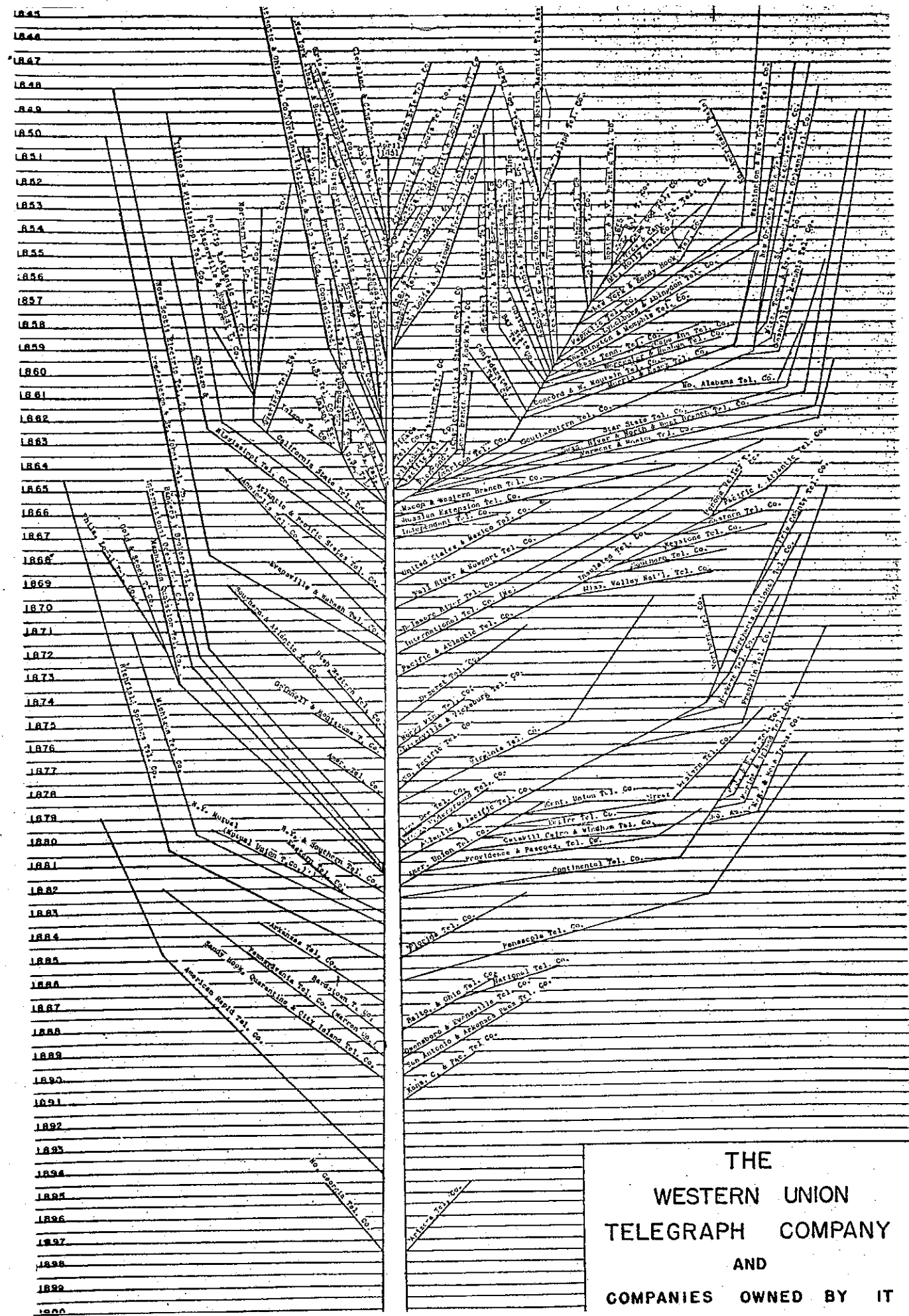| Time	Partition	H	R
	N: $n,n,\ldots,n$		
1	10: 1,1,1,1,1,1,1,1,1,1	3.3219	0
2	10: 2,2,2,1,1,1,1	2.7219	.1806
3	10: 5,2,1,1,1	1.9610	.4097
4	10: 7,2,1	1.1568	.6518
5	10: 8,1,1	.9219	.7225
6	10: 9,1	.4690	.8588
7	10: 10	0	1

Increase in Redundancy Due to Selection

Figure 11. (From Robert L. Thompson, Wiring a
Continent: The History of the Tele-
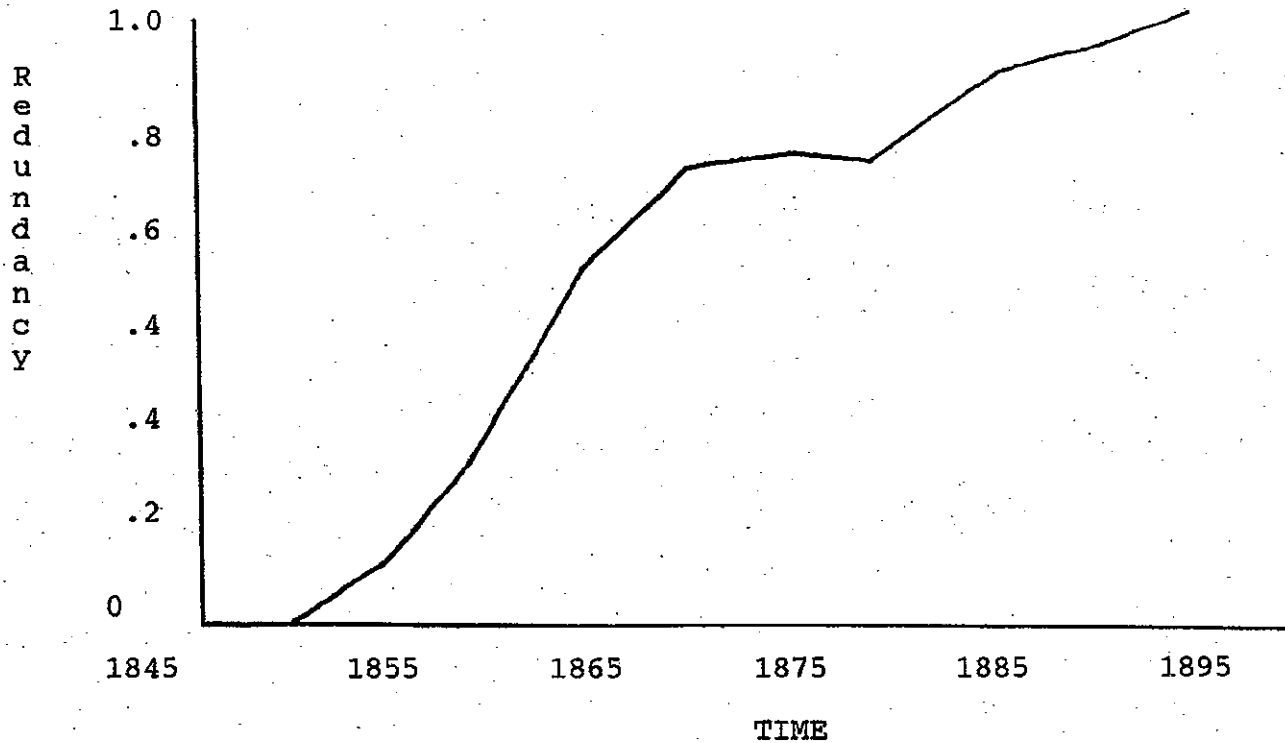graph Industry in the U.S. 1832-1866.
New York: Arno, 1947)

THE
WESTERN UNION
TELEGRAPH COMPANY
AND
COMPANIES OWNED BY IT

REDUNDANCY IN THE U.S. TELEGRAPH INDUSTRY 1845-1900

YEAR	NO. OF CO'S.(k)		PARTITION	UNCERTAINTY	REDUNDANCY
1845	4	4:	1,1,1,1	2.	0
1850	23	23:	1, ... , 1	4.5237	0
1855	39	48:	6,3,2,2,1,. $\overset{35}{.}$.,1	5.0795	.0905
1860	36	71:	15,15,5,2,2,2,1,. $\overset{30}{.}$.,1	4.2509	.3088
1865	23	90:	35,25,6,5,1,. $\overset{19}{.}$., 1	2.9058	.5524
1870	20	107:	82,7,1,. $\overset{18}{.}$., 1	1.6857	.7500
1875	17	117:	95,5,3,1,. $\overset{14}{.}$., 1	1.3960	.7968
1880	16	132:	104,6,4,4,3,1,. $\overset{11}{.}$.,1	1.4905	.7885
1885	6	137:	132,1,1,1,1,1	.3107	.9562
1890	4	144:	141, 1,1,1	.1791	.97502
1900	1	146:	146	0	1.

REDUNDANCY IN THE U.S. TELEGRAPH INDUSTRY 1845-1900

HISTORY OF AMASIA
Solution

A = Allia
B = Bessia
Y = Yippia
Z = Zedia

ANALYSIS AND SUMMARY

~ A and B were friendly, Y and Z were friendly.
~ If any country would mobilize on its border its neighbor
  must also mobilize on the same border.
~ A will let B arbitrate any protest.
~ If any country mobilizes against Y then it is also mobilized
  against Z.
~ If Y supports Z or vice versa, then B would support A.
~ If any country announces support, then Y would mobilize
  against that country if it has a common border with Y.
~ If B is asked to arbitrate involving Y, then Z would support Y.
~ If any country mobilizes on aneighbor's defenseless border,
  its neighbors will declare war and invade.

EVENTS

~ Yippia protests to Allia.
~ Allia asks Bessia to arbitrate.
~ Zedia announces support for Yippia due to public opinion.
~ Bessia announces support for Allia.
~ Yippia mobilizes against Bessia. Y is defenseless against A.
~ Bessia mobilizes against Yippia. B is defenseless against Z.
~ Zedia mobilizes against Bessia.

-- Allia declares war on Zedia and invades.
-- Zedia invades Bessia to gain maneuvering room.
-- Bessia attacks Yippia to gain maneuvering room.

Latest communique from the war zone: Fighting is going on
between the armies of Yippia and Bessia. Allia is invading Zedia.
Zedia is invading Bessia. It's all quiet on the Allia-Yeppia frontier