ISSN 2305-3224

ОБРАЗОВАНИЕ И СОВРЕМЕННОСТЬ

Научно-аналитический журнал

№ 6(10)
2012

ГЕОПОЛИТИКА И ГЕОЭКОНОМИКА

УДК 81.2 (англ.)
Г 79

SOCIAL MOVEMENTS AND ELECTROMAGNETIC CYBERSPACE

Gleason G.

Revolutions are always unexpected. Many of the great revolutions of the modern world – the American Revolution of 1776, the French Revolution of 1789, the Russian Revolution of 1917, the Chinese Revolution of 1949, the Iranian Revolution of 1978 as well as many others – are examples of sweeping political change that toppled old regimes and replaced them with a new political order. These revolutions shared many features, but they were also different in many important respects. The revolutions differed in motivation, in the values they championed, and the effects they brought about. All these revolutions prevailed because in each case new political leaders and new social movements combined in ways which exceeded the anticipations and capacities of the status-quo regimes which resisted them and which they replaced. It is quite possible that factors auguring for change in many societies and in many circumstances were anticipated and countered or deterred. Arguably, these were places ripe for revolution in which revolutions did not take place. The balance between the factors of change and the factors of stability shifted toward stability. What is so often unanticipated and unexpected is how the factors shift away from stability toward change [1].

As we survey the "Arab Spring" transformation that swept across the African Maghreb and the Middle East and compare these events with past revolutions, one particular feature stands out – the great speed at which these events took place. The Arab Spring erupted in

Tunisia in a popular outbreak which started in December 2010. Within months the sitting government was swept out of power. Just a short time after the Tunisian events revolutionary fervor, as if by contagion, swept into Egypt. In January 2011 events that came as a surprise to many outsiders culminated in large public demonstrations challenging the rule of Hosni Mubarak, Egypt's president since 1981. After just 18 days of political demonstrations, President Mubarak was persuaded to resign, relinquishing power to the military. In February 2011, a popular revolt broke out in Libya. At first Muammar Gaddafi, who acted as undisputed ruler of the country since seizing power in a coup in 1969, ridiculed the idea of a revolution in Libya. Yet a civil war soon broke out. With the help of NATO intervention, Gaddafi's opposition pushed him from power in October 2011. The revolutionary events of the Maghreb were followed by civil uprisings in Bahrain, Syria and Yemen. Major public protests swept Algeria, Iraq, Jordan, Morocco, and Oman. More limited protests took place in Kuwait, Lebanon, Mauritania, Saudi Arabia, Sudan, and Western Sahara.

These protests, demonstrations, uprisings, and revolutions have taken very different courses. They are likely to leave very different results in the different countries. Some have followed a path of armed conflict; others have followed principles of non-violence, resistance and civil disobedience. Some uprisings have been violent; some protests have shared techniques of civil resistance in sustained campaigns involving labor strikes, demonstrations, marches and rallies, as well as the use of social media to organize, communicate, and raise awareness in the face of state attempts at repression and censorship.

What is unique about the recent events is the speed at which they took place. The stunning speed of events is a testimony to the profound changes that have taken place as a result of new information technologies. Revolutionary new information technologies have played a very important role, almost as a revolution in the nature of revolution itself. These revolutionary political events raise fundamental questions about the relationship between social movements, information technology and political implications. These events invite us to reconsider the relationship between social networks, the cybernetic "digital revolution" and revolutionary political change. The question begins with the relationship between social networks and political change.

SOCIAL NETWORKS AND POLITICAL CHANGE

The essential core of a social network is a dyadic arrangement between individuals [2]. Dyads are necessarily organized in terms of pairs or twosomes. Every dyad is a pair; but dyads additionally may be ordered in the form of much more complicated structures such as ladders, pyramids, clouds, or constellations. Large, complicated and complex social networks may involve large numbers of individuals interacting in complicated and dissimilar ways, but the fact remains that every social network can be broken down into

what are essentially dyadic relationships – one actor (or individual) interacting with another actor (or individual).

In terms of structure, the individuals in a social network may be viewed as nodes. In terms of process, the individuals may be viewed in terms of the relationships between nodes. Relationships include a broad spectrum of such connections as such things as family ties, kinship, friendship, affection, disaffection, contractual obligations, common understandings and common interests in addition to many, many others [3]. Social networks operate on many levels of importance and salience, ranging from families up to the level of supranational organizations, from acquaintances and "fellow travelers" to clubs to and professional organizations.

Social networks may exist as formal organizations or as informal organizations. Some social networks are highly regularized in terms of policy and law; other social networks are informal organizations and are recognized only by those who are members. Formal social networks tend to be more influential but there are cases in which informal social networks are determinative. Social networks represent "social capital", referring to the value that an individual gets from being a member of the social network. Formal social networks are often transparent in the sense that members know one another because that is public knowledge. Informal social networks are often non-transparent in the sense that members are not always aware of the network. These concepts are often displayed in a social network diagram, where nodes are the points and ties are the lines.

Modeling relationships has given rise to conclusions regarding formality and informality as well as the underlying factors that tie relationships together, explaining the qualities of vectors [4]. The relationships are quite complex but can be described as vectors. The idea of modeling nodes and vectors is the basis of sociometry, a field pioneered by the quantitative sociologist Jacob Moreno [5]. From empirical observation of networks, Moreno noted that in informal networks it is not unusual that individuals do not precisely see the structure around them. In a celebrated study of social networks of school children Moreno noted one group in which "The boys were friends of boys and the girls were friends of girls with the exception of one boy who said he liked a single girl. The feeling was not reciprocated." The influence of modeling relationships in terms of informal social networks has grown over the years as researchers have become aware that the power of social network does not derive from its formality but rather from the strength of the vectors.

The connecting vectors of social networks also have been analyzed in terms of nature, composition and repetition of ties. The adjacency hypothesis holds that actors are related through short chains of social acquaintances. The concept gave rise to the phrase "six degrees of separation" after a 1967 experiment by a social psychologist suggested that two random US citizens were connected on average by a chain of six acquaintances. In his first "small world" experiment, the number six emerged as the mean number of intermediaries – and thus the expression "six degrees of separation" was born [6]. This model was extended in 1998 by a model that maintained that, beginning with a regular lattice, the addition of a small number of random links reduces the diameter – the longest direct path between any two vertices in the network – from being very long to being very short [7].

The idea of social networks is closely related to the concept of physical networks. The study of physical networks originally developed through the study of relay systems and control systems of various kinds. Although there are classical researchers in mathematics and biology who were interested in networks, the first and most fundamental network research was conducted by 20th century investigators of nerve systems. Researchers following the Pavlov tradition such as Petr Anokhin [8] in Russia and Nicolas Rashevsky [9] in the United States put emphasis on nerve systems as networks. At the same time, researchers in the field of electric signal theory were investigating parallel phenomena in analog message processing. With the advent of electric power system grid networks and the rise of communication technology the study of signals in terms of network theory made great advances. Mathematicians such as Andrei N. Kolmogorov [10] and Warren S. McCulloch [11] were also applying new discoveries in the theory of probability to signal processing.

With the establishment of a new scientific discipline – cybernetics – Norbert Wiener and others emphasized the utility of the system models as representing an isomorphism between a cybernetic model and natural processes. The cybernetic model of political processes was applied by such thinkers as David Easton to draw parallels between servo-mechanism control systems and political processes. Easton defined politics as a "A set or system of interactions defined by the fact that they are more or less directly related to the authoritative allocations of values for a society" [12]. According to the Easton model, a system is a collection of elements that are related by observable recurring patterns. A system is purposive in that it converts inputs (demands and supports) into outputs (decisions) through political actions (decisions, implementation actions, and so on) in the situation of a dynamic political environment. Government outputs produce outcomes that change the situation in a continuous fashion. Governments do not produce outcomes though, they only pro-

duce outputs. The systems approach to understanding politics puts great emphasis on social and political networks, much more than traditional, constitutional approaches which heavily emphasize political institutions [13]. Social network insights have been formalized in cybernetic models that have produced a certain amount of benefit in systems analysis, such as those used by the Niels Bohr institute [14].

Social networks are also closely related to political networks and, in particular, the vectors that connect nodes in the management of public goods. If politics is defined as the process of the management of public goods, political exchange may be defined as the principles by which parties in the political process cooperate to advance their individual and joint interests. Public goods are those which are produced by the efforts of many members of the collectivity and the benefit of which in some sense belongs to the collectivity as a whole. Exchange theory begins with the simple observation that cooperation is the core of all politics. People cooperate for many reasons – out of self-interest, out of a desire for commodious living, out of desire to belong to a group, out of desire to sacrifice to find meaning outside of one-self – the list of why people cooperate is very long indeed. People cooperating usually have parallel interests in achieving some goal. But parallel interests do not necessarily cooperation. Cooperation often founders on the inability of parties to maintain a continuous interest in the common goal. Sub-optimal collective action traps often defeat cooperation.

Forms of political authority are closely correlated with the forms of political exchange. Open, consensual, democratic forms of government evidence specific forms of political exchanges. Closed, coercive, authoritarian forms of government also have specific forms of political exchange. The democratic form of politics is based upon political exchange. Democracy is based on consensus. Democracy does not always require consensus, but all democratic principles emerge from the assumption that consensus can be reached. Consensus is itself based on mutual benefit. Democratic politics implies mutually advantageous cooperative interchange. Elected officials supply direction of management in return for electoral support. Parties supply solidarity and regimentation of ideas in return for a role in the competitive process. In open competitive systems of politics, voters supply support in return for the promise of public goods. Democratic forms of government tend to emphasize the transparency of the exchange of value that takes place. Democracy requires "political accountability" (the responsiveness of officials to public demands) but it also requires "public accountability" (the willingness of the public to bear the costs of self-government). Public accountability can only be achieved if fiscally sound, transparent, and equitable mechanisms exist for financing the provision and distribution of public goods.

Democracy is based on exchange within networks. But even non-democratic politics also has exchange at its core. In closed, hierarchical, or authoritarian systems of politics exchanges of benefit are less transparent but nevertheless are crucial to the political process. Authoritarian leaders relay on the militia, the police, the bureaucracy, an ideology, or privileged class or cohort such as an aristocracy or religious caste to provide them support. In exchange, authoritarian leaders provide protection, benefits, or preferred access to public goods. Authoritarian forms of government tend to emphasize the obligation that is incurred by exchanges. Patronage systems are based upon the capacity of authoritarian leaders to exercise discretion over the distribution of benefits in the society. The political contract of authoritarian systems is typically one that is based upon an exchange of fealty for protection, benefit, or promise of advancement. People never simply act; they always act for a reason. They always act to achieve something that they seek. Coalitions are agglomerations of people. Coalitions too do not simply act; they always act for a reason. Coalitions are more effective at achieving individuals' goals when they can articulate common goals. But it is a profound mistake for the analyst to interpret the articulated goal of coalition leaders for the operational goal of the coalition in action.

One of the most fundamental constructions of human competition is the coalition. Significant coalitions may be comprised of political elites, governmental bureaucracies, or other regional or ethnic groupings. The concept of "political elites" is defined by the group or groups having an ability to directly affect political will [15]. Coalitions may be defined as tactical combinations of individual decision makers that form in order to achieve a specific short-term goal. Coalitions invariably and specifically form specifically with respect to a perceived threat of loss that the individuals share. Coalitions are more often responsive than initiative; they tend to act in ways responding to the acts of other coalitions. Coalitions exist either to achieve goals or to preempt or counteract the activity of other coalitions. Because parallel interests do not by themselves necessarily imply cooperation, actors cannot in all cases be expected to cooperate simply in order to achieve their common goals. But actors can be mobilized to subordinate their short-term interests to the longer-term interests of preventing another group of actors – an opposing coalition – from achieving its goals.

When coalitions are formed and begin to function effectively, it may suggest that members are united more by what they are trying to avoid than what they are trying to attain. Coalitions are often more effective,

more enduring, and more compelling when the partners are cooperating to avoid something rather than to achieve something. In the idealistic world of political rhetoric, states and groups enter into coalitions in order to achieve common goals. But in the realistic world of international, inter-ethnic and inter-regional exchanges, significant actors are more likely to enter into cooperative arrangements, and more likely to sacrifice for the success of those arrangements, when they are cooperating to avert common risks than when they are seeking to achieve common benefits. It is for this reason that many coalitions are essentially negative in their origin. They come into being and endure primarily in order to defeat other coalitions. When the threat of loss dissipates, the coalition may endure for some period of time, but eventually the underlying rationale will erode and the coalition without an opposing coalition will come to an end. Coalitions of "everyone against no one" are doomed to short lives.

Some authoritarian systems have harsh relations between the individual and the state. In such systems political opposition may be dealt with severely or even brutally. Yet in such systems there may be internal compromises within ruling elites which allow a substantial amount of leeway for coalition interactions. In these kinds of authoritarian systems there are often strong, influential coalitions that manage to make claims upon fiscal resources. The more leeway there is for coalition competition over fiscal resources, the more likely that a coalition will seek to alter the terms of exchange. Such coalitions will resort to the standard mechanisms of democratic political exchange, namely log-rolling, side-payments, and quid-pro-quo settlements, all of which have a win-win character. Political will is analyzed as a consequence of coalition dynamics. These dynamics are conceived not only in terms of conventional terms social science concepts such as parties, ideologies, or religious affiliation, but also in terms of much more context-specific concepts such as parameters that include measurements of region, tribe, and clan as well as clique and patron-client relations.

THE CYBERNETIC REVOLUTION

The electronic communication revolution has given rise to a level of global "connectedness" that opened vast opportunities for economic expansion around the world. But at the same time the level of connectedness undeniably magnified vulnerabilities around the world. Many of the digital age computer technologies and networks that made globalization possible emerged from electronic signal laboratories, which made significant breakthroughs particularly during the period of the Second World War. The most important breakthroughs in signal processing were those that shifted the world from analog electronic impulses to digital processing.

The invention of the handheld phone and wireless networks helped transform the way that people conduct their affairs and do business around the world. The construction of electronic networks made it possible to create world-wide digital networks linking banks and communication systems, thereby connecting the entire world for nearly instantaneous transfers of and information and money. The invention of a system of interlocked orbiting geosynchronous communication satellites first financed by militaries in the U.S. and in the USSR and later the Russian Federation made it possible to create a geospatial network linking the entire face of the earth. It is now known in the U.S. as the GPS, "global positioning system" and in Russia as GLONASS. The use of these digital systems, which were originally encrypted and encoded, was made publically available for the entire world in 2000. Now the systems have a large number of constantly orbiting satellites that enable locational devices for innumerable private and commercial applications.

The digital world is fundamentally different than the pre-digital world. Digital technology has catapulted its users into world that is dense and continuous and therefore connected. As far back as people can be traced, the human world was primarily discontinuous. People's senses and capacities were geared to the things important to them – stones, water, trees and plants and to each other. Sight, hearing, and sensing were directed to a world in which objects were disparate and apart. We have long known in scientific terms that space is dense. Space is a dense field of physical matter fully occupied by electromagnetic phenomena. But even so, the discrete objects in the world of sentient beings appeared for all intents and purposes to be separated in space and time. So we interacted with objects as such. The continuous electromagnetic field was only important in the case of huge potential differences – when lightning struck. Otherwise, people remained unaware and unaffected by the continuous electromagnetic field in which they existed. That world has changed.

For 500 years we have talked about the Guttenberg revolution as consisting of the possibility to encapsulate, store and transfer information in the form of portable manuscripts. Once the printing press was possible, pamphlets and books proliferated. Knowledge was magnified many times. But the digital revolution is not comparable with the printing revolution. It is the transformation of the ability to store and move informa-

tion on such a far greater scale that it is essentially different in capacity. The digital revolution has transformed the way we collect, process, store and communicate information. The digital revolution has changed the way signal information is used in directing machinery.

Like all knowledge, the digital revolution was cumulative, depending upon the gradual integration of knowledge from a variety of scientific spheres. Charles Augustin de Coulomb observed that the interaction force between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distances between them. James Clerk Maxwell demonstrated that electricity, magnetism and light are all manifestations of the same phenomenon: the electromagnetic field. Maxwell hypothesized the existence of electromagnetic waves. In 1887 Heinrich Hertz demonstrated the reality of Maxwell's hypothesis by experimentally generating radio waves in his laboratory. Carl Friedrich Gauss showed that the electric flux through any closed surface is proportional to the enclosed electric charge. Michael Faraday demonstrated that the induced electromotive force in a closed circuit is equal to the time rate of change of the magnetic flux through the circuit. André-Marie Ampère explained that the magnetic field around a closed loop is related to the electric current passing through the loop. Nikola Tesla demonstrated the advantages of alternating current over direct current. In 1891 George Stoney introduced the term "electron" to describe this smallest unit of negative charge. Robert Millikan measured the electron's charge independently and determined the mass for the electron. In 1896 Henri Becquerel accidentally discovered radioactivity. Lee De Forest in 1906 invented the vacuum tube triode which was the first three-terminal device, enabling amplification and switching of electrical signals. The transistor was invented in 1947 by John Bardeen, William Shockley, and Walter Brattain.

Vacuum tubes were replaced by transistors. In electronics, a transistor is a semiconductor device used to amplify or switch electronic signals. A transistor is made of a solid piece of a semiconductor material, with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be much more than the controlling (input) power, the transistor provides amplification of a signal. The transistor is the fundamental building block of modern electronic devices, and is used in radio, telephone, computer and other electronic systems. The name transistor is a portmanteau of the term "transfer resistor".

The digital revolution made use of all these advances. In 1854 George Boole published a landmark paper detailing an algebraic system of logic that would become known as Boolean algebra. In the western world Claude Shannon is credited with founding both digital computer and digital circuit design theory when in 1937, as a 21-year-old master's student at MIT, he wrote a thesis demonstrating that electrical application of Boolean algebra could construct and resolve any logical, numerical relationship. Shannon's MA thesis has been called the most important master's thesis of all time. Just after close of the war in September 1945, Shannon prepared a classified memorandum for Bell Telephone Labs entitled "A Mathematical Theory of Cryptography." A declassified version of this paper was published in 1949 as "Communication Theory of Secrecy Systems". On the basis of this theory, in 1948 Shannon later published "A Mathematical Theory of Communication [16]. " This article is often cited as marking the beginning of the digital era.

Working along with Harry Nyquist who had been examining bandwidth requirements for transmitting information, Claude Shannon calculated a physical constant of information theory. The "sampling theorem" asserts that a band-limited analog signal that has been sampled can be perfectly reconstructed from an infinite sequence of samples if the sampling rate exceeds 2B samples per second, where B is the highest frequency in the original signal. If a function x(t) contains no frequencies higher than B hertz, it is completely determined by giving its ordinates at a series of points spaced 1/(2B) seconds apart.

The sampling theorem was new for the western world but was not new to the east. The Soviet mathematician Vladimir Kotelnikov had already discovered the sampling theorem in 1933 using harmonic analysis in relation to signal transmission [17]. Vladimir Kotelnikov was a Soviet pioneer in the use of signal theory in modulation and signal communications and developed a theory of optimum noise immunity. Kotelnikov also worked in radar and cryptography, proving the absolute security of the one-time pad. He was associated with the Moscow Power Engineering Institute, Kazan University, the Russian Academy of Sciences and was for a time the Chairman of the Russian Supreme Soviet (parliament). However, Kotelnikov's discoveries were within a small circle of theoretical and laboratory specialists and did not find commercialization in industry as Shannon's and others' discoveries found in the western world. What the digital revolution made possible was transforming information about physical processes into binary digits – bits – in order to encode, compress, transfer, and decode, providing convenient ways to store and communicate information.

Radio waves are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light. Like all other electromagnetic waves, they travel at the speed of light. Naturally-

occurring radio waves are made by lightning, by astronomical objects, and by other causational factors. Artificially-generated radio waves are created as electrical disturbances that can be modulated and transmitted and then received and demodulated for the purposes of radio communication, broadcasting, radar and other navigation systems, satellite communication, and "wifi" (wireless fidelity) transmission. Different frequencies of radio waves have different propagation characteristics in the Earth's atmosphere. Long waves may cover a part of the earth very consistently, shorter waves can reflect off the ionosphere and travel ricocheting around the world, and much shorter wavelengths which bend or reflect very little tend to travel on a direct line of sight.

At the same time scientists in the west were investigating signal theory, scientists in the USSR were also making breakthroughs in applying digital theory in practice. In 1945 Léon Theremin invented an espionage tool for the Soviet Union which retransmitted incident radio waves with audio information. Sound waves vibrated a diaphragm which slightly altered the shape of the resonator, which modulated the reflected radio frequency. Even though this device was a covert listening device, not an identification tag, it is considered to be a predecessor of today's radio frequency identification (RFID) technology, because it was passive, being energized and activated by electromagnetic waves from an outside source.

Radio-frequency identification (RFID) is a radio wave technology designed for the purposes of monitoring through identification and tracking. RFID consists of interrogators (readers) and tags (labels). RFID consists of two components: transmission and processing. The transmission component involves antenna for receiving and transmitting a signal. The processing component is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency signal, and interpreting the signal. There are three types of RFID tags: active RFID tags, which contain a battery and can transmit signals autonomously; passive RFID tags, which have no battery and require an external source to provoke signal transmission; and battery assisted passive RFID tags, which require an external source to wake up but have significant higher forward link capability providing greater range.

The western world made great strides in applying digital theory in the computerized revolution throughout the 1960s and early 1970s making increasingly larger and more centralized computerized systems. Then in the 1970s trends began moving in the opposite direction, moving towards smaller, more decentralized, and more versatile systems. The result was an explosion of applications for more easily applicable, more efficient, and more adaptive systems of information processing. The results ranged from cellular phones, to portable computers; from digital SCADA (supervisory control and data acquisition) to complex and layered networks. Once electronic networks could be linked, the upper threshold was quickly extended to the entire planet with the articulation of ICANN's World Wide Web (ICANN--Internet Corporation for Assigned Names and Numbers).

The digital revolution made it possible to not only process the sequential communication signals that scientists were originally interested in, but also in collecting information in the form of videos, documents, spreadsheets and arrays of information. The growth of digital capacities in banking, industry, science and communication transformed the capacity to change the rate at which information could be collected, processed, transmitted and interpreted.

The digital revolution made it possible to transfer information through radio waves between computers linked by wifi connections that would have been inconceivable only a short time before. Sitting on one side of the room a researcher can prepare a manuscript and upload it through the wifi connection for transmission to another computer in the same room which then interprets the signal, either through an internet server or more simply through a peer-to-peer wifi connection, and then downloads the manuscript. The process involves transforming the prepared written document into a digital code, creating a disturbance by modulating the electromagnetic waves on the sender's side and then by receiving and then demodulating the electromagnetic disturbances on the receiver's side. Pages, books, whole libraries of information can be shifted from point A to point B, carried along by electromagnetic waves moving at the speed of light. Once the technology is in place, the cost of communication becomes so small it becomes negligible; too cheap to monitor.

Globalization was not invented by political will; it was the child of the digital age. Globalization is typically defined as the transition to a single economic and information space, and is certainly one of the most important political and economic phenomena of the modern world. It has produced benefits as well as detriments, but it is in essence politically neutral. Those countries that can adapt to the globalized world reap many benefits. Those countries than do not adapt tend to pay great costs.

POLITICAL CONSEQUENCES OF SOCIAL NETWORKS IN THE CYBER AGE

The digital world has certainly led to a world where people are more interrelated and more mutually dependent upon one another than ever before. For both good and bad, the digital age has brought us closer together. The question of whether the digital age divides us further or whether we can find a digital bridge that makes it possible for us to communicate and cooperate more equitably, more effectively, and more successfully remains to be addressed. One conclusion is plain and clear – the idea of person-to-person communication in the form of social networks played an important role in the traditional past. In the digital future it is sure to play an even more important role. Political observers did not anticipate the speed and fervor of the revolutions of the Arab Spring. Can political institutions predict what they cannot anticipate? Can political institutions be adapted that will enable adjustments of political circumstances in ways that are equitable and effective? Can people themselves adjust to the speed of political change in the cybernetic age?

One of the path breakers in the digital revolution, Norbert Wiener, raised this very question sixty years ago when the outlines of the cybernetic age were only barely discernible [18]. His observation was very simple. The modern world has changed greatly but human beings may have changed little if at all. The basic human neural patterning for decision making is our inheritance but the cybernetic environment which structures the way that information is processed, distributed and apprehended is very new. The network structure of political relationships in which we live and the way people process information and reach decisions is very old. Yet we face challenges that are very new. It may be that the cybernetic age may usher in an era in which the source of the risks is also the source of the opportunities. If the new level of electronic connectedness has made rapid contraction possible, it has at the same time made rapid expansion possible.

References and notes:

1. Political revolutions are unique in many respects. The literature on revolution, both written by observers and by those who shaped the revolution, is too broad for any essay to do justice. Some of the more important works are Chinua Achebe, Things Fall Apart (New York: Random House, 1959); Russel Hardin, One For All: The Logic of Group Conflict (Princeton: Princeton University Press, 1995); Milan Kundera, The Unbearable Lightness of Being (New York: Harper & Row, 1984); Günter Grass, Too Far Afield (New York: Harcourt, 2000); André Malraux, Man's Fate [La Condition Humaine] (1933); Robert Service, Lenin: A Biography (Cambridge, MA: Harvard University Press, 2002); Leon Trotsky, My Life (New York: Pathfinder, 1970); Alexander Dubcek, Hope Dies Last: The Autobiography of Alexander Dubcek (New York: Kodansha International, 1993).

2. John Scott, Social Network Analysis (London: Sage, 1991).

3. On relationships, see Stanley Wasserman and Katherine Faust, Katherine. Social Network Analysis: Methods and Applications (Cambridge: Cambridge University Press, 1994).

4. J.H. Fowler, and others. "Model of Genetic Variation in Human Social Networks." Proceedings of the National Academy of Sciences, Vol. 106, No. 6 (2009): 1720–1724.

5. Jacob Levy Moreo, Who Shall Survive? (New York: Beacon House, 1934).

6 Stanley Milgram, "The Small World Problem". Psychology Today, Vol. 2 (1967); pp. 60 – 67. Also see Duncan J. Watts, "Networks, Dynamics, and the Small-World Phenomenon." American Journal of Sociology, Vol. 13, No. 2 (1999) pp. 493-527.

7. D. J. Watts and S. H. Strogatz. "Collective dynamics of 'small-world' networks." Nature, No. 393 (1998) pp. 440-442.

8. Petr Anokhin, following in the tradition of the great physiologist Ivan Petrovich Pavlov, emphasized the structure and processes of neural patterns as explanatory factors in human behavior. See Пётр К. Анохин, Проблема центра и периферии в физиологии нервной деятельности. (Горький, 1935).

9. Nicolas Rashevsky, Mathematical Biophysics: Physico-Mathematical Foundations of Biology (Chicago: University of Chicago Press, 1938).

10. See for instance, А. Н. Колмогоров, Об аналитических методах в теории вероятностей, Успехи математических наук, Vol. 5 (1938), pp. 5-41.

11. Warren S. McCulloch, "A Heterarchy of Values Determined by the Topology of Nervous Nets." Bulletin of Mathematical Biophysics, Vol. 7 (1945), p 89–93.

12. David Easton, A Systems Analysis of Political Life (New York: Wiley, 1965).

13. Indeed, the traditional "textbook" approach to political institutions focuses on formal political institutions to the exclusion of informal institutions. The key institutional or "structural" elements of the civil society include: 1) the rule of law supported by an independent judiciary; 2) a respect for democratic proceduralism as reflected in competitive elections with secret ballots; 3) recognition of the inviolable rights of

individuals and groups, in addition to rights of collectivities; 4) representative government with public accountability provided for by an independent press and media; 5) a market based economy with limits on the scope and powers of government intervention; 6) and a separation of church and state (secular and theocratic values). Well established, functioning democracies evidence a great deal of institutional variety. For instance, theorists distinguish between consensus democracy and majoritarian (or Westminster) democracy. The consensus system usually includes federalism, separation of powers, bicameral structure of legislatures, with each house having a different electorate, a state-based rather than nation-based political party system, and the veto power of the executive with the power to override it with an extraordinary majority.

The Westminster system is commonly understood to describe a constitutional democracy in which all citizens, individually and through organizations, can participate and at least attempt to influence the workings of government. A simple majority is sufficient to win a vote, but the minority is accorded by tradition and mutual understanding the right to seek to become the majority. The two party system is founded on the idea of loyal opposition. The separation of military and civil leadership is based upon the idea of loyalty to the state and not to particular political patrons. Disagreement is over issues and policies, not over loyalty to the state. Public accountability is provided by an acknowledged latitude of freedom of speech, assembly, and press. The principle of the rule of law implies the certainty of legal rules rather than arbitrary judgments in determining the rights of individuals and in prescribing the authorities of public officials."

Free and open market relations are necessary to the functioning of a civil society. Economists argue that for a market to exist the following conditions must be satisfied: 1) buyers and sellers must engage in voluntary exchanges, acting as price takers; 2) the good (or service) must be homogenous (and thus substitutable) across sellers (such that there is a possibility for the buyer to switch to an alternative seller); 3) the good or service must be a true private good (rivalrous and excludable); 4) there must be relatively open entry and exit into the market; 5) buyers and sellers must have access to complete information; 6) governments (or some alternative organizations) must provide for contract compliance to ensure that property conventions are recognized.

The opposite of open market relations is the directed and administered economy, what was formerly referred to as the "command economy" of the communist regimes. Markets are elemental forms of human exchange. But they are not self-establishing and self-regulating in all cases. They require public organizations which ensure that the rules, standards, norms and procedures of openness are enforced. They require that governments (or some alternative organizations) solve collective action problems by discouraging free riding, opportunism, and rent-seeking behavior.

14. See the Niels Bohr Center for Models of Life, Niels Bohr Institute, University of Copenhagen Project on Social Network Topology. http://cmol.nbi.dk/javaapp.php

15. The élite (the "elect," from French) is a relatively small group which holds a dominant political position within a society.

16. Claude E. Shannon, "A Mathematical Theory of Communication," Bell System Technical Journal, Vol. 27 (July, October 1948) 379–423, 623-656.

17. Котельников В. А. О пропускной способности эфира и проволоки в электросвязи – Всесоюзный энергетический комитет//Материалы к I Всесоюзному съезду по вопросам технической реконструкции дела связи и развития слаботочной промышленности, 1933. V.A. Kotelnikov, "On the transmission capacity of "ether" and wire in electrocommunications." Izd. Red. Upr. Svyazzi RKKA (1933). Reprinted in Modern Sampling Theory: Mathematics and Applications, Editors: J. J. Benedetto und P. Ferreira, (Boston: Birkhauser, 2000).

18. Norbert Wiener, Cybernetics: Or Control and Communication in the Animal and the Machine (Cambridge MA: MIT Press, 1948) and The Human Use of Human Beings (New York: Houghton Mifflin and Company: 1950).