
Approaching Military Revolutions

The notion of military revolution appeared in the vocabulary of strategists, historians and political scientists during the 20th Century. However, before further examination, it is important to try and understand it, and to tackle three preliminary points. First, questions concerning military revolution appeared in two distinct realms. From one side, in the historical realm, in Roberts' work [ROB 56], who, in his research supported by tactical reforms of the Dutch army, tried to show a radical break with the recent past. Even though Parker [PAR 88, PAR 76] and Black [BLA 91a] criticized this thesis, it remains the most quoted study of the emergence of the debate on American RMA¹. From the other side, in the realm of political and strategic science, the nuclear question was quickly perceived as a revolution in itself, since the goal of the armies was no longer to make war but to avoid it². In both cases, these "revolutions" were techno-centered, and were respectively supported by the power of fire (artillery, individual weapons), maritime navigation techniques or the process of popular mobilization (through a slow process of state constitution [FIN 75, FOR 09]), and the scheme of the nuclear weapons and its vectors. In some ways, they already imply information flows.

1 In the field of history, this debate remains very much alive and burning. We can also refer to [CON 72] and [DOW 92].

2 We owe the first observation on the subject to Bernard Brodie who, it is said, after the explosion of the Hiroshima bomb, told his wife that he wanted to give up his research on classic strategy. Yet, from a practical viewpoint, the revolutionary outreach of political consequences of nuclear weapons will be widely questioned.

We can thus consider that the definition of RMA in the debate of a possible “revolution” in the 1990s quickly embraced the ideas that had been previously developed. In a first approach, RMA and its current state in the debate could be based upon the use of computers and network technology in operations conduct. Consequently, it could also be based on the importance given to information as a means of knowledge (of the tactical situation, whether it be operational or political) as well as a means of efficient forces activation. It might also find its basis in the importance given to forms of information prohibition (stealth technology, information warfare, psychological warfare and influence operations), in the positioning of precision-guided munitions fired from a stand-off distance, regardless of climate and operational conditions. Moreover, it might be based on the positioning of armed forces, which have a more gathered organization, but with a capacity to be placed more quickly on farther theaters of operations³. In a broader sense, we will base our study on a definition of the concept of military revolution as “a fundamental breakthrough in technology, doctrine and organization, which renders the existing methods of warfare conduct obsolete”⁴.

Second, if the relevance of the definition “RMA” as a revolution can be questioned, we can reasonably assess that the notion of “military revolution” is historically relevant. Even historians who are reluctant to consider the concept of RMA as true revolution do not deny the relevance of the concept of military revolution. Third and finally, there are some keys and concepts that are necessary in order to fully understand the concepts of military revolution and RMA, and they will provide a framework for this chapter. The first is about the lexical varieties present under the notion of military revolution, which can be found in the American debate on RMA, especially when speaking about its political implications. The second refers to the categorizations of RMA done in the 1990s and of its analysts.

3 The focus here is only on the major categories of connotations assigned to RMA, which we find in its literature. We will come back to what it can cover more thoroughly [SLO 02].

4 Considered as being the first academic contribution on American RMA, this definition is sufficiently operating for now, even if the subjectivity implied in defining an innovation as a “fundamental breakthrough” remains problematic. More specifically, it does not include what we could call “military revolutions ontology” and what these military revolutions are or are not [MAZ 93, p. 16].

1.1. Lexical varieties

Three lexical categories of the conceptual object of “RMA” coexist in the field of strategic studies. They were the subject of a debate, between 1992 (when the first studies appeared on this subject) and 1998. Its goal, *in fine*, was to try and determine the magnitude of the phenomenon of accelerated technicization (meaning the introduction of new military technologies) of American forces. In view of its contemporary understanding, the concept goes back to observations made by the Soviet marshal Ogarkov in the beginning of the 1980s, of a *Military Technical Revolution* (MTR), and the observations of the American *AirLand battle* [FIT 87]⁵. The latter was itself the result of a specific technological effort concerning DARPA⁶, the second *Offset strategy*⁷ and of the deep questioning – the *reform movement* – of the American forces’ methods of action. The Soviet marshal, as he noticed the occurrence of this MTR in the United States, meant to adapt the Soviet forces to it [PAR 95].

It is supposed that this MTR may have solved the qualitative deficit of conventional Soviet forces by “synthesizing new technologies, evolving military systems, operational innovation, and organizational adaptation into a whole that was more powerful than the parts”⁸. And this regardless of whether it was based on a conceptual “system implementation” or on information and communication technologies as such, due to their interactions and their reticulation. Direct energy weapons, stealth technology, “strike-reconnaissance complexes” and reorganizations may then have given the USSR a straight comparative advantage over the United States⁹. In truth, the concept of MTR is the evidence that the Soviets considered the United States to be clearly

5 On the Russian perception of Ogarkov’s considerations before the “application” of MTR before the Gulf War, see [FIT 91].

6 *Defense Advanced Research Project Agency*, in charge of the works linked to research and technologies in the United States.

7 See Chapter 5. The first offset strategy dealt with technologies linked to nuclear energy and to ballistic weapons.

8 [DAV 96, p. 15].

9 Ogarkov’s plans, which were then passed on to Akhromeev at the head of general staff, were almost never implemented. For some, it would be due to a lack of political interest [SLO 02], whereas others consider that the USSR, by following the same path as the United States’ strategic defense initiative, engaged in the MTR race. We must note that in the 1990s and 2000s, the different reorganization plans of the Russian army show many elements which call back to MTR as it was imagined by Ogarkov.

behind¹⁰. However, the concept was soon to be criticized as being too techno-centered (whereas only a few technologies were supposedly used). The concept may not show the doctrinal or organizational adaptation of the forces that implement it. In the same way, technology may have been conceptualized in a much too static way and may have failed to highlight the evolutions it could experience or even to report its own contributions [WAT 95]. In the end, MTR would supposedly be restricted to tactical and operational levels.

1.1.1. *MTR versus RMA*

At that time, in the United States, a second lexical field appears, and which attempts, in its varieties, to show the impact of said revolution on other scopes than the strictly technological and military ones. By re-examining Ogarkov's work, Andrew Marshall – who will play a major part in the debates over RMA¹¹ – favored the phrase “Revolution in Military Affairs”, in order to better report the implications of political, doctrinal and organizational processes in the military institution by technology. All the most, in this sense, RMA implies an organization of technologies, which will be introduced in a given military system, and it also implies what their interactions will be [LAN 99]. With this mind, RMA becomes the “*process*

10 Actually, when studying the Soviet debates on the subject, Andrew Marshall will draw the conclusion that American efforts should be accelerated, so that Washington definitely ensures a technological superiority [TOM 07, ADA 08].

11 Andrew Marshall was the Head of the *Office of Net Assessment* (ONA) from its creation in 1973 until 2014. In charge of detecting the emerging threats against the United States, he answered directly to the Secretary of Defense and has had a major, yet discrete, role in the research institutions network. S.P. Rosen admitted that ONA “*was the first to develop the idea that the American military can be transformed by the revolution in information technology*” (quoted by [SCH 97]). He is said to be the first who foresaw the fall of the USSR, in 1977, based on its loss of economic steam. He also supposedly declared in 1980 that AIDS was a threat to national security. Said by a Chinese General to be the “*intellectual engine of American strategy*” (quoted by [WIN 99, p. 45]), ONA and Marshall are one and the same entity in most publications. From an economic educational background, Marshall was a research member at the RAND (1949). As he was always renewed by all administrations, his influence remains major (“the Church of St. Andrew”) thanks to the schooling he brought to academics who also praised an RMA and who worked with him, such as A. Krepinevitch or T. Manhken, or also thanks to his close relation with a *think tank* such as the *Center for Security Policy* [KRE 15]. See also [ROS 10].

*of socio technical transformation (which) should be supported by a network of cultural and economic forces which takes a concrete shape during a time interval which is hard to define, yet easy to influence*¹². From the start, information plays a decisive role.

In practice, Martin Libicki will show the coextension, rather than the opposition, of the notions of MTR and RMA by telling that “*the most fundamental strategic challenge (...) is the conversion of a military-technical revolution into a revolution in military affairs*”¹³. Yet, this lexicon, which is the basis for all works on American RMA, will also be called into question. R.J. Bunker thus suggested the concept of *Revolution in Political and Military Affairs* (RPMA). According to him, the notion of RMA “*ignored the massive political ramifications that the development of future warfare will have over our society and government*”¹⁴. However, when put into practice, this concept only rarely appears in the literature and was mentioned rather than studied in-depth in the article. Also pertaining to this situation could be the American tendency to favor a relation based on the break from Jomini’s concept rather than on the Clausewitzian continuity between the political and the military scopes as highlighted by Colson and Desportes. Following this, the concept of *Revolution in Strategic Affairs*, suggested by Freedman, also takes us back to an attempt to broaden RMA to a political level [FRE 98].

With the same intention of broadening the field of RMA, Andrew Bacevitch stated at the United States, which benefited from revolutionary changes in their armies, were less subject to RMA than to a “revolution in security affairs” [BAC 96]. Like Bunker, the author’s goal was to bring to light the impacts of the evolutions of the military institution on the international community – a combination of the social and political field – these impacts being seen as insufficiently highlighted. Retrospectively, we can consider that this influence does not go from the military to the socio-political, but that it proceeds from an interaction – particularly in view of information technologies, which come, for a great part, from the civilian world. This lexical quest will also find other ramifications. As he studied the concept of RMA in the scope of geopolitics, Richard Ek unveiled the concept of

12 [BAL 03, p. 19].

13 [LIB 94, p. 1].

14 [BUN 96, p. 9].

“revolution in military geopolitics”¹⁵, based on the political and sociological consequences of the arrival of computers and new military technologies¹⁶.

1.1.2. Military revolutions versus RMAs

In a third category of lexical fields, the attention paid to RMA as it was just starting to be conceptualized and to receive intellectual credit led several authors to study past revolutions from a strategic viewpoint and to take some distance in order to try and grasp differentiated magnitudes. To this end, an author such as Krepinevitch could consider, over time, the succession of several RMAs, based on four elements: technological change, systems development, operational innovation and organizational adaptation. These RMAs include the revolution of infantry (14th Century), of artillery (15th Century), of fortifications (16th Century), of navy rudders (16th Century), the military revolution of the 17th Century (with the linear order), the Napoleonic revolution, the revolution in land warfare (with the Civil War, the use of railway and of breech loading rifles), naval revolution (from the use of steam and the use of belt armor), revolutions of the interwar years (mechanization, aviation, information) and, finally, nuclear revolution [KRE 94]. Yet, very quickly, the author encountered the problem that some revolutions seemed to hold disproportionate impacts on military as well as political practices. Retrospectively, we can also argue that such a rigid classification ends in discrediting the interdependencies of what he defines as revolutions: indeed, phenomena of this magnitude do not appear *in abstracto*.

This led Murray and Knox [KNO 01] to differentiate the notions of “revolution in military affairs” and “military revolutions,” thus converging with the debates of the historians in the 1950s. The first revolutions are then conducted by the military institution, which welcomes and incorporates technological innovations. Yet, they could also be based on deep political and social evolutions within society. By nature, an army, and the way it

15 However, the goal will be less to question the concept of RMA than to study its implications for the theory of geopolitics, particularly the postmodern theory of geopolitics [EK 00].

16 We could argue that “military geopolitics” more specifically take us back to a type of geostrategy, which almost always took into account the evolution of weapon systems. Mackinder himself thought that technology as such held a strong relation to geopolitics, since the first helped to put the second “into action”, railways being the keys to mastering the *Heartland*, according to him [LON 99].

develops, is first and foremost the result of its socio-political environment [MUR 01a]. On the other hand, military revolutions would be the result of great social, political and cultural evolutions, and they would also have direct impacts on the organization of societies as well as on the distribution of powers. The military sphere would then interact directly with the political one, as they would shape one another in turns, in the same space–time¹⁷. The number of military revolutions is supposedly incomparably lower than that of RMA [MUR 01b, MOL 02]. In this way, they reckon that five waves of military revolutions succeeded one another (Table 1.1):

Period	Founding element of the revolution	RMA
17th Century	Modern state and modern military institutions	1) Dutch and Swedish tactical reforms; French organizational and tactical reform; naval revolution; fiscal revolution 2) French military reforms (after the 7 Years' War)
End of 18th Century	French revolution	National political and economic mobilization Napoleonic Wars
19th Century	Industrial revolution	1) Financial and economic strength based on industrialization 2) Technological revolution in land warfare 3) Naval revolution
Beginning of 20th Century	World War I	Tactics and joint operations, <i>blitzkrieg</i> , strategic bombing, submarine and naval air warfare, radar and electronic intelligence
Mid-20th Century	World War II	1) Nuclear dissuasion war 2) Conventional deterrence, precision strikes, lethality radicalization

Table 1.1. Past military revolutions,
according to Murray and Knox [MOL 02]

In a similar view, Rogers considered that introducing a group of innovations could give rise to RMA; yet its transformation into a proper military revolution depends on much more complex factors [ROG 00, ROG 93]. According to him, the switch from one form to the other is determined by specific political and social conditions. In this regard, the military revolution induced by artillery in the 15th Century does not find its cause in the cannons themselves, but in their political use. By enabling the

¹⁷ A typical example would be the Napoleonic war. The 1789 revolution and its political project led to the emergence and the legitimization of a masses rising model. In return, Napoleon's conquests will have direct international impacts.

rapid destruction of its fortifications, its operators were able to quickly conquer new territories, thus initiating an international redistribution of forces when the state adopted modern instruments of power¹⁸. It will also be the case for the French mass movement in Napoleonic Wars. Therefore, even what can be seen as a revolution on a scientific scale has low chances of resulting in a true military revolution if no political conditions are conducive to enable its achievement. Following this logic, the *blitzkrieg* thus seems to be more of a RMA than a military revolution. According to a similar viewpoint, Metz thinks that this dichotomy reflects a distinction between “tactical and operational revolutions”, referring to RMAs and founded on the contributions of technologies, and between “strategic revolutions” being the *stricto sensu* equivalent to military revolutions [MET 00].

If most of the authors agree on the observation of the non-linear succession of several revolutions, the relevance of the resort to the concept of military revolution itself still needs to be questioned. The process of technological transformation (technicization), and in regard to integration of new technologies, but also technical processes in the armies, is constant throughout history. Heilbroner indicates that what makes the true noteworthy revolutions is not so much their frequency rather than their rarity on a historic scale. Following this, David Jablonsky considered that the word “revolution” is more often misused than properly used [JAB 94b]. In truth, bureaucratic institutions can be so heavy that even the smallest innovation can generate the perception of a revolutionary change. Thus, by deconstructing the military revolution induced by the appearance of firearms, Hall shows that the technological artefact does not represent the origins of a revolution. He will see Renaissance as an evolutionary period – rather than a revolutionary one – opening the way to a process of transformation of the armies while interpreting, sometimes well, sometimes wrongly, the contributions of new technologies [HAL 97].

Combining military history and the history of technology, Hall underlines the importance of the cultural melting pot within which transformation will fall, following a methodology which can be compared to one followed by Azar Gat [GAT 91]. He thus shows how the force of siege warfare during the Middle Ages came to weaken due to the technological combinations,

18 Consequently, by adopting the most offensive strategy, the State would actually strengthen its positions. Indeed, the conquest of new territories was the prerequisite to the implementation of administrative and fiscal order, the profits of which would directly benefit the conquering army. Finer called this the “extraction–coercion cycle” [FIN 75].

which were implemented, introducing tire arms little by little and not violently, firearms. In this way, “*basic technological changes stimulated the offensive and defensive capacities in a spiral towards both technical refinement and increasing costs*”¹⁹. According to Hall, the emergence of a consensus on techniques among manufacturers and then of another on the tactical use of weapons in the middle of the 17th Century shows a subtle evolution in military organizations, tactics and strategy²⁰. A similar reasoning can be applied to artillery cannons²¹, seriously questioning the revolutionary nature of technology diffusion. The highlight of the “time” factor will thus become significant in the definition of “revolution”²².

It is important to note that the combination of political, technological, organizational, doctrinal and tactical factors seems to form the base of military evolution at the end of the Middle Ages [MOL 02], and then induces a *combinatorial thematic* which will become recurrent in RMA literature. The effects of feedback and mutual constitution between these different elements will remain constant. In this way, we need to moderate in an “evolutionary way” the “revolutionary” theory according to which the use of cannons will enable feudal walls to be brought down (opening the way to a nation-state able to develop its military capabilities in return, throughout taxes and scientific development [DUP 84, GAT 91]). Even in doing so, we must not deny its relevance. To this end, Hall calls into question the notion of revolution. According to him, it is not neutral in its methodological understanding, because it underlies a legitimization of American strategic rhetoric.

1.1.3. *Reassessing the notion of military revolution*

Still, the notion of military revolution in itself can be called into question, and even denied. E.A. Cohen indicates that an entire school of authors on RMA reject the concept of military revolution in itself [COH 97]. According

19 [HAL 97, p. 18].

20 This could be supported by the diversity of technical options chosen in weapon manufacture. The production and development of firearms has thus shown a constant interaction with their environment of use and a technical refinement until today [BRU 99].

21 However, if it introduces an artillery technical innovation, the use of shells instead of cannonballs is not a strategic revolution in itself.

22 Besides, it only is in the sole field of military history, political science and strategic studies. In the history of economics, Cochet and Henry asked themselves why it took more than 150 years for the first “industrial revolution” to spread [COC 95].

to them, change occurs throughout an evolution, which is technological and conceptual, iterative and progressive, and not a disruptive one. In this regard, for example, the *blitzkrieg* would be an exploitation of infiltration tactics from World War I, but this time by means of tanks, pairing them up with aviation and also with radio, which will be used more broadly during the Great War. Precision guided weapons, which are of major importance in the pro-RMA rhetoric, arose during the same period. However, the majority of authors consider this the radical position in relation to military revolution. Indeed, in a theory which would consider the political and strategic innovation from the sole viewpoint of evolution and which would exclude the possibility of a revolution, the following points would fail to be presented:

- differentials in the understanding/using of innovative combinations (France making a better use of artillery than Burgundy, or the United States having a better use of information and command systems than Iraq);

- major technological and doctrinal breaks, which, when properly used from a political and strategic viewpoint, give results which are seen as surprising (Germany's use of *blitzkrieg* whereas the French, even if they have better tanks, do not embrace such a position, or the use of nuclear weapons in 1945, which will result in an international order which will almost entirely be regulated by the nuclear weapon);

- kinematics, which are differentiated in the spread of military innovation. If more than a century passed before European armies enter the "artillery revolution", it will take less than 2 years for American and Soviet armies to see tanks as the heart of their ground forces; 4 years for USSR to adopt nuclear weapons after the United States²³, and a few months before European armies took note that the United States' success in 1991 was due to their mastering of a number of technologies, including the ones linked to networks.

We can consider that, for the most sceptical authors, RMA referred more to the social discovery of the political and military effects of new technologies than to a proper revolution. Indeed, the study of the reactions of politics and the media during the 1991 Gulf War meets this reasoning. In fact, the war was nothing more than the application of doctrinal and strategic

23 This will somehow complete the "nuclear revolution", showing that the Soviet Union did not intend to stay away from a path leading to power. The same kind of reasoning can be applied to France, Great Britain or China.

concepts, which were more than 10 years old, and which were supported by weaponry manufactured for the most part in the 1970s [TOM 07]. The idea of a “bright” victory, which was, in reality, very much predictable, came out from the lack of knowledge in the state of the art in this area. This approach enabled Henry and Peartree to state; “New technologies emerge to either exploit or compensate for weaknesses in existing technologies. Inventing a theory of information warfare risks falling victim to the kinds of fallacies that Douhet encountered. Unable to see the future, he imagined one based on linear projections of extant technologies” [HEN 98].

For them, as a transposition of the past evolutions, the current RMA would be nothing more than an expensive delusion, in terms of financial but also intellectual investment. Yet for many authors, beyond the validity of the concept of military revolution, the concept of RMA in itself, when applied to the United States and their allies, is the result of a lack of clarification, which could seriously weaken its outreach as well as its relevance. Thus, for Tertrais, at the end of the 1990s, RMA is a “*nebulous concept (...) flexible, practical, but in reality a catch-all*”²⁴. Thérèse Delpéch stated that “*the key technological evolutions, those impacting the art of warfare, have been few through centuries*”²⁵. However, let us stress the fact that RMA has been discredited from the viewpoint of France, which was strategically attentive, but conceptually in a “wait-and-see” policy at the time of American questionings²⁶. Yet, France still embraced the rhetoric and logic of *Transformation* when the concept was approved after a NATO summit in Prague in 2002 – and when Paris was reinstated in the integrated military structure in 2008. Yet, several American authors are also sceptical concerning the outreach of RMA, which could not mean anything more than a slogan.

1.1.4. *An incomplete RMA? From revolution to transformation*

According to the pessimistic counterpart of the sceptical approach, the concepts of RMA and military revolution could be relevant, yet they would be burdened in their realization. In this sense, Murray indicates that RMA could not become the melting pot of a major evolution of the American forces

24 [TER 98, p. 612].

25 [DEL 98, p. 27].

26 As it was going through important dissents within its civil institutes, France did not really produce any innovative concept outside of its military research centers [COU 01].

because hierarchical structures, bureaucratic barriers or competitiveness among services (US Army, US Air Force, Marines, US Navy) are such that any type of modernization would become a relatively slow evolution rather than a proper revolution [MUR 01a]. Basing himself on the works of Heilbroner, Jablonsky speaks of a “viscosity” of history, which would most likely destroy the promises of RMA as they were too techno-optimistic in a unilateral way [HEI 60, JAB 94a]. However, this viewpoint is – partly – called into question by the development of American forces.

Indeed, we must point out that with *Transformation*, which was promoted in the *Quadriennial Defense Review* (QDR) of 1997, 2001, 2006, 2010 and 2014²⁷, the political level intends to implement some of the lessons and recommendations produced by the debate on RMA. This evolution towards *Transformation* thus foreshadows a fourth lexical form of “revolution”, but this time with much more praxeological orientations²⁸. If the term *Transformation* was reused many times – and it was structurally institutionalized by NATO throughout the *Allied Command Transformation* (ACT)²⁹ – it still holds various connotations. These connotations go from the least critical admiration to the most open scepticism. In particular, this *Transformation* supposedly remains linked to ideas from the Cold War, which are unfit for the contemporary international community, and supposedly did not give way to a radical process – a properly revolutionary one – particularly in the design of weapon systems [GON 00, BER 16].

Transformation could then be nothing more than a deceptive process that would highlight a punctual adaptation of structure and forces’ equipment, but which would extend America’s – and NATO’s – preference for high-intensity regular operations. The goal would then be to reproduce, behind the

27 QDRs were established after the *Government Performance and Results Act* (1993) and must isolate the means and views of the department of defense in the short term.

28 Inasmuch as the process would enable the incremental transformation of forces. As a result, the US Army experiences a “split” between *Legacy Force* (deriving from divisionary structures and from the disposal of equipment dating back from the Cold War) and *Interim Force* (represented by *Interim Brigade Combat Teams* – IBCT – equipped with *Stryker* vehicles). The final goal is to result in the *Objective force*.

29 The ACT is one of NATO’s two major commandments and is in charge of assisting the *Transformation* of the forces of the member countries. Settled in Norfolk, it is located near the *Office of Force Transformation* (OFT) which was created in 2001 in order to initiate and to guide American *Transformation*, and then dissolved in 2006.

veil of change, the preferences of strategic cultures. According to a more optimistic viewpoint, *Transformation* might be partly limited by the lack of financial resources and by military interventions after 9/11. It would then progressively augment RMA's benefits, keeping its initial dynamic. At this stage, we can distinguish the different opinions, from the possibility of "permanent revolutions" – usually seen as techno-centered (and then based on biotechnologies or nanotechnologies) – to a more classically evolutionary model³⁰. Let us note that, once more, these opinions and viewpoints are in themselves progressive³¹.

1.2. Types of RMA

To this point, a lexical classification of RMA does not necessarily render the diversity of positions towards the subject, nor the diversity of acceptations RMA can cover, being examined by a group of authors.

1.2.1. An example of techno-centric classification

According to Timothy Andrews, we can distinguish three types of RMA based on the nature and the speed of changes they imply in the strategic behavior of actors [AND 98]. The first type affects the whole scope of military operations quickly, and also the conduct of politics. In order to support his thesis, he refers to the appearance of nuclear war, which takes us back to the notion of military revolution as Murray, Knox and Rogers understand it. In this regard, this revolution would affect the conduct of warfare as much as its nature. The second type of revolution is characterized by technological and/or organizational changes, introduced quite quickly in military systems, and which can disturb the classical balance of power on a national and/or regional scale. For the author, and for other proponents following him, this is typically true of the "armed nation", or of the introduction of submarines or aircraft carriers [MUR 95, GAL 95]. With its way of changing the character of wars but not their nature, this type of

30 We will come back to these different opinions *infra*.

31 Many authors saw an evolution in their thinking throughout debates not only on RMA but also on the process of *Transformation*. This is particularly true since operations carried out in Afghanistan and Iraq.

revolution can have direct political consequences, and can thus be put closer to RTM³².

Finally, the “third type” of RMA is related to “capacitating technologies”, which still need to be integrated to weapons systems. The author defines as such the introduction of steel or steam propulsion in naval construction, of jet engine in aviation or, closer to us, computers and information technologies. According to Andrews, revolution stands more in the speed with which technologies are adopted than in their implementation. At the same time, he thinks this type of revolution rarely affects the balance or the distribution of powers, as long as it is was not converted to any of the two previous types mentioned. For the author, a technological evolution considered minor in its outreach can play an active role in a real revolution thanks to the combination of technological and strategic dynamisms. If he remains unclear on the modalities of conversion of these types of revolutions, he does state that, logically, they can produce effects on the international system. For him, the United States, in order to keep their leading position, must make use of their technological and strategic capacities [AND 98].

With this reasoning, the author meets the rationality already developed by Possony *et al.* [POS 97], and according to which technology becomes a factor that will make Washington’s capacity of influence on the international system durable. This view of “capacitating technology” also fails to take into account the proper “enriching” dynamic of technologies such as information technologies. The applications on the subject by default went through a great evolution: if the computer management of armies’ logistical stocks was, for example, seen as revolutionary in the 1980s, the contributions of information technology then went through a considerable transformation. Through their widespread growth in the 1990s, network communications and data links paved the way for contemporary concepts of aviation and urban combat networks (see *infra*), without even mentioning the convergences between networks and robotics. We can also criticize the fact that, if the outreach of these conceptions is operational, it does not necessarily report the intersecting factors between technologies and international relations.

32 One example among many is that of the purchase of six stealth frigates and as many submarines by Singapore, added to a fast modernization of its air and land forces. This had a radical impact on the balance of forces in the region. Consequently, the freedom of strategic manoeuvre of the city-state increased significantly [COU 05].

1.2.2. *Unlikely revolutions*

Noticing that the variety of conceptions for RMA leads to different meanings and connotations for the word “revolution”, Galdi offers a ternary categorization of RMA [GAL 95]. First, he states that the notion of RMA exceeds technological change. Basing his argument on the erosion of the nation-state in the international system, on the evolution of military institutions (with its evolving relation to violence) and on the spread of technologies at the hands of sub-estate groups, the author notes that conflicts could multiply in the future. Consequently, the state should try to adapt to the international environment through the evolution of its armed forces towards RMA. This weakening of the state would not lead to an over-technicization of its forces, and would mostly highlight its constabulary missions. This view coincides with Moskos’ perceptions on postmodern war [MOS 94] and, in some regards, the French conception of a “strategic break” following the fall of USSR and the re-organization of the distribution of powers it triggered³³.

The second connotation to the notion of RMA is supposedly the most widespread, stressing the evolution of weapon systems and their integration in the arsenals of the most advanced states. Implicitly, such a viewpoint would reify a nation-state born from the Westphalian system, and which would seek to reproduce over time throughout the modernization of its forces. A variation of this thinking implies a continuous succession of technological revolutions in different areas (stealth technologies, information warfare, network-centric warfare, biotechnologies, direct energy weapons, etc.), which would be taken over by military institution. The third connotation denies the “revolutionary” value of RMA. In this regard, a continuous succession of technological evolutions in the whole spectrum of military missions is constantly integrated to armed forces. Supposedly, there would be no RMA per se, since the art of warfare would integrate a continuous succession of evolutions, but not necessarily a linear succession³⁴. This is also the case for Colin Gray, who positions himself on the level of strategic theory, which is not necessarily revolutionized by the technological factor, so that “*the future is the past – with GPS*” [GRA 02].

33 The political factor then overcomes the technological one, yet this does not mean that the latter is ousted. See [TOM 07] and [COU 97].

34 Previously quoted by [MUR 98a, p. 50].

Coming back to Galdi, his approach does not seem satisfactory. First, because the erosion of the nation-state is stressed in the majority of studies and works on RMA, and because this criterion is not specific to the RMA school of thinking. In the same way, this erosion did not lead to erasure: if it had been mentioned since the end of the 1980s, the state remains indeed the main actor of international relations – moreover, sub-state actors most often aim at becoming states. Second, Galdi fails to underline the variety of sceptical thinking on the occurrence of an RMA – and which actually shaped the majority of works about it. Thirdly, the states are not the only ones looking to adapt to the new international environment: sub-state groups also seek the support of new technologies. RMAs are thus inducing a techno-strategic emulation [BRU 05], which partly translates into the rise of actors using hybrid strategies (see *infra*).

1.2.3. Cohen and the “revolutionary types”

In this framework, a third classification of RMA forms comes from Eliot A. Cohen [COH 97]. It is taxonomic and enables us to classify its intellectual operators. It also appears to be the most operating. In order to define it, Cohen asks four questions: Is a revolution occurring? What is the dynamic leading to RMA? In virtue of these questions, what main political challenges await American planners? What is the main external threat impacting the security of the United States? Ideal-typical, the classification gives rise to four main groups:

1) “Owens’ disciple”, named after the Admiral who first coined the “system of systems” concept, combining the ensemble of the American means of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR)³⁵. Advocates of this view consider that RMA does not lie in technologies themselves, but in the structuring and networking of means already available and which, in virtue of technological dynamism, experience a natural and constant evolution³⁶. In this regard, naturally, the United States must focus on the knowledge of their own

35 Owens was vice-president to the Committee of Military Chief of staff during the Clinton administration [OWE 95, OWE 00].

36 “If the United States could integrate sub-systems (already available, or developing) in a system of systems, they would be able to reach a dominant knowledge of the battle space, to teach this knowledge to American forces, and to react to the battle space with speed, precision and with devastating effects. A successful integration could propel the United States to a new qualitative order of military strength” [BLA 97a, p. 29].

technologies – which Owens believes is insufficient³⁷ – but also on their full development. “Owens’ disciple” is generally closer to the decision-making groups taking part in the process of *Transformation*³⁸. This is particularly true of the very influential Admiral Cebrowski³⁹.

2) The “uncertain revolutionary” considers that he is certain that revolutions will occur but that the kinematic of implementation of this change is less clear. Proponents of this category then tend to focus on the maturation of technologies and on a search for experimentation. Rosen [ROS 91], just like the proponents of the first category, focuses less on technology than on the doctrinal, conceptual and organizational translation in armed forces. Yet, in practice, whereas “Owens’ disciple” solves this question through organizational measures, the “uncertain revolutionary” tends to stress the conceptual factor, because he does not think that a fit organization can give rise to the certainties which “system of systems” promises. Authors like Petraeus, in charge of operations in Iraq since 2007, or Bassford, meet this reasoning⁴⁰.

3) The “Gulf War veteran” also believes in the possibility of RMA, but thinks that it dates back to the 1980s, when the technologies which were used during *Desert Storm* were designed and integrated to military institution. In this regard, the quality of soldiers’ recruitment and training as well as their marital ethos took a clear priority over new technologies. Authors supporting this reasoning do not reject the contributions of technology but fear that we forget the elementary military constraints or that we underestimate the vulnerabilities induced by technology and politico-military decision-makers [FRE 02, SPA 02, KIP 01, BOL 04]. Even though

37 Owens used to present a diagram with many acronyms representing weapon systems, communication and intelligence systems which nobody in the room – including himself – was able to define.

38 Let us note that Owens’ superior was General Shalikashvili (former Chief of Staff of the US Army, then Joint Chief of Staff and “father” of the very “RMA-shaping” Future Combat System), who “protected” him against the attacks that targeted him.

39 A.K. Cebrowski, former Head of the Office of Force Transformation, is also the author of the concept of *Network-Centric Warfare* (NCW). Following Owens, he considers that the interaction of systems C4ISR to combat systems should enable a radical optimization of the US forces’ effectiveness. They would then have access, in close to real-time, to any kind of useful information [CEB 98, DE 04b, DE 06, DE 07b].

40 On top of being General and Director of the CIA, Petraeus also took an important part in developing the last version of the American doctrine on counter-insurgency. Specialized in Clausewitz, Bassford will also take part in the writing of the new document.

this category of opinion seemed to disappear at the turn of the 2000s, it experienced a resurgence after American operations in Iraq in 2004.

4) The “sceptical” is the most critical toward RMA. It can be completely called into question, thus highlighting the natural evolution of tactics and technologies, so that authors adopting this thinking are those who most often get closer to the ideal aspect of the debate between the preeminence of strategy and that of technology. They tend to adopt an “incrementalist” opinion as they see, little by little, the integration of innovations – which they surely do not deny – in strategic systems. A majority of military historians (among them Rogers or Murray) and some “pure strategists” like Colin Gray meet this reasoning.

Later on, Cohen would add a fifth category: the very technology-intensive “starship trooper”. Referring to the novel by Robert A. Heinlein⁴¹ and to Paul Verhoeven’s movie adaptation⁴², the model contemplates a RMA that would be technicized to the extreme and in which the current computer technology breakthroughs would only be the beginning of the intensive use of biotechnologies, nanotechnologies, robotics and genetic engineering. In such a context, the “true RMA” would occur around 2020–2030 and would be marked by the weight of innovation as well as that of the scientific figure. However, few authors fit into this school of thought. On the one hand genetics and biotechnologies have not yet led to direct military implementations and, for now, they belong to a prospective field, strongly tinged with futurology. On the other hand, this type of reasoning is generally subject to ethical criticism than praised due to the downward effects it could trigger [HEN 03].

41 In this movie, the hero an earthling from the 22nd Century, does his military service (which will enable him, in return, to exercise his right to vote). He finds himself involved in extremely violent battles against dehumanized opponents (“arachnids”). As soon as it came out in 1959, the book was praised (for denouncing an ultra-technological society, which adopts a political position standing in-between fascism and nazism) as much as it was criticized (for extending a construction of the adversary similar to the representations of the Japanese instilled in the United States during World War II). In truth, the author supposedly synthesises the political behaviors of his time in order to extrapolate towards a futuristic version. A libertarian (his next novel, *Strangers in a Strange Land*, is openly pacifist), he systematically stated that he was against communism as much as nazism. Let us note that the author and his work would go on to have a great influence on the sub-genre of military science-fiction, without much consideration for technology, but with a particular highlight on martial values [HEI 87].

42 Who takes (too) many liberties in comparison to the original work, to the extent of distorting its complexity.

All said and done, the ideal-typical opinions suggested by Cohen are inherently progressive. Thus, several authors who in 1997 considered that RMA was not happening will later review their opinion⁴³. Finally, we can consider that the summary coming out of this analysis, and enabling us to distinguish institutional as well academic actors, remains relevant (Table 1.2).

	“Owens Clone”	Gulf War Veteran	Sceptic	Revolutionary sceptic	Starship trooper
Where is RMA standing?	Already here!	Already seen!	What RMA?	Sometimes here, sometimes not	Beyond the horizon
Motor	Information technologies	Doctrine and human skills	Human nature	Integration of concepts and technology	Biotechnologies
Priority	Lower numbers	Keep numbers	Keep martial ethos	Testing and innovation	Invest in research and development
No. 1 threat	Inertia	Same size rival	Over-invest	Asymmetric retaliations	Intellectual conformism
Innovation	Aftermath	No interest	No revolution, evolution	Rises from the civil sector	Science

Table 1.2. *The types of RMA according to Cohen*
 ([MUR 00, p. 241], modified by the author)

1.2.4. RMA schools at the turn of the millennium

Opinions on RMA are very much split, all the more because the implementation of new weapon systems has increased, along with the interest for debating RMA. This results in an inflection in the position of the “sceptics”, especially on relatively technical thematics. In this context, a work from O’Hanlon takes revolution for granted and offers a new classification for the schools of thought on RMA, based on the authors’ technological preferences [OHA 00]. The first school of thought sends us

43 Such a review will occur, for example – given that it is not limited by it – with [GON 98] and [GON 99], but also with [MAR 01].

back to Cohen's "Owens' disciple". The second, called "dominant battlespace knowledge school of thought", bases itself upon the first, but considers that sensors' multiplication will enable a complete view on the battlespace⁴⁴.

The third school, called "global reach, global power" – a phrase first to appear in 1997 – sends us back to the position of the US Air Force, which considered that air power and long distance strikes will play a decisive role in achieving the process of *Transformation*. Here again, the place held by new technologies – meaning space-based lasers and other hypersonic bombers, for the most techno-optimists – is decisive [LAM 97, PER 95, GOU 97]. It finds many political and doctrinal representatives. If we follow O'Hanlon's thinking, we can think that a former Defense Secretary such as Donald Rumsfeld would be one of them.

Finally, the last school suggested by the author gathers part of Cohen's "sceptics" and considers that the American *high-tech* arsenal will be so powerful that whoever would try to attack the United States would use irregular methods. We can then see a variety of thinking being shaped. They either consider a dissymmetric threat based on weapons of mass destruction; or asymmetric threats, through the use of terrorist tactics, of which 9/11 would be the most completed example or the conduct of guerrillas for which American forces would not be well prepared⁴⁵.

Let us retain from O'Hanlon's classification that authors working on RMA often embrace a view that crosses the knowledge and opinions of different schools of thought, which are by definition ideal-typical. Following this thinking, we can consider that if O'Hanlon's assertion holds a heuristic significance, which is inferior to Cohen's taxonomy, it remains useful to help and understand the evolution of the "RMA/*Transformation*" phenomenon. As it is institutionally adopted and politically encouraged

44 This positioning is not limited to defense academics. The former military Chief of Staff of the US Air Force, Ronald Fogleman, could thus state in 1997 that "in the first quarter of the 21st Century, you will be able to find, localize or follow and target – in close to real-time – anything of consequence that moves upon or is located on the face of the Earth". Quoted by [HOA 00, p. 13]. About the concept, see [JOH 96].

45 This would be the case, among others, for literature on "fourth generation wars". Yet, let us note that some American weapons such as the *Marines*, are better prepared to this type of conflict than the US Army.

throughout *Transformation*, RMA is, indeed, called to generate choices (whether they are doctrinal or means choices), which would be much more complex, particularly due to factors that were underestimated in the literature such as acquisition and logistics costs and their consequence on the structure of forces. With this precision, we still need to note that this first approach of the notion of military revolution yet fails to examine its deep resources, which we will examine in the next chapter.

