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Review

Pavlov at home and abroad: His role in international physiology

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Abstract

Contemporary science is conducted internationally. This is a comparatively recent phenomenon that developed during the last century, most notably after the second world war. During the first half of the twentieth century, however, I P Pavlov became the first major international physiologist, travelling widely and contributing to major scientific meetings around the world. This paper records and assesses Pavlov's international role, with an especial focus on the International Congresses of Physiology, set in the dynamic context of his domestic position in Imperial Russia and later in the Soviet Union.

Keywords: Pavlov I.P; International Congresses of Physiology; History

Contents

1. Introduction

Pavlov's international role and influence can be assessed in several ways. These include bibliometric techniques such as citation analyses of his work, or prosopographical examinations of the careers, impact and networks that he, his colleagues and students created. His professional role was considerable: as a Nobel Laureate, he commanded widespread respect and esteem; and as the head of an important laboratory, he was responsible for training a whole school of physiologists and psychologists who continued his ideas about integrative physiology and behaviour to future generations. In the Soviet Union, Pavlov directly and indirectly influenced most physiological and psychological research for decades (Langue, 1997). Indeed his authority continues to be palpable in contemporary Russia (International Union of Physiological Sciences, 1997). However, I will leave it to other contributors to this celebratory volume to assess these and other aspects of his legacy. My purpose is somewhat different. Pavlov was of the first generation of professional physiologists who began to travel abroad routinely, either to work, visit colleagues or to take part in new international congresses. Although his books were translated from Russian, usually after some delay, much of the work emerging from his laboratory was not readily or

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rapidly accessible to fellow scientists. Therefore his addresses and talks to international congresses were of enormous importance in spreading his ideas, and this paper will record and examine his personal influence in this new arena, with an especial focus on the International Congresses of Physiology.

2. I. P. Pavlov: early years

Ivan Petrovich Pavlov was born in 1849, in rural Russia, at a time of considerable political change and unrest. The year previously Marx and Engels had published their *Communist Manifesto*, at the same time as political disturbances had spread across Europe affecting *inter alia*, Poles, Germans, Rumanians, Italians, French and Danes in what became known as the 'Year of Revolutions'. Pavlov's early years saw equally, if not more, challenging scientific advances: in 1856 Pasteur announced his discovery of fermentative microorganisms, and 2 years later Rudolf Virchow proposed that 'all cells derive only from cells' in *Cellularpathologie*, both observations revolutionising pathology and the study of disease. In 1858, Henry Gray produced his *Anatomy, Descriptive and Surgical*, soon to be known eponymously around the world, and which made an equally great impact in medical teaching. A decade after Pavlov's birth, however, perhaps the most startling theory of all came to the public's attention: Charles Darwin published his *Origin of species*.

These astonishing advances made little immediate impact on the young Pavlov who entered a Russian Orthodox seminary in his native Ryazan, intending to become a priest like his father. There was, however, growing interest among Russia's small intellectually liberal elite in the exciting new scientific ideas emerging in Europe (Cuny, 1962). Some of these permeated into contemporary literature. For example, Feodor Dostoevsky referred to Claude Bernard in *The Brothers Karamazov*, and in *Crime and Punishment* has one character, Marmeladov, discuss 'George Lewes's Physiology' (Dostoevsky, 1866, 1880). That book, *The Physiology of Common Life* by the Englishman George Henry Lewes was also in Ryazan's library (Lewes, 1860a). It was this very book, Pavlov explained years later, that changed his life. Whilst visiting his former pupil, Boris Petrovich Babkin, then professor of physiology at McGill University in Montreal, Pavlov spotted the book on a library shelf. Pointing to a diagram of the gastro-intestinal tract, adapted from Claude Bernard's *Introduction to the study of experimental medicine*, he explained 'When in my very young days I read this book, in a Russian translation, I was greatly intrigued by this picture. I asked myself how does such a system work? My interest in the digestive system originated at this epoch' (Babkin, 1949b) (Fig. 1). According to one biographer, a well-worn copy of Lewes' book remained one of Pavlov's most treasured possessions (Gantt, 1928).

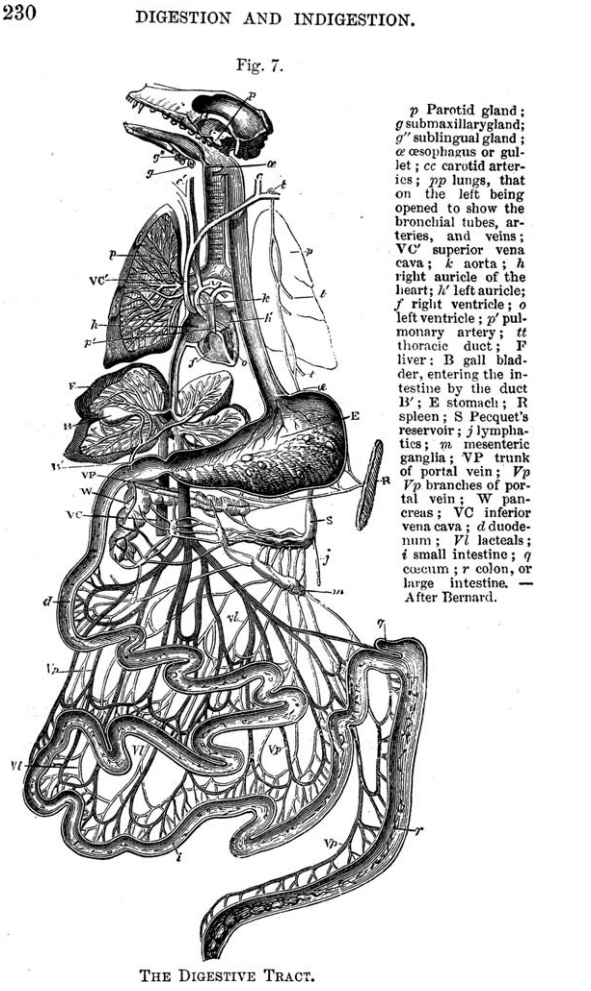

Fig. 1. The digestive tract, as illustrated in George Henry Lewes' *The Physiology of Common Life*, (Lewes, 1860b).

Pavlov started to foster that gastrointestinal interest by abandoning the seminary for medical studies in St. Petersburg and after graduating, he travelled to Germany in the early 1880s. There he studied with two of the greatest physiological teachers of the period: Karl Ludwig in Leipzig from whom he learned the importance of precise and careful observation; and Rudolf Heidenhain in Breslau, where he was trained in the very latest surgical and experimental techniques in gastric physiology. He was following a well-worn route (Rothschuh, 1973a). The 1870s and 1880s were dynamic decades for the establishment of physiology, as the laboratories of German physiologists in particular (a decade or two earlier, it had been Claude Bernard in Paris) attracted students from around the world to learn new concepts and techniques. From there acolytes returned home, to Universities and medical schools where physiology was, if it existed separately from anatomy, a merely part-time teaching responsibility of a physician. In several countries including Sweden, Denmark, Italy, the UK and the USA, this new breed of physiologists promoted the introduction of experimental medicine in medical schools, and campaigned for the recognition and financial resources to create

professional staff positions for physiologists, to build properly equipped laboratories and departments, and to develop the infrastructure of scientific societies and dedicated journals (Rothschuh, 1973b). Pavlov wanted exactly the same and he returned to the medical military academy in St. Petersburg with the intention of establishing his own school of experimental physiology.

National campaigns for the support, growth and development of the subject also stimulated the holding of the first International Congress of Physiologists, at the urging of the [British] Physiological Society, in Basle in 1899 (Franklin, 1938a). This attracted 129 members from 13 countries, a measure of the worldwide constituency of those who considered themselves 'physiologists' at this time. Although half a dozen scientists from the Russian Empire attended that inaugural meeting, Pavlov was not of their number. He remained in St. Petersburg, energetically developing research work on the circulation and beginning experimental studies of the digestive system. He was also heavily involved in the building and equipping of a new imperial research institute in experimental medicine. This was originally envisaged as a bacteriological laboratory, modelled on the Pasteur Institute in Paris. The scientific and political machinations to create the institute, and to broaden its remit to cover a wider definition of experimental medicine have been well detailed (Todes, 2002b). That the comparatively junior Pavlov, who was no bacteriologist, was included in the organising committee probably owed much to the patronage of his boss, Sergei Petrovich Botkin, who was Director of the clinical laboratory at the Military Medical Academy, personal physician to the Tsarina, and one of the most powerful figures in Russian medicine at the time. Pavlov argued strongly for facilities for modern physiological research, including housing for large numbers of experimental animals, and the provision of a room for aseptic surgery. His forceful demands point dramatically to his own research plans for a large-scale programme of investigative physiology, using surgically manipulated dogs. He was successful in negotiating a laboratory budget five times greater than any other Russian physiologist, although his space rapidly became overcrowded and cramped. Two years after its opening in 1891, a general gift to the Institute of 10,000 roubles from Alfred Nobel was used to build further, by then much-needed, accommodation for Pavlov's laboratory (Schück et al., 1962). Further funding came from an unexpected source, as Pavlov's experiments on gastric fistulae and the stimulation of gastric secretion allowed the collection of gastric acid, which was then sold as a therapy for poor digestion and dyspepsia. By 1904, revenue from gastric acid sales had increased Pavlov's laboratory budget by 65% (Todes, 1997).

That was the same year in which the International Congress of Physiologists was held in Brussels, attracting 256 members of the growing international community of physiologists. Again, Pavlov is not listed amongst the participants. However, he did travel abroad in 1904: to Stockholm to collect his Nobel Prize for Physiology or Medicine, an award that was not as inevitable as might now be assumed.

3. The Nobel Prize, 1904 and later

The Nobel Prizes were established by the Will of the dynamite manufacturer Alfred Nobel and were first awarded, in four subject areas, in 1901. Forty individuals were nominated for the first prize in Physiology or Medicine, which was awarded to Emil von Behring. Pavlov had received 8 nominations, as he did the following year, when the Prize went to Ronald Ross (Nobel Foundation, 2005; Todes, 2002c). In 1903 Pavlov was nominated 5 times, but the Prize again eluded him and went to Niels Finsen. Concerns about Pavlov's work centred on the way in which he had worked since he became director of his own large laboratory in 1891. He employed teams of assistants including young military doctors doing MDs, and numerous technical helpers, the *praktikanty* (see Figs. 2 and 3). One estimate suggests that about one hundred people worked with him between 1891 and 1904 (Todes, 2002d). At that time, the Nobel Committee awarded the Prize unequivocally to one person for individual achievement. Could they seriously consider Pavlov? During 1902, a member of the Nobel Committee, Karl Mörner, attended the Congress of Northern Naturalists and Physicians at which Pavlov and members of his laboratory presented numerous papers. His report to the main committee was strongly supportive, 'Pavlov is the soul and the leader even in the research that his workers and students in the laboratory carry out' (Mörner, 1903, quoted in Todes, 2002a). Despite that recommendation, another year passed without the Prize going to Pavlov. By 1904, Pavlov was strongly supported to the Nobel Committee by Jöns E. Johansson, the influential professor of physiology at the Karolinska Institute, who presented an emphatic, gland by gland, review of all Pavlov's contributions to gastric physiology. His advocacy swayed the doubters, and Pavlov was finally awarded the Nobel Prize. In later years, in 1927, 1929 and 1930 Pavlov was again nominated for the Prize, for his work on higher nervous functions. These nominations were neither reviewed nor assessed by the Nobel Committee.

4. Early international links

In 1902, the British physiologists Ernest Starling and William Bayliss first announced their discovery of secretin, a chemical stimulant of pancreatic secretion, and one of a class of active substances for which the word 'hormone' was coined. Their discovery was clearly at odds with Pavlov's strong programme of neural control of pancreatic and other digestive secretions. The intellectual problem of hormonal

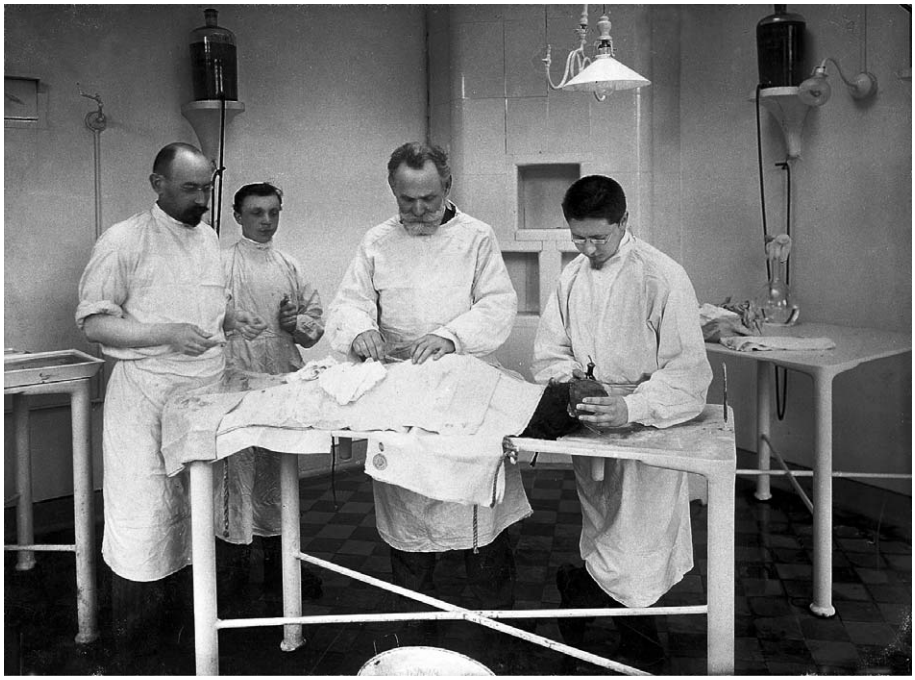

Fig. 2. I. P. Pavlov operating with three colleagues on an anaesthetised dog in the department of Physiology, Imperial Institute for Experimental Medicine, St. Petersburg, c. 1902. Reproduced courtesy of the Wellcome Photographic Library.

versus neural control continued to be an issue for debate, discussion and further experimentation. Although not necessarily agreeing with Pavlov's work, or his interpretation of it, which first appeared in a substantial English translation in 1902 (Pawlow, 1902), Bayliss and Starling acknowledged that it was Pavlov's 'masterly series of researches' that had opened up the field of digestive physiology (Starling, 1906). The Englishmen's work, which seemingly contradicted some

Fig. 3. I. P. Pavlov and students in the Department of Physiology, Imperial Institute for Experimental Medicine, St. Petersburg, c. 1904. Reproduced courtesy of the Wellcome Photographic Library.

Fig. 4. A croquet party at William Bayliss' London house, c. 1910. Ernest Starling is seated on the ground in the front row, third from the right. Seated behind him, slightly to the right is Pavlov. William Bayliss is also seated on the ground, at the far left, and behind him to the right, is J. S. Edkins. Image from the archives of the Physiological Society, reproduced courtesy of the Wellcome Photographic Library.

of the Russian's, had figured in several of the Nobel Committee's later debates about Pavlov's suitability for the Prize. However, in his Nobel Lecture of 12th December 1904, Pavlov made no mention of their discovery or the possibility of chemical regulation of digestion (Henriksen, 2003). In fact, Todes has suggested that it was Bayliss and Starling's work on hormones that encouraged Pavlov to leave the field of digestive physiology, as he was unwilling to re-assess and integrate his work in the light of the possibility of chemical control (Todes, 2002e).

Pavlov visited London for the first time in 1906, to attend as a guest a meeting of the Physiological Society at Oxford in June and to give the Huxley Lecture at Charing Cross Hospital. This was one of the earliest occasions on which his new line of work, on 'psychical faculties in higher animals', was presented outside Russia (Pawlow, 1905). Although there is no unambiguous evidence that he visited Bayliss and Starling at UCL, it is extremely likely that they did meet at this time (see also Fig 4). Over the next few years, his British links increased: he was elected a Foreign Member of the Royal Society in 1907 and an Honorary Member of the Physiological Society in 1909. In 1912, he was awarded an honorary doctorate by the University of Cambridge, the ceremony of which was enlivened by enthusiastic students lowering a stuffed toy dog from the balcony above Pavlov's head, in recognition of his work. The toy dog was taken back to St. Petersburg where it was treasured by Pavlov's grandchildren (Basmanova, personal communication[1]), and it remains in a place of honour in his apartment, which is now a museum (Russian Academy of Medical Sciences, 2005). One of these visits to the UK also provided the opportunity for a social excursion to Bayliss' home, probably after a meeting of the Physiological Society, where he was photographed on the croquet lawn, surrounded by British physiologists including Bayliss, Starling and J. S. Edkins (Fig. 4).

1913 provided Pavlov with his last opportunity for international travel before the First World War, when he was one of 434 physiologists to attend the 1913 International Congress of Physiologists in Groningen. In addition to delivering a eulogy for Lord Lister, in which he emphasised the importance of antisepsis for physiologists, Pavlov was given the honour of delivering the closing address. Yet again he used the opportunity to bring his recent work on higher nervous activity to a large international audience, most of whom did not read Russian (Franklin, 1938b). In the Spring of the following year, the British physiologist Charles Sherrington visited St. Petersburg to discuss the arrangements for the triennial meeting of the Societé des Academies, planned for 1915 (but never held). Despite visiting the Russian Parliament, the Duma, and being received by the Tsar at the Summer Palace at Tsarskoye Selo, Sherrington recalled that a visit to Pavlov's laboratories and then his

[1] Ludmilla Basmanova, Pavlov's granddaughter, told the author this during a visit to Pavlov's apartment in June 2004.

apartment for dinner was the 'most memorable event of our visit' (Eccles and Gibson, 1979a). An incident when Sherrington and his companions arrived, contributed to that memorability, as he described,

Before we left the small lobby he [Pavlov] suddenly turned to us and said, 'The police may come tonight. I have not permission for three guests – I have permission for one, but not for three. If they come, they will put to each of you the question, "why are you here?" The only reply for you to give them is for each of you to say, "I do not know". That is the only reply which precludes all further answer or question'. We broke into a smile. He smiled too and added with a laugh, 'Please remember; that is the right and only reply to make'. The police did not come. Our evening was one of delightful hospitality and entertainment. Mrs Pavlov was there and a grown-up son and daughter, both of whom spoke English well. A glass case containing butterflies, collected by 'father' when a boy, evoked a number of anecdotes of father's boyhood. We left an hour before midnight. We felt we had been admitted to the hearth of a singularly lovable and simple Russian family (Eccles and Gibson, 1979b).

5. The first world war and the effect of the Russian revolutions

Pavlov's impact on the world stage was about to change as Russia entered a time of much turbulence. During the First World War, scientific meetings became almost impossible. In 1916, deprived of international contacts, Pavlov had, with others, submitted an appeal to the Minister of the Interior to found the Russian Physiological Society. At its inaugural meeting in Petrograd in early 1917, Pavlov spoke of the need to unite physiologists across Russia to promote the highest possible level of medical research. Simultaneously the *I.M. Sechenov Russian Journal of Physiology* was founded. The timing was inauspicious and it was not until 9 years later that the Society could hold its second meeting. Confusion was beginning to envelop the country after the recent Russian Revolution, the coming Bolshevik Revolution was to spread chaos, disruption and terror, whilst civil war, famine, and a major influenza pandemic added to the misery endured by Russians. Pavlov had particular problems because he was not only trying to support himself, his family and his laboratory staff, but he also had a large population of experimental dogs to maintain. Many of these had had complicated surgical interventions and complex training, and over 100 died from eating contaminated refuse (Todes, 1995a). Unhappy at the prospect of living under Bolshevik rule, Pavlov wrote to the Soviet of Peoples' Commissars in June 1920, for permission to talk 'with my foreign scientific friends and colleagues about finding a place for me outside of my homeland'. He complained not only of his own personal conditions and those of his colleagues, but also bemoaned the 'insurmountable material difficulties of every type in contemporary Russian laboratories and the absence of contact, of links with international scientific work' (Todes, 1995b). The letter was immediately forwarded to Lenin, who refused to allow such a high profile refugee from his embryonic Soviet State (the Soviet Union was formally declared in 1922). Months of debate passed by without a decision. Pavlov appears to have tried other approaches, as an unidentified visitor reported to Edward Sharpey-Schafer in Edinburgh '[Pavlov has] tried several times to get permission to leave the country' (Anon, 1921). In January 1921, Lenin issued a special decree to safeguard the scientific work of Academician Pavlov and his collaborators. The privileges included the equipping of Pavlov's laboratory 'with the maximum conveniences'; allowing him 'perpetual use' of his apartment; and guaranteeing his family, and later his colleagues, special rations. The decree was to be enforced by three party members, one of whom was the novelist Maxim Gorky (Babkin, 1949c). Despite the additional privileges, life remained difficult for Pavlov and many of his friends and colleagues abroad continued to be concerned about his well-being.

In London in February 1921 Ernest Starling approached the Medical Research Council (MRC) for a small grant to support Pavlov. This was refused, the MRC acknowledging that whilst they 'sympathised keenly with Professor Pavlov in his misfortune' they decided that they were unable to support him 'without evidence that he retains adequate mental and physical vigour for new work, and that other conditions for it are favourable' (Medical Research Council, 1921). In the USA, several attempts were made to assist Pavlov: the Rockefeller Foundation provided him with physiology books and equipment throughout the 1920s and 1930s (Windholz and Kuppers, 1988); and Walter Cannon, Professor of Physiology at Harvard, was a major force in raising money and activating and maintaining international concern for Pavlov's welfare (Wolfe et al., 2000a). One of those thus stimulated was Dr Horsley Gantt of the American Relief Administration who was sent to Petrograd in 1922 where he became a direct link between Pavlov and Cannon (see Fig 5). Indeed, Gantt became an important conduit of information about Pavlov to the world outside Russia. He published several reports of Pavlov's work in English language medical journals (Gantt, 1924, 1927); translated Pavlov's 1928 *Conditional Reflexes* into English (Pavlov, 1928); founded the Pavlovian Society in 1955 (Furedy, 2001, Pavlovian Society, 2005); and was a fervent, lifelong exponent of the work of Pavlov and his school (Gantt et al., 1970).

Two of Pavlov's former students also perpetuated his work from exile outside the Soviet Union. These were Gleb Vassilievitch von Anrep and Boris Petrovich Babkin (see Fig. 6). Anrep was an early visitor to the UK, when Pavlov

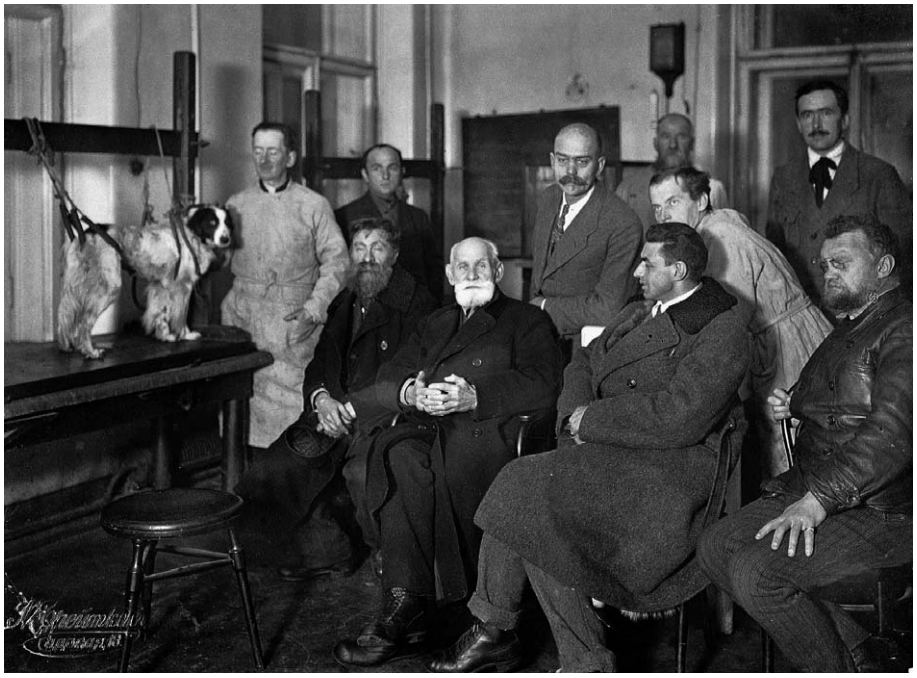

Fig. 5. A visit by Dr Horsley Gantt (seated second from the right) to Pavlov's laboratory, 1922. From the Archives of the Physiological Society, reproduced courtesy of the Wellcome Photographic Library.

sent him to work on secretion with Starling at UCL in 1912. He returned to Russia, and after the Bolshevik Revolution fought with the White Russians under Denikin, until he finally escaped to England in 1918. There, he joined Starling at UCL for 7 years before moving to Cambridge. From there, he transferred to Cairo as Professor of Physiology where he remained until 1952 when a nationalistic rising deprived him of his position, 3 years before his

Fig. 6. Portrait of Pavlov, Anrep and Babkin taken in London in 1928. Reproduced courtesy of the Wellcome Photographic Library.

death. In a lecture in the mid-1930s, he recorded his special debt to both Pavlov and Starling,

Pavlov's personality and that of my later teacher, Starling, had equally dominating influences upon my development as a physiologist, and I think this preface is the most fitting place in which to express my deep regard for these two gallant men of science. Strikingly different in their general temperament, they were alike in the completeness with which they experienced the unbounded joy of scientific discovery. The Pavlov of digestion was a physiologist of the old school; the Pavlov of conditioned reflexes one could almost say was a physiologist of the future; and Starling was a physiologist of the transition stage between the old physiology of observation and the present physiology of scientific analysis. I humbly hope that in my work ... I have been able to live up to the high principles which guided my two teachers (Gaddum, 1956).

Babkin joined Pavlov in 1902, directed to a project on pancreatic secretion. In 1915, he was appointed Professor of Physiology in Odessa in Southern Russia (now Ukraine) but by 1922 his liberal political views brought him into conflict with the new Soviet authorities, and he was imprisoned for 10 days before being sent into exile. Making his way to London he too immediately contacted Starling, who, with assistance from the Medical Research Council, employed him for 2 years at UCL. There, his biographers note 'he regained some peace of mind' (De Burgh Daly et al., 1952). Refusing several offers to return to the USSR, including one from Pavlov himself, he moved to North America in 1924 to a position at Dalhousie University in Canada, and became Research Professor at McGill University in Montreal in 1928 until 1947. Throughout these years, he extended his original work on pancreas into numerous examinations of salivary and gastric secretion. He also produced a particularly warm and intimate biography of Pavlov (from which the story above, about Lewes' *Physiology of Common Life* comes), largely because of his dislike for the hagiographical, ideologically driven eulogies of Pavlov that were then emerging from the Soviet Union (Babkin, 1946, 1949a).

6. Inter-war physiology

Post-war problems bedevilled international science, including physiology. An International Congress of Physiologists was held in Paris in 1920, and although it is included in the numerical sequence of congresses, its place as a truly international meeting has often been disputed, as Germans and physiologists from their former allies were excluded (Whitteridge, 1989a). The first completely open congress was the eleventh, held in Edinburgh in 1923, and attended by approximately 500 delegates. One of these was Pavlov, who, before the meeting, had travelled to France for the Pasteur Jubilee and to the U.S.A. as a guest of the Rockefeller Institute for Medical Research (Windholz and Kuppers, 1988). Despite the pleasure of seeing old friends, the theft of a large sum of money soon after his arrival in New York convinced Pavlov for a while that he was safer in the Soviet Union. Walter Cannon, whom he met for the first time, did much to reassure him (Wolfe et al., 2000a). Unfortunately, Pavlov's U.S. trip also ended badly, when the British Consul refused to grant him a visa, convinced that he was a Bolshevik. Fortunately, when Pavlov returned to Paris, the Consul there was more understanding, and he was allowed to attend the Congress where he took the opportunity of reconnection with the international physiological community. His final address, delivered in English by his son, described new work from his laboratory on the role of inhibition in sleep. The University of Edinburgh used the occasion to award honorary degrees to eight distinguished physiologists, including 'the most famous name in modern physiology': I. P. Pavlov (Anon, 1923).

By the time of the next International Congress of Physiologists, held in 1926 in Stockholm, Pavlov was the undisputed doyen of the conference. 581 physiologists attended, and the geographical location provided a rare opportunity for international exchanges. Many Russian physiologists travelled to the Congress, and several foreigners took advantage of their proximity to Russia to visit colleagues there (Gantt, 1927). Two years later Pavlov was back in England, representing the Soviet Union at the Tercentenary celebrations of Harvey's *De Motu Cordis* which had first appeared in Russian in 1924 with an introduction by Pavlov (Dickson Wright, 1959). It was a busy trip: the Royal College of Physicians of London made him an Honorary Fellow; he attended a celebratory dinner of the Physiological Society at Downing College Cambridge, where he signed the minute book in the company of past and future Nobel Laureates including H. H. Dale, A. V. Hill, O. Loewi, and C. S. Sherrington; and he attended a reception held by King George V, when a photograph was taken of him walking outside Buckingham Palace (Anon, 1928; Krikler, 1987). He also delivered the Croonian Lecture to the Royal Society on 'Physiology of the cerebral hemispheres' and was re-united with two of his most distinguished émigré pupils, Anrep and Babkin (Fig. 6).

In 1929, the International Congress of Physiology was held outside Europe for the first time, at Boston in the USA. The total number of registered attendees was almost 1700, a telling demonstration of the increasing numbers of non-European physiologists. Several Europeans did however make the trip, one large group including British, Swedish, Danish, Russian and German physiologists travelling on the S.S. Minnekahda, although French physiologists preferred to travel together on the S.S. France (Zotterman, 1968). It is not clear how Pavlov travelled to the conference, where one observer considered him "the most notable figure of that great assemblage ... [and] the most eager and untiring participant in the long drawn-out program" (Anon, 1936,

Fig. 7. A plenary session of the Fifteenth International Congress of Physiologists, at the Uritsky Palace, Leningrad (Anon, 1938).

quoted in Braun, 1991). At the meeting, Pavlov was invited to join the International Committee for the International Congress of Physiologists, and also took the opportunity to witness an operation by the neurosurgeon Harvey Cushing (1936). On the social side he visited Cannon's family farm in New Hampshire (Wolfe et al., 2000b), and travelled to see his former pupil Babkin in Montreal.

In 1932, the Fourteenth International Congress was held in Rome. The participants, numbering nearly 1000, were surprised to find Mussolini attending the inaugural meeting, and to learn that the Italian government had directed much of its organisation. 'As usual', one of the Congress historians writes, 'Pavlov was received with immense respect' (Whitteridge, 1989b). Once again, he delivered an address on the latest work from his laboratory on 'The Physiology of the Highest Nervous Activity' (Pavlov, 1933), and ended by inviting members to hold the fifteenth congress in the Soviet Union in 3 years time.

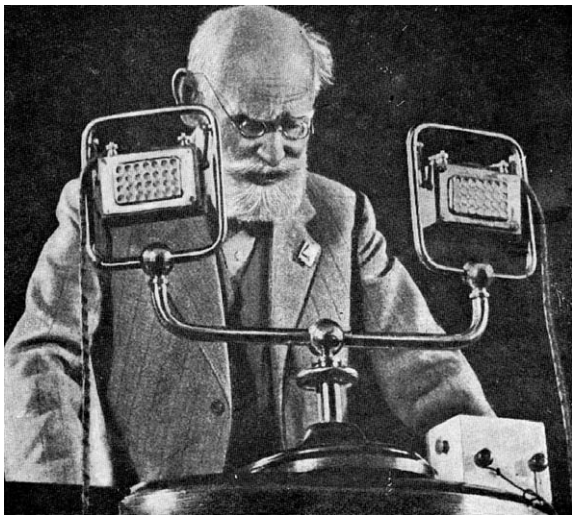

Fig. 8. Pavlov delivering the opening address at the Fifteenth International Congress of Physiologists, Leningrad (Anon, 1938).

Just before that Congress, in late July 1935, the 86-year-old Pavlov was in London again, for what was to be his final visit. He was attending the second International Neurological Congress, held at University College London (Anon, 1935a). His address, delivered in 'halting German' in the final session, focussed on recent work in his laboratory on physiological mechanisms of neurotic and psychotic symptoms. He was rewarded with a standing ovation and the BMJ's correspondent noted somewhat laconically that 'discussion was suspended while he autographed innumerable programmes!' (Anon, 1935b).

7. I. P. Pavlov and the 1935 International Congress

More than 1500 physiologists attended the Congress, which was held at the Uritsky (now the Tauride) Palace in St. Petersburg (Fig. 7). The attendance was the largest in Congress history to that date, apart from the Boston meeting, and approximately one-third of the membership was from the Soviet Union. Pavlov, in his mid-80s, was president of the Congress and in a stirring opening address considered the internationalism of physiology and the importance of the Congresses to younger scientists (Fig. 8). Another war was looming, and he spoke passionately of the scientific comradeship and personal friendship engendered by such

Table 1
Scientific sessions at the Fifteenth International Congress of Physiologists (Anon, 1938)

Nervous and humoral control (3)	Chemical dynamics of muscle
Digestion	Pathological physiology
Internal secretion (2)	Biochemistry
Vitamins and avitaminosis	Physical factors in biology
Permeability	Central nervous system (3)
Intermediary metabolism (2)	General metabolism
Nerve and muscle (3)	Pharmacology (2)
General physiology	Cell growth and development
Sense organs (2)	Chemical dynamics of cell processes (2)
Sexual cycle	Vitamins and hormones
Heart	Circulation
Excretion	Physiology of labour
Descriptive biochemistry	Blood biochemistry
Oxidation	Enzymes
Evolutionary physiology	Comparative physiology

meetings. Replying, Walter Cannon too addressed the worrying state of international politics, the value of personal contacts between individuals, and praised Pavlov's own endurance and scientific dedication in the aftermath of the First World War.

This was the first Congress in which the communications, all 485 of them, were organised into thematic groups, with 30 different topics being presented in 41 sessions held over 7 days, and simultaneous translation into French, German, English and Russian was provided. The subject matter and number of sessions are detailed in Table 1, which provides a telling snapshot of the diversity of physiological knowledge and research in the mid-1930s. The most popular fields were the nervous system and neuromuscular physiology (in which Soviet presentations predominated, presumably because of Pavlov's influence), biochemistry, and general and cellular physiology (Solandt, 1935).

The Congress' scientific and social programmes were, according to one American participant, 'a transcendental success' (Ivy, 1936). The official Soviet newspaper *Izvestiya* was, unsurprisingly, even more effusive in a post-Congress interview with Pavlov, praising him not only for the original idea but also for his personal contacts and reputation that had encouraged physiologists from around the world to visit the Soviet Union. The prestige of holding such an internationally renowned meeting was still heralded in the Soviet Union more than 40 years later (Kann, 1978).

The Congress was to be Pavlov's final appearance on the world stage. Aged 86, he died from pneumonia a few months later, and when the Congress Proceedings appeared in print, they did so prefaced with an obituary (Anon, 1938). Condolences, appreciations and obituaries appeared worldwide. Replying to A. V. Hill's letter of sympathy on behalf of the Physiological Society, Pavlov's widow stressed her gratitude 'No friend has so finely and rightly appreciated my late husband not only as a scientist but also as a man' (Pavlova, 1936). Other friends too shared their grief, 'It is sad to hear that the great old man Pavlov has gone', Henry Dale wrote to Sherrington. 'It is strange indeed', Dale continued, contrasting Pavlov's work and impact with that of Cajal, who had died a little over a year earlier, 'that two great men of such similar humble origins … should each have become a symbolic figure for scientific regeneration, under revolutionary conditions, in his own country' (Dale, 1936). Pavlov's symbolism extended far beyond 'his own country' and as this paper has illustrated, he was the first truly international star of physiology.

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