



Relationship between technological breakthroughs, tactical thinking and elite training, from colonial expeditions to the present

Earth Thought Notebooks

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Published on 17/06/2020

Sciences & technologies

Although asymmetry locally challenges the J.F.C. paradigm, Fuller's paradigm according to which military thought and training adapt to innovation, Squadron Leader Roméo Dubrail and Battalion Chiefs Antoine Mathey and Yann Queran show that this analysis is true in France from 1945 to the present day. Indeed, whether it was during the age of the atom or the age of NICTs, the technological breakthrough initiated a real revival of strategic and tactical thinking and, as a result, major changes in the training of the elite. Conversely, the descending phase of the atomic age showed a sclerosis of military thinking around the use of nuclear weapons.

France must now seek to trace the contours of the future major technological breakthrough, both through dual-use research and through research specific to armies, in order to derive intrinsic advantages in all fields, if it wishes to remain a major nation on the international scene.

In *L'influence de l'armement sur l'histoire* published in 1946, J.F.C. Fuller^[1] highlights the links between civilizations, the evolution of armament and the consequences on the conduct of war. It clearly distinguishes different historical periods with a cyclical character, marked by the hegemony of powers that have mastered breakthrough technologies. It counts six long cycles in the course of history. As with Kondratieff's long economic cycles, each is initiated by a technological breakthrough, then has an ascending phase and finally a descending phase.

In order for the technological break to allow a break in the art of warfare, armies must grasp all its applications through a reflection of military thought leading to a break in doctrine.

According to J.F.C. Fuller, military thought and the learning of the art of warfare are fundamentally subject to technological innovation, also in a cyclical movement. Is this analysis by J.F.C. Fuller still relevant? Since 1945, has military thought and the training of elites continued to be subject to technological innovation?

Christensen and Mr. Raynor were the first to clearly define the notion of technological breakthrough or breakthrough technology. They introduced this notion in 1997 in "The Innovator's solution"[2]. Innovation is considered disruptive when it initiates a new industrial and economic cycle that characterizes a long Kondratieff cycle. From a military point of view, a disruptive innovation must initiate a break in strategic thinking and the training of elites. This triple rupture is part of a new armament cycle as described by J.F.C. Fuller.

This study will be limited to the French army and its ability, since 1945, to link the following three cycles: technological breakthroughs, elite training and military thinking.

Since 1945, the assertion of J.F.C. Fuller's assertion that military thought and training adapt to the major cycles of armament has been verified throughout the age of the atom but also through the "age of NICTs" that began in the post-Cold War era.

If asymmetrical conflicts seem to call into question the adaptation of military thought and the training of elites to the technological breakthrough, these periods are part of the long cycle, "the age of the atom"? which began in 1945, without calling into question the thinking of J.F.C. Fuller. Also, this adaptation remains relevant to the age of NICTs, which began in the 1990s, a period during which France is seeking to reconcile technological breakthroughs, doctrine and training in the same cycle.

Questioning the subordination of military thought to the dominant technology by the "small wars".

The asymmetrical conflicts that occur in long cycles call into question the hegemony given by technological advances to the major powers. In order to face these challenges, the training of military elites must anticipate the adaptation of military thought and develop innovations in the face of guerrilla warfare.

The armed force, prepared for high-intensity warfare, in difficulty in the face of asymmetry

The advent of a new age born of the technological breakthrough should enable the army mastering this innovation to face the whole spectrum of warfare. The majority of its training is geared towards preparing for high-intensity warfare that would engage its full combat potential. Put into perspective by O. Entraygues in his article "Fuller and Military Darwinism: Evolve or die"[3] in 2000, war structures the social life of men, according to J.F.C. Fuller. The search for a disruptive technology aims at having supremacy over its adversary in a logic of conquest of wealth. This idea is part of high intensity warfare. The goal is to outclass the opponent in a decisive battle. Those who adapt most quickly to material changes are the most likely to win the battle.

Ramel and J.V. Holeindre, in "The end of major wars"[4], present three elements to define a major war: state, technology shock and strategic victory. However, they note that in asymmetric warfare, techniques for bypassing the enemy limit the power of the technological shock that struggles to fight smaller, more mobile and flexible organizations that have found a way around this technology. The systematic adaptation of

military thinking to innovation then becomes less obvious, as the technological breakthrough does not allow for victory.

At the end of the Second World War, French military thought focused on nuclear deterrence and the ability to deal with a Soviet invasion. Although France had a mechanized army and a powerful air force, it found itself in difficulty against the Vietminh and the FLN. This mobile enemy, mastering the art of concealment in the jungle or among the population, circumvents power.

The elite must be trained to adapt doctrine to asymmetry.

Armies with a technological advantage should not neglect the development of asymmetric warfare. Indeed, the change in the opponent's method is automatically deducted from his inability to face the front. Although armies master the dominant technological tool over a long cycle, different phases exist that force its adaptation during shorter cycles. Sure of their weapons, armies then become victims of an intellectual decorrelation between the use of the dominant tool and the reality of the field, or even the society in which they operate.

Technology can create a straitjacket for military thinking and distort the vision of decision-makers. In order to avoid the confinement of minds, the training of elites must preserve imagination and innovative capacity. C. de Gaulle, in "The edge of the sword"[5], denounces "the doctrines of schools, which their speculative and absolute character makes both attractive and perilous". More than the learning of doctrine in the form of dogma, teaching must inculcate in officers the ability to adapt military thinking and technological advantage to the reality of operations. The proper training of elites is the one that prepares them for all wars, not just the deadliest.

After half a century of the Cold War, followed by the peacekeeping operations that characterised the following decades, the French army rediscovered counter-insurgency in 2008 in Afghanistan. As in Algeria in 1957, it had to take up the writings of J. Galliéni[6] and H. Lyautey[7] to understand that technological power is only a tool in warfare among populations. The military culture and the critical spirit of doctrine, instilled during training, remain the real assets of French officers in adapting military thought, entirely turned towards coercion, to the conquest of hearts and minds.

In the face of asymmetry, military thought is ahead of technological innovation.

In the face of guerrilla warfare, the most advanced technology can be easily breached by simple means. Thus, the state spends astronomical sums of money on unsuitable equipment. The army best prepared to adapt to tactical changes will have enormous superiority over all others. This intellectual preparation should make it possible to think outside the realm of technological innovation in order to return first to the fundamentals of combat and the obligations of the field, and then to look for technological adaptations.

From then on, the link of subordination of military thinking to technological innovation is

reversed. The return to the fundamentals of combat in order to deal with the constant tactical factor is accompanied by a reflection in the armies, driven by its elites, on the innovations needed to deal with the counter-technology capabilities implemented by the asymmetric adversary. Military research then enters into a game of failure in order to anticipate with each new innovation the adverse measures that could put it in difficulty. This permanent game of failure explains the very rapid pace of innovation in wartime.

Goya, in his article "Innovation during the American-Sunnite War in Iraq (2003-07)"^[8], develops the idea that, in times of confrontation, it is no longer innovation that determines doctrine, but the opposite. Whether during the wars of decolonization or during their recent engagement in Afghanistan, the French armed forces have also had to face the threat of improvised explosive devices (IEDs). The fight against IEDs has made it possible to focus military research on robotization after the failure of jammers in the face of remotely triggered IEDs. Thus, the minirogon (mini robot for engineers) and then the drogon (drone for engineers) were implemented successively in order to expose the engineers as little as possible.

J.Y.C. Fuller's idea according to which, during a cycle initiated by a technological breakthrough, military thinking and then the training of the elite systematically adapt to innovation, is more difficult to perceive in asymmetrical wars. Nevertheless, like Vietminh or today's IA, asymmetrical enemies carry within them the desire to become symmetrical, as R. shows. Trinquier^[9].

Over the long time of the age of the atom, the adaptation remains valid

Asymmetry is one of the average cycles that fluctuates within the long cycle without calling into question the relevance of adapting military thinking and training elites to the technological breakthrough. The age of the atom, which began in 1945, illustrates this paradigm.

Asymmetric conflicts are part of the long cycle

The asymmetric conflicts related to decolonization and participation in operations in Afghanistan can be seen as average cycles within the long cycles defined by J.F.C. Fuller. Phases similar to those developed by the economist J.C. Juglar are perceptible. The technological break is at the heart of this cycle:

- crisis (an asymmetrical enemy against which force is not adapted in terms of structures and means);
- retreat, regression (loss of initiative in the field);
- Technological rebound (countered by the creation of a concept of employment and organisational structures);
- boom (recovery of initiative, tactical victories and changes in the formation of elites).

Periods of asymmetric warfare are not arid in terms of innovations to deal with insurgency. While these phases do not bring about technological breakthroughs, they do allow innovation to adapt in shorter cycles that are aggregated with the long cycle. Thus, the

Indochina war saw the use of means linked to the 3rd dimension for ^{the} projection of airborne forces. During the Algerian conflict, the use of the helicopter made it possible to break the tactical deadlock by giving the tactical leader a capacity for ubiquity on the ground.

These short cycles allow the development of military thinking associated with it. Fully in line with the dominant doctrine (dominated by the technological break of the long cycle), military thinking adapts. Initiated in Indochina then deepened in the face of the FLN, the reflection on counter-rebellion takes into account the immaterial fields and, more specifically, the support of the population. A real break in the training of the elites ensued with the creation of regional schools such as the pacification and counter-guerrilla training centres (CIPCG) in Philippeville and Arzew in 1958, or through officer conferences such as C. Lacheroy^[10] in the universities, or for the benefit of political formations.

1945 or the beginning of the ascending phase of the atomic age

A long cycle responds to a logic of preparation for a symmetrical confrontation. The technological breakthrough brought by nuclear power initiates an ascending phase characteristic of a long cycle described by J.F.C. Fuller. The atom will initiate a real break in military thinking with a real continuity of reflections on high intensity warfare, integrating the nuclear "game changer" into these, as C. will note. Ailleret or R. Aron^[11]. This period perfectly illustrates J.F.C. Fuller's paradigm of the adaptation of military thought and the training of elites to the technological break.

At a time when the priority was to rebuild the country, the strategic perspectives of the atom were identified. The creation of the Commissariat à l'énergie atomique (CEA) by General de Gaulle, in 1945, opened a period of research for civilian purposes.

and military. These beginnings are marked by the intellectual effervescence of a generation of visionary officers such as P.M. Gallois^[12], A. Beaufre^[13] and L. Poirier. A real break in military thought was born.

This dynamism of thought is very largely influenced by the military authorities. General de Lattre, in his speech at the Staff College on January 31, 1947, exhorted all officers "to personal work and free research"^[14]. This intense period of military reflection around strategic thinking is characteristic of an ascending phase of an armament cycle. However, it was not until the advent of the Fifth ^{Republic} that French strategy was that of nuclear deterrence. In 1967, the Ailleret Doctrine was the translation of this strategic vision establishing the concept of "all-out deterrence". This reflection will be the last bearer of a real strategy for the use of nuclear weapons, putting an end to a real period of intellectual proliferation.

From 1970 onwards: the "descending phase" of the atomic age

A weapon of non-use par excellence and a pillar of the strategy of national independence, the sanctuarisation of nuclear fire was to freeze military thinking from the 1970s onwards. The inability to find innovative solutions to the threat of nuclear war

reduced land forces to a mission of ultimate sacrifice before the apocalypse. This impasse resulted from the primacy of the "Toga on the Sword" introduced by the Fifth Republic. This paradigm reduces or even annihilates the initiatives of the military elites and their ability to influence. Moreover, the chaotic management of the Algerian crisis exit accentuates this phenomenon.

Within the armies, this will lead to a paradox between the need to open up their elites and a dogmatism that will curb personal initiatives, as was the case for G. Brossolet and his book *Essai sur la non bataille*[15] which was the precursor of "guerrillatechno". This reflection was the object of a vast controversy when it was published because it did not conform to the military thinking of the time.

This end of the cycle suggests some signs of the sclerosis of military thought linked to a castrating effect of the atom, as if nuclear weapons could be the imaginary Maginot line of our defense. The result is a short-sightedness on the part of the military and civilian elites as to the prospect of the fall of the communist world and the ability of our armies to cope with a major conflict beyond a confrontation with the USSR.

Thus, the paradigm of J.F.C. Fuller's paradigm is verified in the period from 1945 to 1970 insofar as, like cyclical economic developments, technological ruptures in the military field do indeed lead to a strategic revolution, taken into account in the formation of the elites, with ascending and descending phases. Moreover, it makes it possible to better explain the current cycle marked by the development of NICTs.

A new cycle induced by NICTs validating the adaptation of military thinking to technology

The ^{third} industrial revolution, which began in the 1980s with the new information and communication technologies, led to a real technological breakthrough within the armed forces and the appearance of a new long cycle. Military thinking, then training, adapted to this innovation.

A new cycle for the armed forces

After the ages of bravery, gunpowder, steam, oil and atomic energy, J.F.C. Fuller's cycle theory seems to continue with NICTs and their military applications. This new cycle is part of the economic dynamics of the 1990s. From the end of the Second World War, armies, and in particular that of the United States, seized all the opportunities offered by the boom in information technology.

In 1966, the US Army initiated the ARPANET project, the forerunner of the Internet. In France, the RITA project came into being in 1960, but like the ARPANET, concrete applications only saw the light of day in the early 1980s. In the mid-1990s, the revolution in military affairs (RAM), based on technological advances in information and communication, profoundly changed military thinking and the training of elites.

As with each of the cycles enunciated by J.F.C. Fuller, the RAM, after overwhelming victories in Iraq in 1991, Kosovo in 1999, Afghanistan in 2001, and again in Iraq in 2003, must deal with the constant tactical factor in wars among populations. Vincent Desportes, in "Armées: technologisme ou juste technologie"[16], sees in it a technologist [temptation](#) emanating not from the military, but from the American military-industrial complex that encourages armies to adapt to technologies that are increasingly expensive and profitable for companies. Technology then formats military thinking and imposes its use on it, even though its effectiveness is being questioned in Afghanistan.

The renewal of military thinking and the training of elites

The application of NICTs has fundamentally changed the notions of command and control (C2) within armies. Military thinking is taking it up and turning it into doctrine. The concept of battle space digitization (BSD) was born in France at the end of the 1990s. The FELIN programme is only an extension of the NEB. After interconnecting the brigade command posts down to platoon level, it is the infantryman's turn to be connected within the "bubble". Nevertheless, it is worth considering whether these technologies are not part of the downward phase of the long NICT cycle.

The use of these materials imposes a doctrine of use that goes far beyond the weapon. The doctrine must encompass the joint, or even joint, weapons that the NEB interconnects. Military thinking can no longer think about weapons independently of each other. Once the doctrine is established, the soldier must then be instructed in the use of these materials. The mistake is to imagine that the use of these materials is the responsibility of the simple executors and to reduce the doctrine to a piece of equipment.

All these changes in the art of war induced by NICTs, but also their applications in wars among populations, make it necessary to review the training of elites. This technological break is profoundly changing the education provided to young officers. Because information and communication are at the heart of this innovation, the man-at-arms is no longer just the technician of war. He has to grasp the notions of ethics and humanity so that his technological advantage can be effective within populations. But the military elite is not the only one concerned by this strategic rupture. Civilian elites must learn the capabilities of the military tool in order to be able to use it effectively. It is with this in mind that the Saint-Cyr Foundation was created in 2006, IRSEM in 2010, and IHEDN was reorganized in 2008.

Anticipating a new cycle: preparing the doctrine for the challenge of robotization.

Current advances in the field of robotics presage the advent of a new military age around a technological breakthrough in the field of artificial intelligence. Although propaganda is very strong in the field of combat robots, their use has become a daily occurrence. In reality, they are essentially remote-controlled robots used for intelligence or IED intervention. However, like the SLATE programme in France, weapons capable of detecting the start of shots fired and of responding automatically are already in service in some armies. These innovations call for a renewal of military thinking.

This technological break in the field of artificial intelligence will also be a break in military thinking. Didier Danet and Jean-Paul Hanon, in "The battlefield revolution: evolution or rovolution?"[17], see [it](#) as a rupture even deeper than the one born from the invention of the atomic weapon, since the question will no longer be "how to make war", but "who makes war?". The subordination of military thought and the training of elites to the technological rupture is thus clearly established. Robotisation changes the doctrine and requires that the elites be perfectly aware, through ethical training, of the moral limits to the use of these new weapons.

The strength of a modern army is not to reject technological breakthroughs, but to know how to draw from them the effective tools of war tomorrow. Artificial intelligence should not obscure the debate on robotization, especially since its concrete application does not seem to be emerging in the medium term. It is the duty of the military and civilian elites to anticipate innovations in this field in order, firstly, to define our doctrine of use and, secondly, to equip ourselves with the capabilities to fight against the robotic means that our adversary will not fail to develop.

The age of the atom, described by J.F.C. Fuller, has been succeeded by the age of NICTs. The upward phase of this innovation has initiated a renewal of military thinking and the training of both military and civilian elites. In order to maintain their technological lead, armies are already studying the consequences of a technological breakthrough in the field of doctrine and ethical training.

Conclusion

Although asymmetry locally challenges J.F.C. Fuller's paradigm that military thought and training adapt to innovation, this analysis is true in France over the period from 1945 to the present day. Indeed, whether it was during the age of the atom or the age of NICTs, the technological breakthrough initiated a real revival of strategic and tactical thinking and, as a result, major changes in the training of elites. Conversely, the descending phase of the atomic age showed a sclerosis of military thinking around the use of nuclear weapons.

France must now seek to trace the contours of the future major technological breakthrough, both through dual-use research and through research specific to armies, in order to derive intrinsic advantages in all fields if it wishes to remain a major nation on the international scene.

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Release date 24/11/2017
