Cliophysics: A scientific analysis of recurrent historical events

Yuji Aruka¹, Belal Baaquie², Xiaosong Chen³, Zengru Di⁴, Beomjun Kim⁵, Peter Richmond⁶, Bertrand M. Roehner⁷, Qing-hai Wang⁸, Yang Yang⁹

Version of 5 December 2021

Key-words: Experimental physics, historical events, comparative analysis

1: Institute of Economic Research, Chuo University, Tokyo, Japan. Email: aruka@tamacc.chuo-u.ac.jp
2: INCEIF (International Centre for Education in Islamic Finance), The Global University of Islamic Finance, Lorong Universiti A, 59100, Kuala Lumpur, Malaysia. Email: belalbaaquie@gmail.com
3: School of Systems Science, Beijing Normal University, China. Email: chenxs@bnu.edu.cn
4: School of Systems Science, Beijing Normal University, China. Email: zdi@bnu.edu.cn
5: Physics Department, Sungkyunkkwan University, Seoul, South Korea. Email: beomjun@skku.edu
6: School of Physics, Trinity College Dublin, Ireland. Email: peter-richmond@ymail.com
7: Institute for Theoretical and High Energy Physics (LPTHE), Pierre and Marie Curie campus, Sorbonne University, National Center for Scientific Research (CNRS), Paris, France. Email: roehner@lpthe.jussieu.fr
8: Department of Physics, National University of Singapore, Singapore. Email: qhwang@nus.edu.sg
9: Astrophysics Department, Beijing Normal University, China. Email: 757103802@qq.com
Abstract
Named after Clio, the Greek goddess of history, cliophysics is a daughter (and in a sense an extension) of econophysics. Like econophysics it relies on the methodology of experimental physics. Its purpose is to conduct a scientific analysis of historical events. Such events can be of sociological, political or economic nature. In this last case cliophysics would coincide with econophysics.

The main difference between cliophysics and econophysics is that the description of historical events may be qualitative as well as quantitative. For the handling of qualitative accounts cliophysics has developed an approach based on the identification of patterns. To detect a pattern the main challenge is to break the “noise barrier”. The very existence of patterns is what makes cliophysics possible and ensures its success. Briefly stated, once a pattern is detected, it allows predictions to be made. As the capacity to make successful predictions is the hallmark of any science, it becomes easy to decide whether or not the claim made in the title of the paper is indeed fulfilled.

A number of examples of clusters of similar events will be given which should convince readers that historical events can be simplified almost at will very much as in physics. One should not forget that physical effects are also subject to the environment. For instance, if tried at the equator, the experiment of the Foucault pendulum will fail.

In the last part of the paper, we describe cliophysical investigations conducted over the past decades; they make us confident that cliophysics can be a valuable tool for decision makers.
Introduction

Objectives
In this paper we will try to convince our readers that it is possible to analyze recurrent historical events scientifically. It will be seen that this is a natural extension of physics and econophysics. Historical phenomena are characterized by high levels of background noise (in a sense defined more precisely later on) but nonetheless it is possible to find regularities and patterns. This is our first objective. Mathematical models may come later. Regularities and patterns already give predictions and conjectures that can be tested, which is the distinctive trait of science. This lecture will be really successful if it leads those of our readers who have an interest in history as well as in science to try this approach by themselves. A kind of “training-ground” is proposed in appendix A.

Recurrent events in physics
At first sight the objective of the paper may seem overly ambitious but one should observe that the title does not promise a scientific analysis of history in a general way. It focuses on recurrent events that is to say historical events which repeat themselves in similar form. It is well known that in science reproducibility is a key requirement. It may be objected that historical episodes do never repeat themselves exactly in same form. But neither do physics experiments. As already mentioned in the abstract, if one tries the experiment of the Foucault pendulum in Singapore it will fail\(^1\). In other words, it means that in this experiment the pendulum cannot be considered as a closed system. It is subject to an exogenous factor which cannot be eliminated. Needless to say, subatomic phenomena will be even more affected by exogenous factors. In a sense head-on collisions of protons in an accelerator occur in many different ways. In such cases, in order to ensure reproducibility, large numbers of collisions must be recorded and their outcomes classified in diverse groups of reactions.

Table 1 shows that in its historical development physics was firstly successful in the study of phenomena in which the background noise is almost nil. The refraction of light, the orbits of planets are subject to very little exogenous factors. For such phenomena measurement errors are the only source of variability, and this is a factor which can be gradually reduced as measurements become more accurate. Table 1 does not list all fields of physics; for instance, crystallography, electromagnetism and a number of others are omitted. It focuses mostly on fields of physics

---

\(^1\)At the North Pole the oscillation plane of the pendulum will be seen to make a full 360 degree rotation in 24 hours, in Europe it would take some 35 hours and in Singapore it would take an infinite length of time, meaning that the oscillation plane will not rotate at all.
Table 1 The development of physics consisted in identifying patterns among increasing levels of noise

| Field of physics | Keywords (topics)                                      | Keywords (researchers)            |
|------------------|--------------------------------------------------------|-----------------------------------|
| Optics           | refraction, rainbow explanation, telescope             | Descartes, Galileo, Leeuwenhoek   |
| Astronomy        | Kepler’s laws, gravitational attraction                | Tycho Brahe, Kepler, Newton       |
| Mechanics        | pendulum, orbits of planets                            | Huyghens, Le Verrier,             |
| Thermodynamics   | Second principle, ideal gas                            | Carnot, Clausius, Joule           |
| Statistical mechanics | many particles, entropy                               | Boltzmann, Maxwell                |
| Hydrodynamics    | Reynold’s number, turbulence                           | Reynolds, Prandtle, Navier        |
| Quantum mechanics| energy levels, uncertainty principle                    | Planck, Heisenberg, de Broglie    |
| Chaotic systems  | bifurcation, attractor,                                | Prigogine, Feigenbaum             |
| Econophysics     | stable laws, predictive economics                      | Pareto, Mandelbrot, Stanley       |
| Cliophysics      | recurrent historical events                            | Work in progress                   |

Notes: The objective of this timeline is to emphasize the critical role of the background noise. In the earliest systems investigated with success there was hardly any background noise (if one excepts the noise due to measurement errors). On the contrary, hydrodynamic systems are affected by turbulence which is a random phenomenon and quantum or chaotic systems are defined in terms of probability which means that any measurement requires a great number of events.

Fig.1 Historical development of physics. The first successes of modern physics (that is to say not including progress made in ancient Greece) concerned phenomena in which there was almost no background noise. In contrast, hydrodynamical phenomena are affected by turbulence, subatomic phenomena are subject to basic quantum uncertainty, chaotic phenomena are very sensitive to initial conditions which is referred to as the butterfly effect.

which were developed in the 20th and 21st centuries. In hydrodynamics, quantum physics and chaotic systems there is a high level of background noise, that is to say exogenous, random factors. This may come to the point, for instance in percolation effects, that sometimes it is unclear whether or not an effect is reproducible.

The spirit of physics

All too often the approach of physics is reduced to its mathematical formalism. This conception has become prevalent particularly since 1900. However, the spirit of physics can also teach us important lessons for how to conduct experimental investigations.

The first lesson, namely the reduction of the background noise was already mentioned in the previous subsection.

The second lesson is the simplicity requirement. Instead of a ball rolling on a wooden plank, Galileo could have studied the trajectory of cannon projectiles. That would probably have raised the interest of his sponsors, but the attempt would have ended in failure for the obvious reason that this problem is much more difficult.

Is it possible to consider simple cliophysics “experiments”? We think so.
Let us consider the case of a pendulum. This is also a topic in which Galileo was interested. More precisely, he studied the period of a pendulum that is now called a simple pendulum. It is a pendulum which moves in a steady vertical plane. However, a spherical pendulum has at least half a dozen different movements: the Puiseux effect, the Foucault effect, the added mass effect, and so on. If all these movements are allowed to occur simultaneously, the movement becomes complicated to the point of defying any modeling attempt. How could physicists overcome this obstacle? The answer is simple.

For each of the different effects they designed a specific experiment which eliminated all other effects except the one they wanted to consider. For instance, to observe the Foucault effect it is well known that one should use a very long pendulum (50m or more) for otherwise the Puiseux effect will interfere with the Foucault effect and will lead to fairly random measurements. In the same spirit to observe the added-mass effect one should use a pendulum which moves in water rather than in air for otherwise the added-mass effect will be too small compared to other effects.

Can we use the same approach for social and historical phenomena? We believe so. The challenge is to select the events in which the effect that we wish to observe appears most clearly. How to do that will be explained in the next subsections.

Firstly, we explain how the background noise can be reduced. Secondly, it will be explained on an example how to generate events which can be defined by only 2 or 3 parameters.

**Recurrent events in history**

We face the same difficulty as in physics in the sense that each of the episodes will be subject to diverse exogenous factors in the form of background noise. Our clusters of similar events may include episodes taking place in different environments (e.g. various countries and centuries) which may translate into fairly high background noise. How can we overcome such a serious obstacle?

Clearly, we should follow the example of physics. Instead of trying to study the fairly complex episodes which interest historians (e.g. the American Revolution or the French Revolution of 1789) we should focus on very simple and basic cases in which there is little background noise. We will list a number of cases of that sort in a short moment.

It is almost certain that historians may find such cases weird and uninteresting but this should not stop us. After all, in the time of Tycho Brahe and Kepler very few people found any interest in their accurate measurements. The field was dominated
by astrologers for whom the accuracy of existing tables was sufficient.

We should completely put aside any anthropocentric attempts to understand human behavior in the way practised by historians. We should perform basic measurements of simple effects. Little by little, through the magic of cross-fertilization, our understanding will expand. At first sight it was not obvious that the study of the refraction of light may help us to understand the rainbow phenomenon, but nevertheless this is what happened.

It is at this point that the role of physicists, and particularly of econophysicists, will be crucial. Now that it is fairly clear that historians will neither approve nor be interested in cliophysics, the only way this field may develop is through the cooperation of physicists; in this term we include physical chemists, astrophysicists and also laymen with a taste for experimental investigation.

**Historical episodes suitable for cliophysical investigation**

**Overall view**

As emphasized above we must focus on episodes with as little background noise as possible. In this section we mention two categories of cases.

- Cases in which similarity in objectives and agents ensures a relative uniformity and low variability. The cases listed in Table 2 are of that kind.

However, when considered across nations and various time periods, the events listed in Table 2 involve a sizeable number of parameters. In other words they are certainly less simple than the free fall experiments performed by Galileo.

- Just in order to show that one can find recurrent events which depend upon even less parameters than those in Table 2, we introduce the set of events listed in Table 3. We call them extremely simple events; they are of the same degree of simplicity as Galileo’s free fall experiments. At first sight they may appear somewhat weird. The important point is that they depend upon only 3 well defined yes–no parameters. It will be seen that despite their extreme simplicity, it is nevertheless possible to draw some meaningful conclusions from their comparison.

**Requirements for extremely simple events**

Events well suited for comparative analysis must be as simple as possible (i.e. involve only few parameters) and in addition they should satisfy the following requirements.

- The most important condition is that these events must be well documented in all their aspects for otherwise any comparative analysis would be impossible. This

---

2 It should be remembered that Kepler himself was the official astrologer of the emperor of the Holy Roman Empire.
Table 2 Examples of low noise events

| Event                                    | Number of cases | Example                              |
|------------------------------------------|-----------------|--------------------------------------|
| 1  Peasants’ revolt                      | ~ 300           | Wat Tyler revolt, England, 1381)      |
| 2  Major mushroom strike                 | ~ 20            | France, May 1968                      |
| 3  General strike planned by union       | ~ 20            | Switzerland, November 1918           |
| 4  Rejection riot                        | ~ 50            | Tulsa, Oklahoma, 1921                |
| 5  Protest riot                          | ~ 100           | Detroit, Michigan 1969               |
| 6  Massacre of peaceful demonstrators    | ~ 50            | St Petersburg, January 1905          |
| 7  Mutiny on land                        | ~ 50            | Pennsylvania Line mutiny, 1783       |
| 8  Mutiny on ship                        | ~ 20            | Hermione mutiny (Royal Navy ship, 1797) |
| 9  Prison riot                           | ~ 100           | Attica prison, New York State, Sep 1971 |

Notes: Note the distinction between “mushroom strikes” which are fairly spontaneous movements by grassroot workers (closely analyzed in Roehner and Syme 2002) and general strikes organized by unions. Note also the distinction between rejection and protest riots. The former are aimed against a minority group which is not accepted by the residents. A protest riot is directed against the state. Some riots have a mixed status; for instance, the Gordon riots in London (1780) were anti-Catholic but were also directed against the government who had passed a law which restored some of the rights of the Catholic minority. Some of the events listed above (particularly 2,3,4) have been studied in Roehner and Syme (2002). The number of cases are understood to be at worldwide level but, needless to say, these numbers give merely orders of magnitude.

means that they should attract sufficient attention from contemporaries to receive detailed accounts.

- These events should not be limited to a specific country but exist everywhere so as to allow comparison between various countries and time periods.

So far, the only events we have found that conform to these requirements concern the execution of renowned dignitaries. We beg our readers to pardon the recourse to such macabre cases. Actually, there is probably a logic in this, in the sense that it is precisely because such events are gruesome that they impressed contemporaries and were duly recorded. Naturally, that is all the more true when the executed persons are kings, queens or other well known dignitaries.

Another virtue of this example is to press on the idea that, as was strongly emphasized by sociologist Emile Durkheim (1894), we should completely drop our anthropomorphic vision. What matters here is not whether the topic is macabre or not, but whether the cases are simple and well documented.

Protocol of execution of dignitaries

Table 3 gives several examples of executions of renowned persons. What can be the interest of such a list?

The key-point is this.

If considered individually (i.e. without any mention of parallel executions) they do
not raise any question. We can just accept each description as a unique event. This makes it impossible to gain any understanding.

In contrast, their comparison brings about several questions.

Many accounts have been devoted to the life of Mary Stuart, Queen of Scots and her trial during the reign of Queen Elizabeth I. However, little attention has been given to how she was executed.

### Table 3 Pattern versus variability in the execution of dignitaries

| Victim             | Year | Status | Axe or Sword | Head displayed | Head exposed | Hand cut |
|--------------------|------|--------|--------------|----------------|--------------|----------|
| Marcus Cicero      | −43  | Consul | S            | no             | yes          | yes      |
| Anne Boleyn        | 1536 | Queen  | S            | ?              | no           | no       |
| Catherine Howard   | 1542 | King’s wife | A | ?              | no           | no       |
| Jane Parker        | 1542 | ?      | A-S          | ?              | no           | no       |
| Mary Stuart        | 1587 | Queen  | A            | yes            | no           | no       |
| Charles I          | 1649 | King   | A            | yes            | no           | no       |
| Oliver Cromwell    | 1661 | Count  | S            | yes            | yes          | yes      |
| Johann Struensee   | 1772 | Count  | A            | yes            | yes          | yes      |

Notes: From Cicero to Struensee the protocol of the execution was almost identical and served the same objective, namely to destroy a once powerful political leader. Whereas in the case of Oliver Cromwell the objective was also the same, the method was fairly different because in 1661 Cromwell was already dead which means that it was a posthumous execution. His body had to be exhumed from Westminster Abbey. Subsequently to his beheading his body was cut into pieces and his head was displayed on a pole on the roof of Westminster Hall until 1685. In the case of Jane Parker (who was the wife of the brother of Anne Boleyn) the two sources we have found (one in French, the other in English) give conflicting information, hence the S–A mark. Head displayed means that the head was shown by the executioner to the public. Head exposed means that instead of being buried the head was displayed in a public place. Thus, Cicero’s head and hand were displayed in the Forum. Note that Cicero was not tried but simply blacklisted by his political opponents. Blacklisted persons could be killed by anybody.

Sources: Fraser (1969) and biographical articles of Wikipedia.

---

**Fig.2:** A key-feature in the execution of queens, kings and other high dignitaries was to show their head to the population. Historical records attest that the executioner was specifically instructed to show the head while spelling out the reason of the execution (e.g. “this is the head of a traitor”). Such events are particularly suited for comparative analysis because their close similarity allows us to focus on slight differences.

In the case of Anne Boylen one can mention the following observations.
• Anne Boleyn was the second wife of King Henry VIII. A recently discovered historical record (Alberge 2020) shows that Henry VIII planned every detail of her beheading.

• If one excludes the dubious case of Jane Parker, Anne Boleyn was the only person in our list who was beheaded with a sword. Some historians argued that among all persons executed during the reign of Henry VIII her case was unique. Clearly this is a point which is difficult to prove because we do not have detailed information about the numerous executions which occurred. At least it can be said that in a sense her execution was set up with “special regard”.

More could be said about Table 1 but we will limit ourselves to only one additional comment. It concerns the case of Count Struensee in Denmark. As Prime Minister he was an adept of the Enlightening and he was also the lover of the queen. Before being beheaded he had his right hand cut off. Interpreting this as special cruelty would certainly be a misconception for the case of Marcus Cicero shows that this custom also existed in the Roman Republic. It is well known that in the 18th century ancient Rome was still a model. This was particularly true for Roman law and classical architecture.

**Fate of vanquished enemies and traitors**

Beheading vanquished enemies or traitors has been practised worldwide from ancient times to the 21st century. Many specific historical cases are cited in Roehner (2007, p.56-57). The judicial executions of dignitaries considered above should be seen as a formalized subset of a much broader tradition. Ignorance of this tradition will lead to the misunderstanding of many historical occurrences. Here are three examples.

• On the South Bank of the London Bridge there is a tower called Bridge Gate which has a flat top. On this place, from 1300 to 1678, there were dozens of heads of traitors (including those of Thomas More and bishop John Fisher) spiked on poles. After 1678 they were moved to Temple Bar. For better preservation the heads were dipped in tar.

• After his victory in Sudan against the Mahdists at the battle of Omdurma (2 September 1898) English Major-General Kitchener (he would become Lord Kitchener only in 1914) had the body of the Mahdi exhumed and his head sent to Cairo.

• After the Bastille was taken by the people in the early days of the French Revolution the head of governor de Launay was paraded at the top of a pole. Although a familiar image of the Revolution it is not in the least specific to this event. In fact this was a well established usage. Naturally, historians whose interest is narrowly focused on the Revolution may not know that, and therefore cannot understand the

---

3 After the “Pilgrimage of Grace” which was a Catholic uprising, some 200 noblemen were executed.
4 The victory was made possible because in the confrontation the troops sided with the insurgents.
real significance.

By capturing attention this image may distract historians from aspects which were more specific to the Revolution. One of these aspects is the important fact that the insurgents had weapons. As a matter of fact, the main reason for attacking the Bastille was to take the powder and guns that were stored in the fort. This is well attested by the fact that de Launay was asked to deliver the stored weapons and it is only on his refusal that hostilities started.

It is only through comparison with other cases that one comes to realize that it was not common for insurgents to be in possession of guns and even cannons. A comparison with the Gordon riots of June 1780 in London is quite revealing. Rudé (1955, 1964) describes the rioters as being armed with “bludgeons, crowbars and chisels”. Nevertheless and quite surprisingly, they were able to take several of the main prisons, e.g. Newgate, Fleet prison, King’s Bench prison, New Goal prison. Why did the rioters not attack armuries, naval stores and other places where they would find arms?

The Gordon riot was not an isolated case. The “John Wilkes riot” of 10 May 1768 saw the gathering of 15,000 demonstrators, all unarmed.

In short, neglect of comparative analysis of the kind promoted by cliophysics will result for historians in serious pitfalls: e.g. failure to rightly interpret head spiking or blindness to the fact that the Parisian insurgents were armed (which was mainly due to the fact that the National Guard was on their side).

In the same line of thought, let us briefly mention another case in which lack of a comparative perspective led historians, and particularly French historians, to misjudgements. It concerns religious tolerance in France. As one knows, after several decades of civil wars between Catholics and Protestants, in 1588 the Edict of Nantes opened a path of secularism and tolerance. Naturally French Republican historians warmly approved King Henry IV for signing this edict.

However, being focused on France, they do not realize that this edict was an anomaly in Europe. All other European powers (Britain, Germany, Poland, Spain, Sweden) had introduced laws favoring religious uniformity. The mildest of such laws closed access to state employment to members of the religious minority. There were many other laws which were more severe.

Moreover, in 1618, i.e. three decades after the introduction of the Edict of Nantes, started the “Thirty Year War” which opposed Catholics and Protestants in Germany and was one of the most destructive European conflicts, at least before the world wars.

Then, in 1685 the Edict of Fontanebleau revoked the Edict of Nantes. Needless to
say, the revocation raised strong disapproval among French historians. Yet, at this time, intolerance was still the most common attitude in all nations; e.g. the Quakers were not allowed in Puritan Massachusetts under the threat of death.

What we wish to emphasize is that disapproval is an anthropomorphic attitude which leads historians to misjudgements. The best antidote is the comparative perspective promoted by cliophysics.

**Testing cliophysical models**

The hallmark of scientific analysis consists in the successful testing of laws. These laws, we will argue here, can be quantitative as is usually the case in physics but can also be qualitative as will often be the case in cliophysics. Qualitative laws state that, under a number of specific conditions, one shall observe a given effect. In quantitative laws one will in addition be able to predict the magnitude of this effect.

In this section we will explain how comparative analysis naturally leads to qualitative predictions and how such predictions can be tested. Firstly, in order to become more familiar with this method we show how it can be used in physics.

**How to use the comparative approach in physics?**

Suppose you are living in the time of Galileo (1564–1642) and Descartes (1596–1650) and you ask yourself what are the forces involved in the phenomenon of free fall. A first idea is to try Galileo’s method of dropping balls of different sizes and densities from the tower of Pisa. However, with the poor means of observation available in that time, this method did not work very well.

Another approach is to try clever comparisons of extreme cases. The expression “extreme cases” means that we do no longer compare the fall of balls made of iron or wood but instead wish to try balls whose densities are radically different, for instance by observing the fall of (a) lead balls (b) soap bubbles (c) feathers.

As one knows, there are 3 forces at work. (i) the weight \( mg \) (ii) the buoyant force (iii) the friction of air. In (a) one sees almost only (i). In (b) the buoyant force (ii) is magnified and by trying bubbles of different diameters, one can identify its characteristics. In (c) it is the friction of air which is amplified. In his publications Galileo does not report that he used such a comparative method. It would have given him a better understanding of the different effects at work.

**How to use comparative analysis in cliophysics? The case of the Pacific**

As an illustration of how this method may work we consider the “zone of influence” effect.
A country $A$ may have a zone of influence $Ab$ in a country $B$ when it has rights in $Ab$ that it does not have in the rest of $B$. For instance, France had rights in the French concession of Shanghai that it did not have in the rest of China.

In an extension of this meaning, a zone of influence may consist in a whole country. For instance, Egypt was a British zone of influence until the end of World War II because it gave access to India, the jewel of the British Empire.

The degree of influence ($d_{i}$) that country $A$ exercises in region $Ab$ is variable on a scale from $d_{i} = 0\%$ when there is no influence at all to $d_{i} = 100\%$ in case of a colony. In the case of Britain one may say that it had a 60% influence in Egypt and a 100% influence in India, at least in the parts of India which were under direct British rule.

Clearly, it is a challenging task to determine the $d_{i}$ of a given area. On 2 June 1954, in a “Security Conference”, President Eisenhower declared: “We have got to keep the Pacific as an American lake”. What is the implication in terms of degree of influence?

Ever since the United States took possession of the West Coast (the conquest of California was in 1847 during the US-Mexican War) it has had an hegemonic position in the Pacific Ocean. As a matter of fact, from 1850 to around 2010 it was by far the most important power of the Pacific rim. Therefore it is quite understandable that in 1954 President Eisenhower could called it an American lake.

In a book by Di et al. (2017) and in a paper by Baaquie et al. (2019) the authors try to determine what is the US $d_{i}$ over the Pacific rim and what may be the implication for the future of the relations between China and the US.

US responses to successive encroachments upon its hegemony from 1880 to now were systematically studied. It turns out that during this time interval the US has been unwilling to consider a negotiated partnerships preferring to give a free hand to its military

Now, in December 2021 four years have past since the first publication and 2 years since the publication of the paper by Baaquie et al. Although the future is still cloudy these past years confirmed the fairly pessimistic predictions at least in the sense that no progress has been made in the direction of a compromise.

What kind of compromise can one think of? Here too the analysis of clusters of former similar episodes comes to our help. It shows that zones of influence belonging to different countries may co-exist. That is what happened in China in the time of foreign concessions: Japan and Russia in the north, Britain and France in the South.

Yet, one can remember that in April 1951 President Truman reined in General McArthur’s in his plans against China. In this plan “between 30 and 50 atomic bombs” would have been dropped on China, see the interviews of MacArthur taken in 1954 but which were published in the “New York Times” ten years later on 9 April 1964 (p.16).
and Germany in the east. This arrangement created little friction between foreign powers, at least until Japan started its invasion in 1933. The occupation of the whole western coast by Japan completely destroyed the previous state of equilibrium.

Another example of an agreement about respective zones of influence occurred in Africa between Britain and France. The co-existence of the two zones of influence did not provoke much friction.

The United States has already a near 100% zone of influence in South Korea, Japan and Australia and possibly a 60% zone of influence in India. Could that not be the basis of a fair arrangement with China that would leave enough breathing space to each side. Naturally, our prediction that things will go from bad to worse is probabilistic; its interval of confidence depends upon whatever new factors may appear which did not exist in the former cases.

**Conclusion and perspectives**

Cliophysics has had a difficult start because its early publications, e.g. the book of 2002, were aimed at historians. With the benefit of hindsight it has become clear that most historians do not accept the approach of cliophysics. At the other end of the spectrum, because (so far) it was expressed in qualitative rather than mathematical terms, cliophysics did not attract the interest of econophysicists or astrophysicists. Our advice is to firmly rely on the spirit of physics. For several centuries it has guided physicists in their experimental explorations and we believe it will also be an excellent guide for cliophysical explorations.

As nothing can replace personal experience, we describe in Appendix A a test-study that can be tried by those of our readers who are in sympathy with the approach and goals of cliophysics. We are aware of the fact that the episodes described in this appendix may involve too many parameters. Therefore, the first challenge is to define simple sub-episodes which may be compared in an effective way and lead to well-defined patterns. Simplicity is the key for success.

**Appendix A. The fate of Loyalists as a training-ground**

Those Americans who sided with the British during the War of Independence had their property confiscated and eventually they emigrated to other parts of the British Colonial Empire. The fate of such “Loyalists” has attracted the attention of historians.

 Needless to say, all great changes, whether political or religious, produce Loyalists that is to say people who wish to stick to former conditions. When Sweden became
a Protestant country in the 16th century, the people who remained Catholic were “Loyalists”. As they did not enjoy the same rights than Protestant citizens, instead of remaining in the country some of them fled to Catholic countries. The same observation can be made in Britain where Puritans, Quakers, Catholics and members of non-conformist denominations emigrated to America: Puritans to Massachusetts, Quakers to Pennsylvania or New Jersey, Catholics to Maryland.

Apart from religious revolutions one can also consider political upheavals, e.g. the English Revolution, the French Revolutions of 1789, the Russian Revolution of 1917, the Chinese Revolution of 1949, the end of the Algerian war of independence in 1962, the recent change of regime in Afghanistan (2021), all these cases produced Loyalists. Were they indicted by the new regime? Did they have their property confiscated? How many were killed? How many emigrated? How many returned a few years later? For all these questions the main difficulty is to find reliable sources. However, thanks to the Internet, this task has now become possible while it would have been impossible prior to the Internet era.

References

Alberge (D.) 2020: Chilling find shows how Henry VIII planned every detail of Boleyn beheading. The Guardian 25 October 2020.

Baaqui (B.E.), Wang (Q.-H.) 2018: Chinese dynasties and modern China. Unification and fragmentation. China and the World, Ancient and Modern Silk Road 1,1,1-43.

Baaqui (B.E.), Richmond (P.), Roehner (B.M.), Wang (Q.-H.) 2019: The future of US-China relations: a scientific investigation. China and the World. Ancient and Modern Silk Road 2,1,1-53.

Bloch (M.) 1924: Les rois thaumaturges. Étude sur le caractère surnaturel attribué à la puissance royale particulièrement en France et en Angleterre. Istra, Paris. Translated into English under the title: The royal touch. Sacred monarchy and scrofula in England and France. Routledge 1974.

Di (Z.), Li (R.), Roehner (B.M.) 2017: USA-China: cooperation or confrontation. A case study in analytical history (in Chinese).

[This book can be read at the following address: http://www.lpthe.jussieu.fr/roehner/prch.php]

Durkheim (E.) 1894: Les règles de la méthode sociologique. Flammarion, Paris.

[The book has been translated into English under the title:

Incidentally, in 2021 Protestantism remains the official State Church in Denmark, Finland, Iceland and Norway but in Sweden there is no official State Church currently.
“The rules of sociological method”.
Both the French and the English version are freely available on Internet.

Fraser (A.) 1969: Mary, Queen of Scots. Weidenfeld and Nicholson, London.

Roehner (B.M.) 1997a: Jesuits and the state. A comparative study of their expulsions (1520-1990). Religion 27,165-182.

Roehner (B.M.) 1997b: Spatial determinants of separatism. Swiss Journal of Sociology 23,1,25-59.

Roehner (B.M.), Rahilly (L.) 2002: Separatism and integration. A study in analytical history. Rowman and Littlefield, Lanham (Maryland).

Roehner (B.M.), Syme (T.) 2002: Pattern and repertoire in history. Harvard University Press, Cambridge (Mass.).

[An updated version is available at: http://www.lpthe.jussieu.fr/~roehner/prh.pdf]

Roehner (B.) 2007: Cohésion sociale. Odile Jacob, Paris.

Rudé (G.) 1955: The Gordon riots. A study of the rioters and their victims. Transactions of the Royal Historical Society, 11 June 1955, p.93-114.

Rudé (G.), Harvey (J.K.) 1964, 2000: Revolutionary Europe, 1783-1815. John Wiley and Sons.