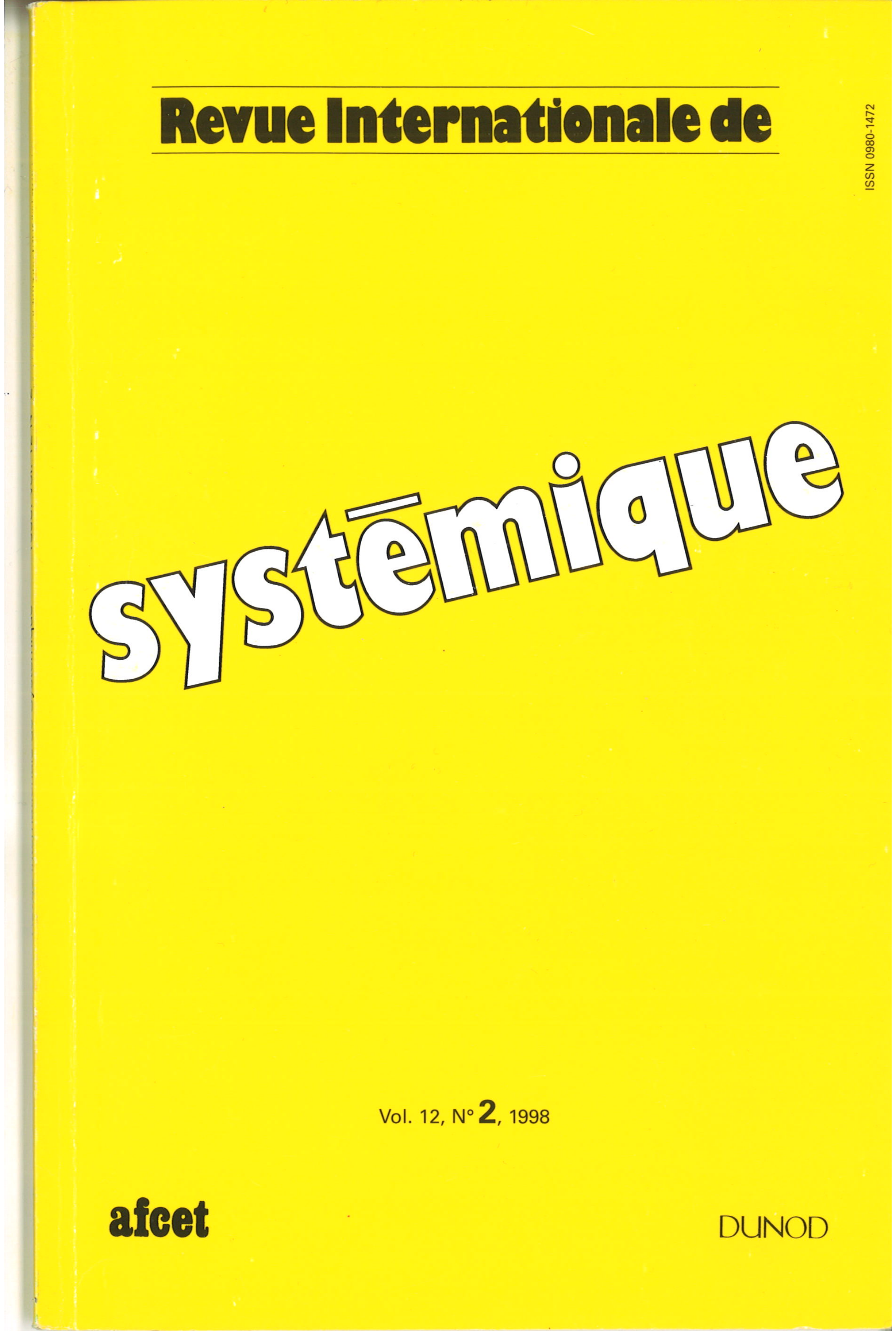


AFSCET

Revue Internationale de systēmique

# Revue Internationale de Sytémique

volume 12, numéro 2, pages 161 - 176, 1998

## A parallelism between natural and social interfaces

Hajime Eto

## Références

J. BAMBERGER, *The Mind Behind the Musical Ear*, Harvard Univ. Press, Cambridge, Mass., 1991.

J. D. BARROW, *Theories of Everything*, Oxford Univ. Press, 1991. Traduction française : *La grande théorie*, Albin Michel Paris, 1994, Chap. 5, p. 127.

J. BRUNER, *Actual Minds, Possible Worlds*, Harvard Univ. Press, Cambridge, Mass. 1986.

G. COHEN-TANNOUDJI, Le temps des processus élémentaires I, *in Le Temps et sa flèche*, Ed. Klein E. et Spiro M., Editions Frontières, Gif-sur-Yvette, France, 1994, pp. 93-130.

M. FELDEN, *Et si l'homme était seul dans l'univers ?* Grasset, Paris, 1994, Ch. 4.

R. FIVAZ, *Morphodynamics, Ergodic Theory of Complex Systems*, Systems Research 10, 2, pp. 27-51, 1993.

R. FIVAZ, *The Nature of Order in Complex Systems*, Systems Research 11, 3, 43-65, 1994.

R. FIVAZ, *Ergodic Theory of Communication*, Systems Research, 13, 2, pp. 127-144, 1996a.

R. FIVAZ, *Principles of Economic Growth*, Int. J. General Systems, 25, 3, pp. 259-290, 1996b.

D. R. HOFSTADTER, *Gödel, Escher, Bach*, Penguin Books, Harmondsworth, G. B., 1979.

M. JACOB, Le temps des processus élémentaires II, *in Le Temps et sa flèche*, Ed. Klein E. et Spiro M., Editions Frontières, Gif-sur-Yvette, France, 1994, pp. 131-153.

J. JAFFE and S. FELDSTEIN, *Rythms of Dialogue*, Academic Press, New York, N. Y., 1970.

J. JAYNES, *The Origin of Consciousness in the Breakdown of the Bicameral Mind*, Houghton Mifflin, Boston, Mass. 1976, p. 447.

D. LAYZER, *Cosmogenesis*, Oxford Univ. Press, New York, N. Y. 1990, Ch. 3.

H. H. PATTEE, The Problem of Observables in Models of Biological Organisations, in *Evolution, Order and Complexity*, Khali E. L. and Boulding K. E., Eds., Routledge, London 1996.

I. PRIGOGINE et I. STENGERS, *La nouvelle alliance*, NRF, Gallimard, Paris, 1979, Ch. 8.

H. G. SCHUSTER, *Deterministic Chaos*, Physik Verlag, Weinheim, Germany, 1984, Ch. 6.

R. THOM, *Modèles mathématiques de la morphogenèse*, 10/18, Paris, 1974.

A. T. WINFREE, *The Timing of Biological Clocks*, Scientific American Library, Freeman & Co, New York, N. Y., 1987.

E. C. ZEEMAN, *Differential Equations for the Heart Beat and Nerve Impulse*, in Towards a Theoretical Biology, Ed. C. H. Waddington, Edinburgh Univ. Press, Vol. 4, pp. 8-67, 1972.

REVUE INTERNATIONALE DE SYSTÉMIQUE
Vol. 12, N° 2, 1998, pp. 161 à 176

# A PARALLELISM BETWEEN NATURAL AND SOCIAL INTERFACES

Hajime ETO [1]

Abstract

The concepts of interface and bubble in physical chemistry are shown to hold in a parallel way for social phenomena of interface between conflicting groups and bubble in finance. This parallelism may be useful as a metaphor in transferring natural scientific methods of complex systems to social science which recently tends to reduce complex social problems to simplified models.

Résumé

On montre que les concepts d'interface et de bulle, issus de la chimie physique, ont leurs correspondants dans les phénomènes sociaux d'interface entre groupes en conflit et de bulle dans le domaine financier. Ce parallélisme peut être utile comme métaphore permettant le transfert de notions scientifiques aux systèmes complexes naturels dans les sciences sociales qui, ces derniers temps, tendent à réduire les problèmes sociaux complexes à des modèles simplifiés.

## I. INTRODUCTION

One of the difficulties in social sciences is the impossibility of experiment. Natural science controls natural conditions in laboratories and analyses the idealised system where "analyse" means "divide" as in Descartes. Sociology (e.g. Max Weber) abstracts the society into ideal types, where the idealisation

1. University of Tsukuba, Institute of Policy and Planning Sciences, Tsukuba, Ibaraki, 305 Japon.

Rev. intern. systémique. 0980-1472 Vol. 12/98/02/ $ 7.00/© Afcet Gauthier-Villars

is for conceptual syntheses while that in natural science is for experimental analyses. Recently, social science quantitatively analyses (divides) the society into quasi-societies represented by quantifiable (e.g. monetary) terms. In this way the quantitative approach has made a certain success at the cost to ignore the whole society.

Social science is divided into disciplines whereas people in the real society face real complex problems across disciplinary frames. Against a gap between the disciplinary knowledge and the connected real society, people in the real society demand integrative approaches to the society.

The systems approach is to unify the analysed quasi-realities and to restore the whole reality. As far as the systems approach is based on science, this task is paradoxical because it is science itself that has analysed (divided) the whole reality into the quasi-realities. Fortunately or unfortunately, however, natural science is not so highly successful in quantitative analyses and often successfully explains the complex reality in conceptual manners using experimental knowledge. Interface science is one good example. Now that social science is analysing the complex society to simple models, the natural scientific success for the complex reality may be informative for social science and useful for cross-disciplinary integration of natural and social investigations based on scientific treatment of complexity [e.g., Laszlo, 1988].

Interface science is an interdisciplinary science between physics, chemistry, meteorology, oceanology, engineering and others. It treats interfaces between two phases such as between gas and liquid phases, and interfaces between same phase with different properties such as between atmospheres of different temperatures. As many scientific theories have been discovered or created for ideally pure and homogeneous conditions in artificially controlled laboratories, they often fail to explain complex phenomena at interfaces. As regards complexity, the interface in nature shares similarity with that in society.

The society cannot be homogeneous. All of social or human relations are interfaces between different people, and all of social groups or organisations are heterogeneous. In this respect, social science may be regarded to treat interfaces. Social science is based on statistical way of thinking. Individuals are usually regarded as indistinguishable elements of a group (may be compared to elements of a set in mathematics or samples from a population in statistics). In this sense, individual persons in social science are analogical to cells, molecules or particles in natural science. In treating social relationship, social science shares a certain methodological similarity with interface science treating nature.



Interface science has been developed in various areas of physical chemistry such as smog [e.g., Friedlander, 1977], reactions at interfaces [e.g., Harrison, 1969], heterogeneous reactions [e.g., Shooter, 1969], adsorption or chemisorption [e.g., King and Woodruff, 1990], the growth of polymer particles in polymer solution [e.g., Kamiide, 1990] and antibody-antigen interactions [e.g., Macken and Perelson, 1985]. The inflation, the rise and collapse of stock prices have also been called the bubble, but their similarity has not been recognised. As its result, the President of the American Financial Association proposed to re-name the financial bubble as balloon [van Horne, 1985]. In contrast with the simple motion of balloon in air, however, the behaviour of bubble in liquid is as complex as social behaviours. For this reason, the theory of bubble may provide a start point to bridge between some of social and natural phenomena. This is a metaphor at first but may be useful in building operational models. Indeed, operational models themselves can be viewed as metaphors [Klein, 1994].

Preliminaries will be given in Sections II and III. A parallelism between nature and society will be presented in Sections IV and V in which subsections IV.x correspond to subsections V.x. In sequel, the words of equilibrium, stable, stationary or steady state are not used disjointly. These words may be replaced with the word "metastable" [Adamson, 1990] to denote equilibrium behaviours in certain aspects.

## II. NATURAL SCIENTIFIC APPROACH TO SOCIAL PHENOMENA

The parallelism between natural and social sciences may date back to classical philosophies. For example, Hegel's Logik is a parallelism between nature and society by the same dialectics. The parallelism sometimes misguides scientific investigation to the ignorance of empirical facts but in other time guides to the unification of theories. Among the transfer of natural scientific methods to social science, the financial study made one of the fastest growth in the last two decades. This generated a new field called mathematical finance or financial engineering.

The US government raised the interest rate to attract money from abroad to the US monetary market in the early 1980s. A number of new financial commodities were invented and were put on the market in the stalemate of technological innovation. This was called the financial innovation. Manufacturing firms shifted their resources from technological innovations to financial activities. The word "bubble" was used to denote a rapid inflation of amount of money in circulation and the rapid rise of prices with a risk of a rapid collapsibility. As many firms were concerned only with monetary prices for which the numerical data was readily available, the quantitative analysis was easy and useful to the firms. Supported by financial industries, new professional societies and journals of finance started. Many applied mathematicians joined this field and published many articles using mathematical tools.

In the mid 1980s, the US government demanded Japan to lower the interest rate in order to maintain the US interest rate higher than the Japanese one and thereby to continue to attract money to the US. After the gold standard system is gone, the currency is now free form the real materials, and its amount is largely determined by demand which largely depends on the interest rate in borrowing from the central bank (the Bank of Japan) under control of the government. As the central bank lowered the interest rate, a great amount of money was borrowed beyond the real supply of material commodities. This caused bubbles in Japan and raised the prices of commodities in general and the stock and land prices in particular. A lot of public land connected to National Railway stations were sold to private firms at high prices by the Ministry of Finance. Consequently, land adjacent to the sold land was priced very high on the land market. Expecting the rise of prices, speculators borrowed money at a low interest rate and purchased commodities such as land not for their own use but for selling on the land market after the price-rise. When land owners disagreed to sell the land to the speculators, mafia (specifically called the landprice raiser) threatened the owners and forced them to sell the land. Finally the National Tax Administration Agency and Tokyo Metropolitan Tax Offices joined the landprice raising in order to increase the tax revenue and to help mafia.

As the speculation is a kind of forecasting or information creation, this gambling business was called an information industry in the post-industrial society. This nice name and the high profitability attracted many information engineers and applied mathematicians. Many scientists and engineers moved from scientific R&D to the financial sector. They were engaged in the computerisation of financial business for the efficiency improvement of money games and in the analysis of prices of stocks, land and others by using the numerical data on computers with the aid of mathematical techniques. The bubble as the inflation of the total amount of money in circulation caused the rise of living cost and enlarged the income gap between the speculators and the rest or between the financial sector and the manufacturing sector. The public began to accuse the interest rate policy of the government, and the US government began to criticise the land price policy of the Japanese government in the end of the 1980s.



As last Japan raised the interest rate in 1989. This changed nothing in real terms because the purchased land and stocks of companies continued to exist. Only their prices were down in monetary terms. By definition of profit in the accounting system, only the speculators lost. As commercial banks had all joined the speculative money games, the banks also lost a lot. People left the collapsed stock market. Hence the manufacturing sector failed to procure money on the capital market and was forced to cut the investment, e.g., in R&D. First in the Japanese history, the industrial R&D expenditure decreased in the 1990s. The economic and technological recessions hit Japan. The collapse of bubble resulted in the incurable moral corruption among economists, information engineers and applied mathematicians.

Now a framework may be needed to explain why and how some fractions of the society were so deeply involved in the bubble against the rest of the society. As social science could not prevent the bubble, one must explore for the framework outside social science. Such exploration may be regarded as making an analogy or metaphor for the transfer of knowledge across different disciplines [van Gigch, 1991].

## III. SPECULATION AND SOCIAL INTERFACE

In Hegel's Logik, the word "speculation" had a good meaning of profound thinking in abstraction from the material word and hence not directly related with the dirty world. As modern science places the high value on real facts and formal logic, "speculation" began to carry a bad meaning of thinking without real evidence. While speculation used to denote thinking by individual philosophers isolated from social relation, the speculation in economics often denotes the purchase of commodities to sell after the price-rise. This word gives people an impression of immoral business to earn money by gamble without working and with no increase of material wealth. The word "investment" in the bubble denotes taking a chance of price-rise on the market in the near future without long term investment in production and is hence regarded as synonymous to speculation or zero-sum money game in that someone earns the exactly same amount of money as others lose. This notion of investment is opposite to "Protestant's ethics" of investment and to "the spirit of the capitalism" by Max Weber. For this reason, it is called the speculation in distinction from the classical notion of investment.

The commercial sector has been concerned with price variation and speculation. Partly for this reason, the commercial sector has been looked down especially in the Chinese Confucianism that ranked the merchant class at the between water and dirt. Dirt is thus detached from fabrics, adsorbed and aggregated at interface films of bubbles. Bubbles work as a catalyst in the aggregation of dirt. When clothes are dried without removing bubbles, concentrated dirt remains as stains at the surface of fabrics. Washing is to collect dispersed dirt from fabrics and to condense it in other places to survive there. Thus, dirt recycles itself via bubbles.

The floatation of metallic mineral collects mineral by bubble. The frothing agent makes bubbles, which collect foreign material such as mineral particles at the interface between water and bubbles. Mineral particles are hydrophobic and hence are not solved in water. So they tend to sink with soil under water but are adsorbed at the interface between water and bubbles by the interface electrification and rise to the water surface by the buoyancy of bubbles against the gravity, while soil is not adsorbed by the electrification and sinks.

## IV.5. Disequilibrium, interfacial tension and interfacial free energy

The greater number of molecules exist, the stronger is the inter-molecular attractive force such as the van der Waals force. Therefore the force is stronger in the inward direction of liquid than in the outward direction toward air because more molecules exist in liquid than in air. Consequently, the force is not balanced at the liquid-air interface. This imbalance causes excess energy, which appears as the interfacial free energy. The latter energy takes the form of interfacial tension that makes the liquid surface convex toward air in trying to minimise the surface area of the liquid. When bubbles exist in liquid, the total sum of the surface area of the liquid increases. As the interfacial tension of liquid tries to decrease the surface area, it works to break bubbles. When they are electrically charged, the phase boundary electric potential difference is generated. Then, for the balance of energy, the interfacial tension decreases and hence bubbles survive. Electrically charged, they attract or adsorb materials of the opposite charge.

The dispersion of bubbles or colloids plays dual functions. On one hand, as the dispersion proceeds, each bubble or colloid is divided to smaller ones. Therefore their number and hence the total sum of their surface areas increases. Thus the interfacial free energy increases. This distabilises the system. On the other hand, as the dispersion proceeds further to the molecule or cell dispersion in which bubbles (air) or colloids are "solved" to molecules, cells or micelles (micellar solution), the interfacial free energy decreases because the surface of bubbles or colloid particles and hence the interfacial tension then disappear. This stabilises the system.



## IV.6. Interfacial active agent

Soap or detergent decreases the interfacial free energy and, for a counter-balance of the decreased energy, increases other energy, which activates the interface. As a frothing agent, soap generates bubbles when it is solved in water (hydrolysis) and is ionised. For a counter-balance of the ionisation energy, the interfacial free energy decreases in the system of water and soap. This decreases the interfacial tension of water. The decreased interfacial tension helps activities at the interface and makes it easier for water to reach and contact dirt at the surface of fibre woven in clothes: soap is an interfacial active agent.

## IV.7. Suspension and emulsion with double layer

Small solid particles such as soil can be dispersed fairly well in liquid because they repulse each other for their electric charge. This state is called suspension. But, as particles are not solved but only suspended, the suspension cannot remain very long in the stable state. Hydrophobic colloids dispersed in water are slowly separated from water. But they remain well dispersed in water if hydrophilic colloids are added as a stabiliser to protect the former colloids.

When soap is ionised in water, its component (sodium stearate) gets both the hydrophilic radical and the hydrophobic-lipophilic radical. The former radical is well dispersed in water, and the latter adsorbs oily dirt and forms the adsorption layer. Oily dirt or lipid adsorbed by the hydrophobic-lipophilic radical is dispersed in water as protected by the hydrophilic radical. A similar state is seen for milk in which fat is dispersed in water in equilibrium (emulsification). Babies can digest milk because it is emulsified.

In the micellar solution, the foreign material is surrounded by molecules with both the hydrophilic (generally lyophilic) radical and the hydrophobic (generally, lyophobic) radical. As the amphiphilic radicals have the opposite electric charge, the interfacial boundary electric potential difference is generated and the adsorption forms the double layer. As the lyophilic radicals have the same electric charge (which is the opposite of the lyophobic radicals), the micelles have the same electric charge on the side of liquid. Therefore they repulse each other and are dispersed in the liquid. So the micellar solution is stable.

## IV.8. Heterogeneous contact reaction and corrosion

The intermolecular force is much weaker than the newtonian force at a distance and hence works when molecules closely contact each other. Whereas the classical dynamics such as the celestical dynamics is a theory of action between material points at a distance, bubbles are products of contact reaction at interface. As the interfacial electric potential difference is generated at interface, the interfacial free energy, hence the interfacial tension, decreases to counter-balance the generated electric energy. This stabilises the dispersion of bubbles.

Clouds and smog are aerial disperse systems of colloids called the aerosols. The thunder is the electric discharge of interfacial electric potential difference when warm and cold atmospheres contact. The rust or corrosion of metals is a product of contact reaction at the water-metal interface. The rust corrodes the metallic bond by bounding the free electron of metal to diminish free energy.

Disperse systems such as milk and clouds are opaque even if the dispersion media such as water or air are transparent. This is because light is scattered at the interface between different substances (i.e., between the dispersion medium and the dispersion phase). Similarly, the disperse system scarcely conducts heat and sound. For example, the glass-foam is used for heat and noise insulation because glass-foam or bubble interface scarcely conducts them.

## V. TOWARD A THEORY OF SOCIAL INTERFACE

The discussions in Section IV indicate that the concepts of bubble, interface, heterogeneous contact reaction and disperse system jointly explain many natural phenomena across disciplines. They may also explain social phenomena because the society is heterogeneous where different races, classes, ethnic groups and interest groups are dispersed and contact or react each other at the interface.

### V.1. Generation of bubble and interfacial tension in open social systems

Financial bubbles are generated when speculators with excess money raise the price of commodities. When the government makes financial policies, it cannot predict their behaviour because they always try to defeat governmental policies. In this sense, the speculation is regarded as a disturbance from outside of the financial policy formation system. As speculators always exist in the free market system, the financial system is open to disturbance.

Usually, social members are coherent and cooperative each other by the mutual attraction with the cultural bond, whereas speculators are away from the bond and foreign in the society. The intense tension is generated at the interface between speculators and the rest of the society as prices rise. The coalescence of speculators decreases the interfacial tension and raises the prices further. Although paradoxical, this seems to be believed by financial mathematicians as if they knew, as a mathematical fact, that the coalescence of bubbles diminishes the total sum of interfacial tension of bubbles by decreasing the ratio of the total sum of surface areas to the total sum of volumes of bubbles. This is consistent with an empirical law that the large lie is more believed than the little one.



### V.2. Inflation and distortion of bubble

A natural law that bubbles inflate as they rise in water is also a law in finance. Financial engineers program to automatically buy stocks when the prices rise against the Adam Smith's law that the price-rise lowers the demand. Financial engineers believe a process: The price-rise attracts speculators, who distribute a rumour of another price-rise to attracts other speculators. Thus, bubbles generate bubbles as in an auto-catalytic reaction that a lie needs another lie.

The rumour is to distort the reality. With the inflation of bubble, the reality is more distorted. When the ship-building industry declined in the 1980s in Japan, speculators dispersed a rumour that firms in this sector were planning to convert their factories on the sea-shore to marine sports facilities. As its effect, the stock prices of these firms rised. Following the decline of this industry, the steel and chemical industries declined. As their factories were also located on the sea-shore for the convenience in shipping of their heavy materials and products and for the drainage and the discharge of used water, speculators repeated the same rumour. Since these industries were the major ones in Japan, their factories were quite numerous. Therefore, the over-supply of marine sports facilities was certainly predicted if their factories were all converted. However, speculators continued to distort the reality and the stock prices of all firms in the declining industries continued to rise in the second half of the 1980s. The inflation of bubble was accompanied with information distortion. The distorted information is dispersed on the financial market via the invisible network of speculators. Although they are independent each other and plan no cooperation, they form an implicit coalition in a "cooperative game" because they have the same objective to profit from the price-rise.

### V.3. Stability of bubble as interface reaction in heterogeneous system

With the above-stated information distortion of bubble, prices continued to rise above the reasonable ones. This was because software developed by financial engineers continued to buy stocks as far as the prices rose. They made software as if they knew a natural law that bubbles continue to rise even after they reach the water surface because new bubbles come up and push up old ones. Such a stability of bubbles above the reasonable level is possible in a society with speculators as foreign components. Financial engineers developed software as if they knew a natural law that bubbles are stable in contaminated water. This natural law on the generation and stability of bubble in contaminated water also holds for phenomena in heterogeneous societies. The stability of bubble on the financial market also depends on the persistence of speculators' activity. As both the government and speculators persist their respective interest, the financial market becomes viscous. The "law" that heterogeneous systems are viscous hold both for nature and finance.

### V.4. Aggregation or adsorption in heterogeneous system

The higher the prices are, the more strongly the financial market attracts speculators. Bubbles attract or collect speculators who are foreign and alienated from the society. Speculators themselves are not intentionally cooperative but they are attracted to the same market as if in a coalition of a game, because of the affinity of their same behaviour as regards money.

The affinity attracts, collects or adsorbs speculators to an unintentionally aggregated coalition in the zero-sum money game. On one hand, the aggregation unites and strengthens them on the financial market. On the other hand, however, it weakens the freedom of wild power of each speculator as in a natural law that the aggregation diminishes the free energy. Thus, the system is stabilised with the price above the reasonable one as was evidenced on the land market in the post-oil crisis recession in Japan.

### V.5. Imbalance of power, border tension and free energy

Free energy is generated at the border to balance the centripetal or intranational attractive force. With the centripetal force, the border spans outward as the free energy takes the form of border tension. These natural laws also hold for social or international relations. The stronger the national unifying attraction is, the more energy is generated and the more extensively the national border inflates outward. A nation united with stronger centripetal force advances to other's territory by stronger centrifugal force.

### V.6. Interfacial active agent

Different social groups or competing coalitions are often closed to each other and lack communication through interface between them. Poor communication often leads to hatred and conflict. For the resolution of conflict, it is needed to promote communication through interface between them. Then, communication mediators or osmosis agents are needed, who penetrate through interface into opposing groups and thus activate communication. As the theories of meta-game [Howard, 1971] and hyper-game [Fraser and Hipel, 1984] demonstrate, the most serious type of antagonistic conflicts (the prisoners dilemma) could be resolved by communication between "prisoners" through prison's walls via reliable mediators.



Many social systems institutionalise mediators as the press, the judicial court, peace activity agents such as the United Nations, which can contact both parties for communication, bring them to the negotiation and harmonise them.

### V.7. Suspension and double character for stable dispersion

Aliens are sometimes concentrated in a particular "ghetto", inside of which peace is well kept, although they may have a conflict with the outside. In other time they are well dispersed in a society and peace is then kept at least at surface appearance because of the weakness of divided power of the aliens as a minority. As they may not be really mixed or harmonised with the rest of the society, this may not be a real solution but merely a suspension. National or international peace is often a suspension in which weak powers are dispersed. The state of suspension is not a real solution but easily shifts to a conflict.

When the mediator is affined both to opposing or phobic groups, it contacts and adsorbs them. Thus, the mediator has a double character to be friendly or philic to the both (amphiphilic). When this double character is established in a society, conflicts are solved in a stable way.

### V.8. Heterogeneous contact reaction and corrosion

At a macroscopic level, the national spirit is effective in unifying people. At intra-regional or intra-organisational levels, however, people often react more sensitively to the interpersonal close contact than to the national power. This strengthens the bond of minority, within which the tension is relaxed. Such a strong bond tenses the unity and hence often tenses a conflict with the majority. The strongly bonded unit can disperse its members among the majority against the rule of the latter. The bond inside the minority that binds the freedom of the members corrodes the bond of the whole society.

Rulers often try to divide and disperse minority among majority. But such a dispersed system may be difficult to control because the dispersed minority is invisible like the guerrilla in civil war. Therefore the ruling majority often governs the minority by adsorbing it in concentration camps. City or regional planning often reserves "ghetto" for "dirty" business or "contaminated" and hence contemned people. The minority sometimes reacts to the given plan and "corrects" their original character to assimilate itself to the majority and to be absorbed in the latter like the chemisorption but, in other time, is merely collected in reservation camps and is deprived of freedom and activity energy.

A heterogeneous society with conflict between groups is often not transparent but opaque despite or because of activity of mass-media which often scatter biased information and scarcely convey the truth through the interface between them.

## VI. INTEGRATED CONCEPT OF INTERFACE SCIENCE

At the historically young stage, modern science was concerned with the simplification of nature and thereby successfully developed simple mathematical theories. These results are taught as a major part of science at school. This gives a strong impact on social scientists who admire the natural scientific method as the model. They often consider national economy as a homogeneous system with no conflict but competition or international economy as a system with a few nations connected via a line or via a trade channel. However, the real economic system has many conflicting components connected by interfaces rather than by a linear channel.

Natural science is recently more concerned with complex systems than in the past. Interface science is one example. An ironical statement may be claimed that natural science is now more concerned with complex systems than social science. Social science, which has learned the simplification from natural science, may learn the complexification from the latter. The parallelism or metaphor presented above may be useful for the methodological transfer across sciences.

The bubbles chamber invented by Glaser in 1952 contains over-heated liquid without foreign material. Then the nucleation and the evaporation do not occur and no bubble is generated. When a charged particle passes through the chamber, liquid molecules hit by it get energy from it. This generates bubbles along its trajectory. Earlier, the cloud chamber was invented by Wilson in 1897. This contains over-saturated gas without foreign material. When a charged particle enters it, the liquefaction takes place and cloud is generated along its trajectory. If foreign materials are contained, bubbles or cloud are



generated without entering particle. A variety of experiments can be designed with heat, pressure, contained liquid or gas, entering particle, shape and material of chamber and foreign material as control parameters. If the parameters are given social interpretations, the experiments provide analogical information for social interface. The chambers (and other simulators for bubble or cloud) are artificial but their phenomena may be complex enough for social analog simulation.

## VII. CONCLUSION

A parallelism is presented between natural and social phenomena of heterogeneity and dispersion in general and interface and bubble in particular. This may provide a metaphor which transfers empirically verified knowledge of interface in nature to the investigation of interface in society. Seemingly strange events in finance and politics such as the stability of high price of stocks above the real value and the concentration of minority are expressed by a "universal language". This may lead to a unification of natural and social sciences by empirical approaches a half century after the decline of the logico-mathematical method for unified science by Russell, Carnap and others.

### Acknowledgement

The author heartily thanks Professors Emeritus K. Tokumaru (University of Tsukuba), T. Ochiai (Ochanomizu University) and I. Mita (the University of Tokyo), all in chemistry, for their warm encouragement and severe criticism on the earlier draft of this paper.

### References

A. W. ADAMSON, Physical Chemistry of Surfaces, 5th edition, Wiley, New York, 1990.

I. D. CLARK and R. P. WAYNE, The theory of elementary reactions in solution, In (C. H. Bamford and C. F. H. Tipper eds), The Theory of Kinetics, Elsevier, Amsterdam, pp. 302-376, 1969.

N. M. FRASER and K. W. HIPEL, Conflict Analysis, Model and Resolutions, North-Holland, Amsterdam, 1984.

S. K. FRIEDLANDER, Smoke, Dust and Haze, Wiley, New York, 1977.

L. G. HARRISON, The theory of solid phase kinetics, In (C. H. Bamford and C. F. H. Tipper eds), The Theory of Kinetics, Elsevier, Amsterdam, pp. 377-462, 1969.

N. HOWARD, Paradoxes of Rationality, MIT Press, Cambridge, Mass, 1971.

K. KAMIIDE, Thermodynamics of Polymer Solutions, Elsevier, Amsterdam, 1990.

D. A. KING and D. P. Woodruff, Chemisorption Systems, Elsevier, Amsterdam, 1990.

J. H. KLEIN, Cognitive processes and operational research, Journal of the Operational Research Society, *45*, pp. 855-866, 1994.

V. N. KONDRATIEV, Chain reactions, In (C. H. Bamford and C. F.H. Tipper eds), The Theory of Kinetics, Elsevier, Amsterdam, pp. 81-188, 1969.

E. LASZLO, Evolutionary dynamics in nature and society. *Revue International de Systémique*, *2*, pp. 109-121, 1988.

C. A. MACKEN and A. S. PERELSON, Branching Processes Applied to Cell Surface Aggregation Phenomena, Springer, Berlin, 1985.

D. SHOOTER, Experimental methods for the study of heterogeneous reactions, In (C. H. Bamford and C. F. H. Tipper eds), The Practice of Kinetics, Elsevier, Amsterdam, pp. 180-278, 1969.

J. P. VAN GIGCH, System Design Modeling and Metamodeling, Plenum, New York, 1991.

J. C. VAN HORNE, Of financial innovations and excesses, *The Journal of Finance, XL*, pp. 621-631, 1985.

R. P. WAYNE, The theory of the kinetics of elementary gas phase reactions, In (C. H. Bamford and C. F. H. Tipper eds), The Theory of Kinetics, Elsevier, Amsterdam, pp. 189-301, 1969.



REVUE INTERNATIONALE DE SYSTÉMIQUE
Vol. 12, N° 2, 1998, pp. 177 à 201

# QUELLE RELATION POSSIBLE ENTRE NIVEAU D'ASPIRATION SATISFAISANT ET POINT FOCAL ?

Paul BOUVIER-PATRON [1]

Résumé
Le projet développé dans cet article vise à présenter la rationalité procédurale de Simon dans le but d'en tirer quelques enseignements pour aborder la question de la coordination et interpréter le point focal de Schelling comme niveau d'aspiration satisfaisant ou « satisficing ».
Le point de vue répandu en sciences économiques est de supposer que les individus sont des êtres qui maximisent et qui sont coordonnés par des prix via le marché sans donc tenir compte des relations spécifiques qui existent entre acteurs économiques. Ces relations spécifiques sont basées sur la négociation. La question de la négociation est traitée habituellement en recourant à la théorie des jeux, laquelle s'appuie sur le principe de Cournot de la maximisation « chacun de son côté ».
H. Simon conteste le cadre fictif de cette représentation où les individus sont des maximisateurs et insiste sur le fait que la rationalité des acteurs réels est limitée. Ceci conduit à prendre en compte la rationalité procédurale : compte tenu de l'impossibilité des individus de découvrir toutes les alternatives de choix à leur disposition ainsi que les conséquences de ces différents choix, s'impose la nécessité de rechercher et d'élaborer des procédures pour prendre des décisions (le but des décisions étant d'atteindre un « satisficing »). Cette façon de voir peut être étendue à la question de la négociation entre individus qui vont rechercher ensemble un « satisficing » collectif (par confrontation des règles individuelles et élaboration de règles collectives). Le compromis obtenu n'est pas un optimum mais un point de « rendez-vous », autrement dit un point focal selon Schelling : le point focal est accessible grâce à un savoir commun partagé entre les acteurs. L'idée défendue ici est que le point focal de Schelling est équivalent au « satisficing » de Simon. Néanmoins, le point focal est traditionnellement représenté, au sein de la théorie des jeux, comme un équilibre Cournot-Nash d'un jeu particulier.

Mots clefs : Coordination, Négociation, Point Focal, Rationalité Procédurale

1. Au moment de la rédaction de cet article en 1995, l'auteur était Research Fellow à l'université de Southampton (UK).

Rev. intern. systémique. 0980-1472 Vol. 12/98/02/ $ 7.00/© Afcet Gauthier-Villars