French neurophysiology between East and West: polemics on Pavlovian heritage and reception of Cybernetics

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Introduction

In the course of XIXth century, close contacts between French and Russian physiologists were established, most of all in the school of Claude Bernard (1813-1878), where I.M. (Ivan Mikhailovich) Sechenov (1829-1905) made important discoveries. The work of I.P. (Ivan Petrovich) Pavlov (1849-1936) on conditioning was developed in part in a Franco-Russian tradition of experimental medicine. Physiological measurements were used in a broad perspective of objective psychology. In this period, the model of experimental animal salivation was an ongoing topic, with classical contributions by Bernard in his *Mémoire sur les salives*[1], on saliva secretion from sublingual and sub-maxillary glands and salivation described as a "remarkable reaction", among "automatic reactions" or "psychic reactions"[2].

Such filiation was highlighted by Henri Piéron at the 1956 colloquium of the *Association de Psychologie Scientifique de Langue Française* held in Strasbourg. Accordingly, Pavlov worked on psychic secretions of sub-maxillary glands with Tolochninoff in 1902. This was the experimental program of psychic reflexes foreseen by future Nobel Prize winner Charles Richet. In his book, *Recherches expérimentales et cliniques sur la sensibilité*[3], Richet wished psychology would become one of the most interesting parts of physiology. Pavlov reckoned his intellectual debt to Richet and

Sechenov in his most famous publications[4] ; however, in his allocution made at his 1924 jubilee in Petrograd, Pavlov concluded Richet's and Sechenov's ideas were mere preliminary hypotheses to his experimental work[5], which then had no comparable equivalent in France, other than a few studies by Maloizel and Victor Henri in Albert Dastre's laboratory at the Sorbonne.

Nevertheless, relations between pavlovism and French physiology may be closer than usually expected. In 1959, Molly Brazier and Mark Rosenzweig discovered the study of psychic reflexes with salivation started before Pavlov in the 1850s, with at least three physiologists, among which Bernard[6]. Brazier suggested Pavlov was not aware of their results, since Bernard's researches on this topic were not described in classical scientific journals, but in his book entitled *Des fonctions du cerveau*, previously published in 1872 in the *Revue des deux mondes*. According to Rosenzweig, Bernard observed salivation before 1854 with a parotid fistula in a horse, when some movement of the experimenter indicated to the horse it was on the point of being fed with oat[7]. However, conditioning was not experimentally realized before Pavlov's method developed in the 1900s. Piéron admits he became aware of Pavlov's work after the 1906 Huxley Lecture Pavlov published in the Lancet, when Pavlov had already publicly described his research programme on conditioning at the April 1903 International Medical Congress in Madrid. The work by Jean-Claude Lecas demonstrates French physiologists did not generally follow Pavlov, whether a few American psychologists took great care in reproducing and complementing studies by Pavlov's school. In this period, a general decline in reflex studies was taking over in French physiology, whereas Franco-Russian relations were excellent, with important Russian studies translated into French, published and commented in the journal l'*Année Psychologique*. Lashley became acquainted with Bechterew's work with French translations in Watson's course[8]. This represents a first *chassé-croisé* in the history of Pavlovian heritage in the international context. More were to come on the front scene. A critical neo-Pavlovism emerged in the United-States, where Pavlov's experiments were being reproduced, with French physiologists and psychologists remaining both loyal and distant. After Second World War, cybernetics was considered as an anti-Pavlovian doctrine in USSR, whereas Wiener was close to communism and praised Pavlov's work on conditioning. Official Russian neo-Pavlovian physiology rejected cybernetics, whereas, after Staline's death, its

subsequent intrusion in scientific life allowed some deviations from Pavlovian theories and the rehabilitation of pre-cybernetics researchers such as P.K. (Pyotr Kuzmich) Anokhin (1898–1974) and N.A. (Nikolaï Alexandrovich) Bernstein (1896–1966).

The place of France in these paradoxes is central, especially since cybernetics was born in Paris and promoted by famous scientists, Louis de Broglie, and some Marxist circles, whether others remained faithful to Stalinian commitments. France was a link between USSR and western scientific culture in the reception of cybernetics between Anglo-American conceptions and Soviet principles. I wish here to emphasize the role of French scientists in the Pavlovian heritage, neo-Pavlovism, new ideas on brain mechanisms in Cold War period, where the rise of cybernetics was of prime importance in the reestablishment of international scientific relations between West and East.

Early studies on conditioning

Although France was not initially deeply interested in Pavlovian conditioning, some early students of Pavlov settled in Paris and performed high quality experimental work in the thirties and forties. Psychologist, Wladimir Drabovitch, was among the first with his 1912 studies made in the psychological laboratory of the Sorbonne under Pierre Janet[9]. As early as 1926, he drew the attention of physiologist Louis Lapicque on the use of the chronaxic concepts, “chronaxie de subordination”, to explain conditional reflex formation. Interaction between Lapicque’s dogmatic model and Soviet physiology highlights possible convergences between Pavlovian theories and western experimental neurophysiology, which lasted up to the sixties, although generally condemned in international reviews[10]. Between 1934 and 1937, Drabovitch developed peripheral and cortical chronaxic measurements during voluntary movement in conditioned dogs[11]. Marthe Bonvallet, Rudeanu and Herbert Jasper were involved in these same studies. Drabovitch’s work represents the only French studies on conditioning cited in the 1939 *Annual Review of Physiology*[12]. Lapicque mentions them in his 1943 book, *La Machine Nerveuse*[13], and comments Drabovitch’s use of the term “active movement” in a non-Pavlovian way, as “dictated by the desire to achieve a result”, for which he did not blame him[14]. This collaboration allowed Lapicque to extend his concept of chronaxy to

psychology, which could lead to an attractive neo-Pavlovism, his ideas had not been proved inadequate by Cambridge school of physiology in the same period.

In the thirties, another former member of Lapicque's laboratory, Alfred Fessard, discovered the conditioning of Berger's rhythm desynchronisation in man, at Piéron's *laboratoire de Physiologie des Sensations* at the *Collège de France*[15]. This observation was made simultaneously in the United States and studied for more than a decade[16], without much involvement of French scientists thereafter. A poor interest in Soviet physiology among French physiologists and psychologists cannot explain this refusal to follow these researches. In fact, Lapicque, among others, had been impressed by Russian neurophysiology, especially on the occasion of the 1935 *International Physiological Congress* in USSR. In a conference published in the journal *Union Rationaliste*, he reported well-equipped laboratories with more cathode ray oscilloscopes than his own[17] ! During the international meeting, a tenth of all reports were presented by members of the French delegation, presided by Lapicque. Piéron chaired the session on sense physiology together with Edgar Adrian and von Skramlik, with two final speeches in French by A.A. (Alexei Alexeevich) Ukthomsky and Lapicque, respectively on physiological lability and inhibition, and some recent progress in the understanding of the nervous system[18]. Besides Lapicque, other French physiologists and psychologists shared a left handed political sensibility. Marxist psychologist, Henri Wallon, a member of *Antifascist Intellectual Comittee* with Langevin, edited several texts between 1935 and 1937, including one on Russian Psychology after more than twenty years of Soviet regime, and a conference series held at the *Commission scientifique du Cercle de la Russie Neuve* between 1933 and 1934[19], edited in two volumes entitled *A la lumière du marxisme*[20], with the participation of biologist Marcel Prenant.

In the forties, another student of Pavlov, Nicolas Popov (1888–1954), was experimenting in Piéron's laboratory, not far from Fessard. He had previously worked in USSR on desinhibition, extinction and space orientation reflexes in pigeons. By 1944, he had begun electroencephalographic recordings in conditioned animals, following M.N. (Michail Nikolaevich) Livanov's studies using multiple cortical electrodes on rabbits, at the *Institute of the Brain* in Moscow. Popov's "electrocortical" measurements, as he called them, were

taken as neural correlates of extinction, several forms of inhibition and Zavadsky's desinhibition described by Pavlov's school[21]. Popov's experiments with EEG and associated cortical ablations were in general agreement with Pavlovian conceptions. Later, in the late 1940s, Popov was interested in time factor of conditional reflexes. He studied systematically the effect of variable delays between the two stimuli, which he called *cyclochronie,* and showed how it oriented conditioning towards reinforcement or extinction.

Thus, France represented a rather quiet but not negligeable place for Pavlovian studies up to the 1950s. Certainly, more studies were performed in the United States, Canada and Great Britain. Among Palvlov's students, Jerzy Konorski (1903-1973) worked in London, B.P. (Boris Petrovitch) Babkin (1877–1950) left USSR in 1922, and became professor at McGill university (1928–1942). After 1920, G.V. (Gleb Vassilievich) Anrep worked in London and Cambridge. He became a member of the *Royal Society*. V.N. (Vassilii Nikolaevich) Boldyreff emigrated to Japan in 1918, and then to the United States four years later, where he directed Pavlov laboratory at the sanatorium of Michigan until 1940. Ten-Kate settled in Holland and a Pavlov society was created by Gantt in the United States. Some British scientists, as J.S. Rosenthal, worked in USSR under the direction of Pavlov. Grey Walter started his career working with him on respiratory stress on conditioned dogs in Cambridge. In 1916, Lashley studied salivary reflexes in man in a psychological perspective[22], while in the same year Watson adopted the Pavlovian theoretical scheme in his presidential address to the *American Psychological Association*. In the forties however, Lashley developed strong criticisms to Pavlov's concept of generalization in a framework which he referred to as neo-pavlovism[23]. The same year, Adrian published his *Oxford Waynflete Lectures* in a famous book, *The Physical background of perception*[24], where his criticisms against Pavlov followed Lashley's arguments. Adrian defended the principle that different patterns of stimulation could be equivalent, since when a movement is learnt with one hand, it can be reproduced, even tough with much effort, with the other, different paths being used. Thus, learning could not be explained entirely with facilitated pre-defined circuits. The brain was accordingly more complex than a mere machine only sensitive to stimuli. Adrian insisted on the concepts of recognition and memory traces. In 1949, he was even more explicit on Pavlov and the efforts of Konorski to amend his views[25]. For Adrian, Pavlov's merit was his experimental conditioning

paradigms seen as a general tool for neurophysiology. Five years later, Piéron was surprisingly less hostile to Pavlov's heritage for at least two reasons. Studies in a pure Pavlovian style were still being made in his laboratory, and a renewal in conditioning experiments appeared after 1955. In his address at the Strasbourg inaugural conference, Piéron commented on the study of four properties of Pavlovian conditioning, *anticipation*, which he studied in invertebrates as an adaptive process, *association* by contiguity during learning, *spontaneity* of some conditionings, and the *arousal of emotional states* during conditioning.

Cybernetics emerged in the forties from this disparate international context, where Paris was to play an important rôle. The diversity of reactions to cybernetics then crystallized all possible incomprehensions between Soviet scientific views and western ideals among physicists, mathematicians and physiologists. Philosophers joining the cacophony, multiple *chassés-croisés* arose. I would like to focus in the next section on those relating to the history of Pavlovism, where France took part. It may seem paradoxical that Soviet judgements made cybernetics a western capitalist science relying on a materialistic animal-machine conception, whereas Adrian, following Lashely, and in accords with many physiologists and psychologists, opposed this same critics to Pavlov. Simplistic dichotomies used in past controversies should be avoided in present analyses, without opposing West and East, cybernetics to pavlovism, dialectical to reductionist materialism.

The introduction of cybernetics in physiology opened discussions of animal-machine problems. However, these were already on the front scene, before Norbert Wiener published both in Paris and New-York his famous book *Cybernetics*. Adrian has noticed Pavlov himself was made guilty of defending animal-machine ideas[26], including by USSR Marxists, before his work was taken as the Stalinian model of physiological sciences. These discussions were mentioned in many books written in the forties, as those by Adrian and Lapicque.

Animal-machine controversies raged in France. The year before he published *La machine nerveuse*, Lapicque had met mathematician and expert in calculating machines, Louis Couffignal[27], over thirty times. Couffignal was to become an influent adept of French cybernetics. These discussions were relating to the

modelling of automatic processes in cerebellum. Lapicque envisaged this structure as a "centre de subordination" of motor relays, in a vast framework including Pavlovian conditioning with additional selection of nerve paths as train switches governed by higher centres. Lapicque wrote "mechanisms preestablished in a fix manner are conceivable and probable for some acts, but are not sufficient [to explain voluntary actions]. Modifications of nervous paths switches are necessary." Lapicque wished to establish a model of differential switching in cerebellum accounting for motor learning. He felt "the regular periodic organization of cerebellar elements made cerebellum close to artificial machines. Some of its processes may be understood by comparison with calculating machine or automatic telephone relays."

At the 1962 Royaumont colloquium on information concept in contemporary science, where Wiener was invited, Couffignal confessed his discussions with Lapicque gave no result since cerebellum-machine analogies were merely structural. In 1950, Paul Chauchard clarified Lapicque's ideas in his article *Psycho-physiologie des cerveaux artificiels*[28], published in the communist journal *Esprit*, specifying Lapicque also had come to Couffignal's conclusion. Nevertheless, Lapicque's interpretation of Pavlovian conditioning is an example of speculations first developed in the twenties[29]. Among them, Paul Weiss' reflex resonance theory easily associated with conditioning experiments echoed in the work of some Russian physiologists in the same manner as chronaxic theory or theoretical studies of psychiatrist William Ross Ashby[30].

The importance of France in the birth of cybernetics must be reminded to understand the complex relations between this research field and physiology. Since the twenties, Wiener was travelling over Europe and his carrier was already exceptional. At age eleven, he entered Tufts University to take courses in mathematics. He joined Harvard to study zoology, where he obtained his doctorate of logic and mathematics at age eighteen. He worked with Bertrand Russell, taught philosophy at Harvard, and worked with *General Electric* on ballistic tables until end of First World War, before obtaining a professorship in mathematics at MIT. In 1925, he visited Germany, France, where he did not encounter much success. After Second World War, Wiener, then 51, took over again his journeys around the world. Couffignal visited him in the United States in 1946 thanks to the intervention of Léon Brillouin, then living in New-York, author of

"*La science et la théorie de l'information*"[31]. Shortly after, Wiener came to France, visited Lapicque, Couffignal, Fessard and his school, in the presence of McCulloch and Lorente de Nó. In 1947, he was invited to a colloquium organized by Bourbakists in Nancy on harmonic analyses. Enrique Freymann, director of Hermann editions, told Wiener he knew an editor interested in publishing his work. To Wiener's surprise, Freymann declared that was him[32]! Freymann also helped the the Bourbaki group, and by 1948, the book *Cybernetics* was jointly published by Hermann editions and MIT Press, in collaboration with John Wiley & sons, New York. Hermann edition had to fight to keep its rights[33]. Cybernetics was born, in a French context.

Positive reactions soon emerged in periodicals, first from Marxist circles, before USSR officials', placing France in a strange position between Soviet world and West. One of the first reactions was from Révérend Père Dominique Dubarle (1907–1987)[34], deeply interested in science and technologies. He wrote a full page in *Le Monde* entitled "A novel science: cybernetics – towards a governing machine... Will mechanical manipulation of human reactions ever create the best of worlds? "[35]. The optimistic tone and the idea of introducing machines in society went beyond Wiener's ideas. In 1950, cybernetics was on Parisian front scene, with support from physicists, mathematicians and physiologists, whereas criticisms were emerging in the USSR after 1951[36]. The joint session of the USSR Academy of Sciences and Medical Science named "Pavlovian session" opened on June 28th. It represented a court organised by scientists themselves to deprive the world of "dissident" physiologists, open to western science and escaping the Pavlovian orthodox scheme of neurophysiology. Among them were Berntsein[37] and Anokhin, who both defended ideas close to cybernetics in the thirties. Anokhin was forced to reject cybernetics[38]. This event was part of what is called the «Soviet Science Wars », where Staline controlled science in the name of dialectical materialism, rejecting contaminated western style scientists, in the spirit of Jdanovism which, since 1947, acknowledged a bipolar world, with USSR and the United-States, and a direct control over all Soviet productions. The fratricide war between scientists at the Pavlovian session is not as simple as the control of Soviet art circles, since Staline used interposed scientists. On the other hand, western science, Sherringtonian physiology for example, was not under direct attack[39]. But Russian physiologists were seen as escaping Pavlovian orthodoxy

by others. From 1951, cybernetics was criticized in this perspective by orthodox or repentant physiologists, and philosophers guided by Staline[40].

Such political context put the Parisian milieu in an awkward position, since some Marxists enthusiastically accepted cybernetics, while others rejected it in a Stalinian way. In 1951, Louis de Broglie organized meetings devoted to cybernetics to discuss current studies on propagation and deformation of signals, with edited acts in the *Revue d'Optique*[41]. De Broglie foresaw cybernetics as a unified study programme. In 1952, he wrote: "cybernetics is fashionable: it unifies domains before separated and can lead us to new ideas on mechanics and physics, but also in normal physiology or pathology, psychology, and why not sociology. It is of legitimate interest."[42] The same year, the journal *Esprit* published a special issue on cybernetics with articles by G. Th. Guilbaud, Dubarle and Chauchard[43]. Guilbaud was critical to American technocracy and pointed cybernetics, while Couffignal's project of calculating machine was congratulated. De Broglie joined Marxists when, in 1953, he rejected Niels Bohr's and Werner Heisenberg's interpretation of quantum mechanics (Copenhagen interpretation) judged as simplistic in USSR. This denial made the front cover of Marxist journal *Les Lettres française*[44], since dialectical materialism was advocating deterministic physics relying on strictly defined material entities. Michel Paty has concluded de Broglie was only following his theoretical work[45], while an interpretation in social history holds de Broglie was adopting his former ideas of the twenties, then criticized by Pauli, and advocated in the 1950s by American Marxist physicist Bohm, escaping the United-States and supported by communist Parisian circles[46].

The 1953 paper by André Lentin published in *La Pensée* represents the climax of attacks over cybernetics in a Stalinian style, taken over by an anonymous USSR author called *The materialist*. However, positions progressively changed after Staline's death. In 1956, Marxist journal *La Pensée* published the lecture given by Arnost Kolman (1892-1979)[47] at the *Social Science Academy of Soviet communist party central comity* entitled "What is cybernetics?" A major argument was "the 1951 presidency of a cybernetics colloquium in France by one of the foremost contemporary physicists, Louis de Broglie, should not be underestimated."[48] Therefore, the role of France in the diffusion of cybernetics in Eastern Europe is indisputable. Another example was Couffignal's

book *Les Machines à penser*[49] noticed in German democratic republic journals[50]. Thus, in this period, 1950-1955, Paris was legitimized as a meeting point for cybernetics between Marxists and a generally receptive international scientific community. These tensions placed France between East and West, but more profoundly between contemporary anti- and pro-Americanism, rather than at various distances from Marxism and dialectical materialism.

Pierre Mounier-Kuhn has shown Marxist anti-Americanism was vigorous in some research fields. In the area of calculating machines, Couffignal claimed for methodological options, radically opposed to American ones. They were applauded by French Marxists, with the outcome of delaying French research. According to Mounier-Kuhn, *La Pensée* spread the idea of a French autonomous and distinctive science among research scientists, technicians and academics of Marxist sensibility, especially in physics[51]. Nevertheless, a modern and apolitical pro-Americanism also flourished with numerous contacts between American scientists and the role of the Rockefeller foundation or the US army in funding French research. The school of Alfred Fessard is an example, where relations with the United-States were essential; they were established after close previous contacts with Great Britain before Second World War.

Therefore, France was a link in the introduction of cybernetics from western countries to Soviet world deprived of pre-cybernetician spokesmen. Besides the reception of cybernetics, one of the problems at stake was the possibility to criticize Pavlovian heritage and propose interpretations grounded on novel neurophysiological data, escaping Pavlovian orthodoxy and Marxist views. The 1951 colloquium held in Paris on "Calculating machines and human mind" gave the opportunity to American, British and French scientists to answer these questions. Among them were Louis de Broglie, Louis Couffignal, Henri Piéron, Alfred Fessard, Henri Gastaut, Denise Albe-Fessard, Pierre Buser, Jacques Paillard, Jean Scherrer, Louis Lapicque, Paul Chauchard, Alexandre Monnier, Antoine Rémond, Lorente de Nó, McCulloch, Torres Quevedo, Grey Walter, William Ashby and Norbert Wiener. I analyzed elsewhere ideas of Fessard and Gastaut on one side, and Lapicque's on the other, closer to Americans. An essential point in these discussions dealt with the validity of analogy suspected by dialectical materialism, and often put forward against cybernetics. Fessard's usage was more refined and addressed against his American counterparts prone to consider

models as true explanations of brain functioning. Fessard argued "an identical final result can be obtained by distinct mechanisms."[52] American scientists seemed to minimize the distance between machine and mind in a reductionist manner, criticized by Lapicque himself acknowledging his committing himself in this perspective with the title of his book *'La Machine Nerveuse*". On the other hand, Fessard urged to use analogies at a lower structural scale, between electronic circuits and chains of neurones to bring out functional and structural homologies. This view was following Sherrington's attempt to compare the synapse with valve diodes, an analogy used by Couffignal and Wiener, and widely criticized in USSR. Fessard seemed cautious compared to his foreign colleagues, but did not deny the importance of their work. In a paper given in 1952 at the *Société Française de Psychologie* on "Brains and machines", Fessard wrote "feedback transmission plays a great role in vegetative functions, upon which homeostasis is grounded, in the case where this property is a nervous control [...] reverberant transmissions are responsible for some complex brain phenomena, as those involved in the formation of constant responses, in conditioned reflexes, the storage and revival of recollections [...] It is the merit of studies on models to have proved it, but physiologists, psychologists and psychiatrists [...] should not escape this scientific path following the metaphysical fever of a few."[53] Fessard's position can be interpreted as opposing the radical views of his American and British colleagues on brain-machine metaphor, also criticized in the United-States[54].

Besides these discussions devoted to cybernetics, international neurophysiology thrived with the famous 1953 colloquium in the Laurentides on "Brain mechanisms and consciousness" [55], where consciousness emerged as a new scientific concept. However, neurophysiological review papers on higher nervous activities, a Russian terminology, rarely mentioned USSR studies. A slow revival in the field developed in USSR. Pavlovian session was condemned at the 8th Physiological Congress of Kiev in 1955, with the rehabilitation of L.A.(Leon Abgarovich) Orbeli, I.S.(Ivan Solomonovich) Beritashvili, P.K. Anokhin and N.A. (Nikolai Appolinarievich) Rozhanski[56]. The same year, Anokhin was asked to chair the Physiological Department of the first Medical Institute in Moscow[57]. He also became director of the *Physiological Sechenov Institue* in Moscow. Anokhin published several books including internal inhibition as a physiological problem[58]. In the same years, Bernstein reworded his theoretical

ideas with the language of cybernetics, while Orbeli did not really take over his humiliation by orthodox neo-Pavlovians.

From 1955, France was more than a theatre of ideological conflicts relating to cybernetics, but it became the meeting point of Soviet and western neurophysiologists. Konstantin Ivanov showed how the new Soviet regime allowed scientific contacts with the West, in a new political context of appeasement and the refusal of nuclear war, a view initially criticized by Khrouchtchev, he finally accepted. In 1954, USSR Academy of Sciences appealed for international exchanges. France soon became a place where neurophysiologists could meet, initially in the Marseilles school of Henri Gastaut. In 1955, Gastaut organized an international colloquium on "Electric activity of the brain in relation with psychological phenomena". Papers were published under the title "Conditioning and reactivity in electroencephalography"[59]. This was the fifth Marseilles colloquium, the first of which was held in 1950 on behalf of the *Réunion Européenne d'Information Electroencéphalographique*. During the 1955 meeting, "western and Eastern worlds could exchange their views on conditioning and reactivity in EEG for the first time since long ago", Robert Naquet declared [60]. The great discovery of the colloquium, reports Gastaut, was that the vast majority of discussions dealt with electroencephalographic aspects of conditioned activities. New parallels between Pavlovian higher nervous activities and modern neurophysiology were drawn. The last day of discussions was entirely devoted to these questions. Gastaut wrote "such results were unpredictable in western countries where circumstances had depreciated Pavlovian methods with the benefit of psychological techniques, and the disappearance of electroencephalographic researches on conditioned reflexes and higher nervous activities."

The following year, the Symposium organized by the *Association de psychologie scientifique de langue française*, in Strasburg was devoted to conditioning and learning, with the invitation a Russian developmental psychologist A.N. (Alexis Nicolaevich) Léontiev (1903-1979). A year after, the first *International Congress of Neurological Sciences* in Brussels gave Pierre Buser the opportunity to pursue the paper given by Fessard and Gastaut in Strasburg on the neurophysiology of conditioning with electrophysiological correlates and interpretations in terms of neuronal structures. The review entitled "Interpretation of

conditioning on the base of electroencephalographic data" was made in collaboration with Annette Roger. Much emphasis was put on Russian studies, with a historical international overview, besides difficulties in collecting and translating Russian studies. Since then, a great number of western studies addressed specific problems from Russian literature. We can mention French papers by the Marseilles' school, Scherrer, Jouvet and Buser (relating to studies started under Hernández-Peón), and especially those on conditioned secondary cortical responses by P. Buser, A. Rougeul and P. Borenstein.

In 1956, Gastaut was invited by V.S. (Vladimir) Sergeevich Rusinov and Georgiy D. Smirnov (1914-1973), both present at the Marseilles' colloquium. He proposed A.V. (Alexander Vassilievich) Topchiev, Secretary of the USSR Academy of Science, to hold the new Marseilles' meeting in Moscow. This was, according to Naquet, the "*colloque de Marseille à Moscou*", held in October 1958 at the House of Scientists in Moscow, where IBRO was founded. The Moscow colloquium was so successful that funds allowed a special survey on EEG, personality and sensori-motor functions.

The period 1955-1960 was pivotal for international neurophysiology, where France was at the heart of revival of West-East exchanges. However, soon after, American and Russian scientists also established close and direct relationships. Wilder Penfield was invited in 1955 by the Academy of Sciences to spend two weeks in USSR, where he met Topchiev and Smirnov[61]. Also, Horace Magoun was continuously interested in Soviet science since the February 1958 Macy conference on "Central Nervous System and Behavior", where Mary Brazier analysed the history of Russian physiology. The two following years, Magoun invited E. Grastyan, V.S. Rusinov, E.N. Sokolov and A.R. Luria[62]. However, Gastaut's meeting in Moscow was by far the most outstanding, with the revival of conditioning studies in various areas including instrumental conditioning (Buser, Rougeul), pharmacology and psychiatry. At the Salpêtrière, Georges Heuyer (1884-1977), holding the first chair of paediatric neuropsychiatry, created the *Laboratoire du conditionnement, chirurgie, psychiatrie infantile*, where Catherine Popov made important contributions, with Jean Scherrer and Léon Michaux.

In the following decade, French neurophysiologists rediscovered the work of Bernstein and Konorski, especially at the Marseille *Institut de Neurophysiologie et Psychophysiologie*. Gilbert Lelord and Jean Massion visited the *Nencki Institute of Konorski* in Warsaw. Fessard asked them to write a report on their visit, later published in the *Année psychologique*[63]. This was actually part of an exchange with two students of Konorski, Mrs Jankowska and Jan Bruner working in Fessard's Institute. A new research topic was developed by Bruner and Ladislav Tauc on conditioning at the neuronal level, a subject Fessard had discussed at the Moscow colloquium. Concepts of integration, facilitation, convergence of heterogeneous paths on a single neurone, and later, desensibilisation, facilitation, heterosynaptic depression and habituation were put together. These paths were opened by Jan bruner and Tauc, then in collaboration with Eric Kandel, on Aplysia neurones. France was the site where concepts from West and East merged in the frameworks of Pavlov, Konorski and Lashley.

From 1950 to 1960, France witnessed the union of neurophysiologies from areas of the world long separated. Western scientists realized the importance of Soviet science progressively discussing its main implications for contemporary research and establishing new collaborations for future decades, especially in the field of cognitive sciences. Franco-Russian neurosciences have always awaken much interactions and passion since the XIXth century, up to the sixties, and now on, through Cold War, whereas present time asks for continuous relations for the advancement of science and a better knowledge of its history.

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