CRAM AND CRITICISM: H. G. WELLS AND LATE VICTORIAN EDUCATION

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Abstract. Before the publication of *The Time Machine: An Invention* (1895), H. G. Wells's early works offer insight into the challenges of the late Victorian educational system. Wells benefited from a unique set of educational reforms intended to provide education for the lower middle class. He did so in the capacities of a student taking examinations to earn grants for school, an independent learner working toward a degree, and a schoolmaster developing teaching methods. Although designed to correct inadequacies in the system of education, said reforms were not without controversy. Wells's writings on cramming in science education and complexities of studying by correspondence, as well as his *Text-book of Biology* (1893), deserve to be considered as part of a wider debate about education in the late nineteenth century.

H. G. Wells's career as a successful writer of fiction and social commentary lends to his youth a sense of romanticism, causing some to envision him as a struggling writer before his big breakthrough with *The Time Machine: An Invention* (1895). Wells's fiction was at first, however, a sideline. His graphomania in younger years was reserved for science and particularly for science education. It is this collection of writings, often ignored by historians and Victorianists, that connects Wells to his own experiences as a member of the lower middle class. As a young man, he was impeded by class and circumstance. The unique opportunities provided by Victorian educational reforms, however, gave Wells a start as both an educationalist and writer.

Although a number of prominent scholars have noted Wells's lifelong connection to education, few have examined his contribution to the educational debates of the late nineteenth century.[1] This contribution came primarily in the form of columns in educational journals or letters to the editor in periodicals. Wells's early fictional works also examined social problems, including educational issues, as part of a scientific romance or realist novel. By the early twentieth century, Wells voiced his social criticism

[1] The latter category includes John R. Hammond, 'H. G. Wells as Educationalist', *The Wellsian: The Journal of the H. G. Wells Society*, 4 (1981), 1-7, and David C. Smith, *H. G. Wells: Desperately Mortal* (New Haven: Yale University Press, 1986).

through characters in 'discussion' novels where characters engaged in dialogue on social issues, after which he published more polemical (and less popular) works.[2] The older Wells would in many ways return to the direct approach of his pre-fictional writing, and analysis of his fiction can obscure the importance of his earlier writings. These works deserve to be taken seriously, not merely as a precursor to later work, but as part of the conversation on scientific education and educational method in the late Victorian era.

Wells's critiques in the journals of the late nineteenth century reveal not only his deep concern about education in general, but also a willingness to acknowledge the contradictions of the Victorian educational system. As in much of Wells's later life, his cogitation was conducted in public, through the printed word. Throughout his childhood, increased literacy (a result of the Education Act of 1870) and the availability of inexpensive books in Britain had created a vast reading public.[3] The middle and lower classes had access to vast quantities of information which, like today, varied widely in its usefulness, reliability, and accuracy. The expansion of learning, both formal and informal, was thus a topic of social concern and printed discussion. Education had been available primarily to the wealthier classes, but this was changing as the government became increasingly involved. Public debates about education focused on curriculum and methods in elite schools and colleges, and were conducted in *The London Times* and other broadly read newspapers, as well as *The Journal of Education* and other periodicals engaged in the professionalisation of teaching.

According to social historian Asa Briggs, Wells played 'a prominent part in shifting the terms of the debate about education and class to the middle-class/working-class matrix'.[4] This contribution originated in Wells's own background and his acute personal awareness of the role of class in access to education. While it is common knowledge that in the twentieth century he wrote extensively about education, including *Love and Mr. Lewisham* (1900) and *Joan and Peter: The Story of an Education* (1918), his early pieces on education appeared in the 1880s, while he was a student, pupil-teacher, and schoolmaster. It was then that he came to terms with his dismay over superficial teaching practices and his ambivalence about the

[2] Simon J. James, *Maps of Utopia: H. G. Wells, Modernity, and the End of Culture* (Oxford: Oxford University Press, 2012), 158.
[3] Ibid., 1-3.
[4] Asa Briggs, 'A Study of the History of Education', *History of Education*, 1 (1972), 5-22 (15).

examination system, which supported a meritocracy, but encouraged rote learning rather than deep thought. Wells's work on the necessity and difficulties of 'cram' (the memorisation of information in order to pass examinations) serves to demonstrate his ingenuity in both examining and adapting Victorian methods of science instruction.

The necessity of cram

To understand how the young Wells both negotiated and contributed to the educational issues of his day, it is necessary to explore the educational milieu in which he lived. Victorian England saw a series of educational reforms, in response to both the expansion of a literate public and competition from other countries. In 1849, the College of Preceptors was founded in order to professionalise teaching, creating qualifications and examinations for school teachers. In 1862, the Revised Code introduced 'payment by results', based on a new examination system. Pupils could sit examinations in various subjects, with grants being awarded to their school for good scores. In 1870, the Elementary Education Act created school boards and required that elementary education be provided for children aged five to thirteen. Reforms provided for a non-denominational education and required the regular inspection of schools. These changes and others that followed from them were indicative of a concern for the education of children, particularly those of the lower middle classes. While it can be argued that such changes were designed to increase social stability by ensuring that everyone knew their place in the Victorian hierarchy, they also granted extraordinary opportunities to young people like Wells.[5]

Thomas Morley's Academy, which Wells attended as a child, was representative of the educational reforms of the time. Despite the moniker 'Academy', Morley's establishment was traditional and basic. Wells noted that notwithstanding the Elementary Education Act of 1870, the school remained only partly modernised and was 'Dickens-like', with poor ventilation, dreary work sessions, and ready punishments.[6] Nevertheless, Morley's connection with the College of Preceptors meant that his teaching was better than most. It was there that Wells was introduced to examinations administered by distant government or professional entities. The

[5] Some educational reformers worked to preserve social hierarchies through moral and religious education that emphasised a hard-working ethic and obedience to authority, as discussed in Paul Sharp and John Dunford, *The Education System in England and Wales* (London: Longman, 1990), 2.

[6] Ibid., 86.

bookkeeping examination of the College of Preceptors was a focus of Morley's, and he drilled the boys continually so that they could pass it. Wells thus received his first certification in bookkeeping, appropriate for a lower middle class boy seeking a better life as a shop clerk.

A few years later, the new educational system provided the teenage Wells with greater chances for self-improvement, even as he entered an apprenticeship to Samual Cowap, a chemist. In order to learn enough Latin to be a successful chemist's assistant, Wells took lessons from Horace Byatt, headmaster at Midhurst Grammar School, who immediately realised the young man's potential for book learning. Byatt provided Wells with books each evening, masquerading the sessions as 'classes', to prepare the young man for taking examinations for the Science and Art Department, the source of government grants. Byatt himself knew little about these subjects, but was happy to take advantage of the government's desire to advance science education. Economic competition from Germany and France had spurred the creation of new government organisations like the Science and Art Department, which was tasked with promoting these subjects and training teachers.[7] The Department offered grants to headmasters whose students passed examinations and encouraged emphasis on science and manufacturing. Horace Byatt, as well as other intelligent headmasters, were well placed to take advantage of the system at the height of its efficiency and funding. First as a pupil and later as a pupil-teacher, Wells repeatedly earned grant money for the Midhurst Grammar School with his first-class College of Preceptors examination results. Much to Horace Byatt's chagrin, Wells's extraordinary success at absorbing vast quantities of information earned him a full scholarship to the Normal School of Science at South Kensington. For one term, Wells would study biology under T. H. Huxley and enter into the public debate on education.

The influence of T. H. Huxley

Wells's early critiques of the educational system were grounded in the popular debate about schooling. Thomas Henry Huxley, defender of the theory of evolution in public lectures and an inspiration to young science students in the classroom, deepened Wells's notion of science and revealed to him its larger moral and social purpose. Huxley represented the scientific side in the debate on education that has been referred to as 'The Two

[7] P. S. Uzell, 'The Science and Art Department and the Teaching of Chemistry', *The Vocational Aspect of Education*, 29 (1977), 127-32.

Cultures'.[8] He promoted the study of science instead of classic or liberal education for undergraduates. In the 1840s, the University of Cambridge's efforts to force Mathematics examinations as a prerequisite for students trying for a Classics degree had backfired on reformers.[9] Since then, there had been disputes fought in the press over the role of a non-humanities curriculum.

Huxley's lecture of 1880 and Matthew Arnold's of 1882 popularised the controversy. Huxley had promoted the idea that scientific facts and scientific thinking were significant to a well-rounded education, while Arnold, although agreeing that scientific knowledge was important, believed that facts and method were not as foundational to human existence as classical knowledge.[10] The debate was not confined to the hallowed halls of Oxbridge, but was also informed by disputes over how best to educate the working class.[11] Wells was directly influenced by the scientific view gleaned from Huxley's teachings. A number of Wells's later critiques about scientific education can be framed within the two-cultures debate.

Wells failed to pass his exams at the Normal School. He attributed this failure to an inability to focus his mind after Huxley retired due to illness, but may also have been because the teaching methods used by subsequent teachers were not of the same quality as Huxley's. While Wells was most effusive about the intellectual acuity displayed by Huxley (and his assistant G. B. Howes), it is clear that Huxley's forceful lecturing style and excellence at demonstration drawing played a major role in Wells's enthusiasm.[12] Huxley himself was a critic of cramming information, and, as a self-taught scientist, Huxley's teaching may have reflected a broader view of life and knowledge than those of the more classically trained professors. He was

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[8] This term was popularised in C. P. Snow's Rede Lecture of 1959.

[9] Alice Jenkins, 'Mathematics and Liberal Education in Victorian Cambridge', paper delivered at CRASSH conference 'Changing the Humanities/the Humanities Changing' (July 2009), retrieved 19 May 2018, from https://sms.cam.ac.uk/media/1184763.

[10] Matthew Arnold, 'Literature and Science' [1882], in *Matthew Arnold: Selected Essays*, ed. Noel Annan (London: Oxford University Press, 1964), 208-32 (216).

[11] Marcella P. Sutcliffe, 'The Origins of the "Two Cultures" Debate in the Adult Education Movement: The Case of the Working Men's College (ca. 1854-1914)', *History of Education*, 43 (2014), 141-59.

[12] Wells would not have been alone in this regard, as Huxley was by all accounts an outstanding lecturer. Several of his students' comments have been collected by Charles Blinderman and David Joyce of Clark University, and can be read at https://mathcs.clarku.edu/huxley/comm/LTHAccts/L&LII.html.

certainly popular on the public lecture circuit, where his speaking style was held in high esteem.

Huxley's retirement left Wells without a role model to emulate. He returned to his previous self-study habits after failing his exams, studying on his own for College of Preceptors teaching examinations. He was skilled at organising his own studies without guidance. While at Midhurst, he had developed his own 'schema' (detailed later in his novel *Love and Mr. Lewisham*) to study for exams, and it served him in good stead.[13] Although Wells possessed neither the social class nor the degree needed for a high-paying position, he was able to gain practical experience as a schoolmaster at Holt Academy and Henley House School in London, where he insisted on a contract that allowed him time to study. This last position paid only £60 per year, but it exposed Wells to various forms of pedagogy in a stable environment. The lack of laboratory equipment, for example, gave him practice at blackboard demonstration, a talent he had developed at the poorly equipped Holt Academy.

Once again, atypical educational pathways helped Wells to achieve success, this time at the university level. Having failed at the Normal School, he still had the option of taking examinations for the degree at the University of London. In 1826, the University of London had been founded as an alternative to expensive Oxford and Cambridge. By the 1880s, it allowed men and women from all walks of life to sit Matriculation, Intermediate and Final examinations for Bachelor's degrees. People from any social class and any region had the chance to study however they could, wherever they could, then come to London (or to an approved local or imperial centre) to sit the exams. Private tutorial colleges arose to feed the demand, and individual tutors advertised in the newspapers. The first commercial correspondence colleges appeared to serve those studying independently and made enormous profits advertising in educational journals. Without the means to pay for guidance, Wells studied alone for his university science exams, at the same time as he prepared for his teaching exams.

The evenings Wells spent cramming for both the Licentiate of the College of Preceptors and the Intermediate Examinations in science at London University helped to balance his studies of teaching with his work in science. The College of Preceptors teaching exams, which he passed in 1889, required that he research educational theory, providing a foundation for his own experience. The submission of his thesis on Froebel added academic weight to his critiques of pedagogy. He also passed his science

[13] H. G. Wells, *Love and Mr. Lewisham* [1899] (London: Collins, 1959), 18.

Matriculation Exams in 1889. The disciplines were separate yet informed each other. After passing the Intermediate Examinations with a second class in Zoology, he began preparing immediately for more examinations, again independently, in order to join the Fellows of the Royal Zoological Society. He wrote to his mother in early 1890: 'There is just one more period of steady study – up to the Degree, Final, or Greats next October & then I hope to begin the great and momentous business of casting about from some abiding & remunerative resting place.'[14] The goal was the credential and thus a better life. The means to this end was cramming information and sitting exams, a process in which he was, by this point, an expert.

Criticism of the system

The lessons of T. H. Huxley and Wells's teaching experiences at several schools combined to form a cogent appraisal of the educational system. Huxley had provided an example of a well-rounded intellectual, a leading voice in debates about science curriculum and the value of science in improving society. Wells's own teaching experiences had demonstrated the importance of combining theory and practice, and the difficulties of schools that were poorly equipped and poorly staffed. In just over five years, Wells wrote at least thirty-five critiques of science education in journal letters and articles. These pieces brought together his vast experience, as both student and teacher, in the many aspects of the educational system in late Victorian England. His criticism was public, discerning, and robust. Between 1889 and the publication of *The Time Machine*, Wells published extensively in *The Journal of Education, Science and Art, The Educational Times*, and the *Pall Mall Gazette*.

Throughout these writings, Wells took an active role in the two-cultures debate, claiming that a focus on classical education hindered science. In 1891, he wrote for *The Educational Times*: 'There are authorities who find the maximum of truth, beauty, and mental value in the Greek classics, and who regard science as the fermenting soil from which spring such matters as Eiffel towers, aërial advertisements, and heterodoxy.'[15] True science, instead, went beyond mere application; it 'trains hand, eye, and mind together, enlarges the scope of the observation, and stimulates the

[14] Letter, H. G. Wells to Sarah Wells, 25February 1890, in *The Correspondence of H. G. Wells. Volume 1: 1880-1903*, ed. David C. Smith (London: Pickering & Chatto, 1996), 143.

[15] H. G. Wells, 'The Value of Science', *The Educational Times*, 44 (1891), 154-5 (155).

development of the reasoning power.'[16] Science demanded a way of thinking, one that privileged rationality and intellectualism. Even when discussing non-scientific subjects, such as the need for better tutelage for English essays, Wells denigrated the continuing study of Latin and Greek.[17] He saw the classics as reinforcing the thinking of the past, rather than the future.

Wells's early writings show several interconnected concerns: the way science was presented to the public and to students, the poor training of schoolteachers, the influence of the examination system on pedagogy, and the practice of studying to prepare for these examinations. The importance of a broad view of science as an intellectual process rather than a set of facts pervades all of these. His first critical article appeared in the *Henley House Magazine*, published by the Henley House School. In this piece of August 1889, Wells wrote: 'Science is the understanding of things, not the collecting of them merely, and certainly not the naming of them.'[18] Most science instruction continued to demand memorisation of numerous plant and animal features. These features were not consistently organised or grouped, making them difficult to associate with other parts. His year with T. H. Huxley had taught Wells the new methods and principles of natural science, where zoological and botanical forms were studied by type, rather than as 'a scramble over endless unmeaning names, ending in a vague, inaccurate, and often misleading knowledge'.[19] The new models of the scientific method were as significant as the details they revealed.

Many of Wells's writings evaluated the methods of instruction in schools, particularly at the lower levels. If a school could afford it, Wells wrote in 1891, natural history should be taken up in earnest. But if it would be taught poorly, without proper support, it was best not to teach it at all.[20] Wells's criticism did not spare schoolteachers either. His writings both chastised schoolteachers and sympathised with their limitations. The first of

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[16] H. G. Wells, 'Science, in School and After School', *Nature*, 1300 (1894), 525-6 (525).

[17] H. G. Wells (as An Outsider), 'On Certain Defects in English Public Schools', *The Journal of Education*, 293 (December 1893), 667-71 (668).

[18] H. G. Wells, qtd. in David C. Smith, *The Journalism of H. G. Wells: An Annotated Bibliography*, ed. Patrick Parrinder (Haren: Equilibris, 2012), 70.

[19] H. G. Wells, 'School Zoology', *The Educational Times*, 365 (1891), 400-1 (401).

[20] H. G. Wells, 'Natural History in Schools', *The Journal of Education*, 268 (November 1891), 581-3 (583). This view echoes that of T. H. Huxley in a Manchester speech of 1871. See Cyril Bibby, *T. H. Huxley: Scientist, Humanist and Educator* (London: Watts, 1959), 41.

three articles entitled 'The Sins of the Secondary Schoolmaster' explained poor teaching in terms of parental demands, the overly wide variety of subjects, and the lack of pedagogical training.[21] At the same time, he acknowledged that society's expectations of schoolteachers were too high – they were supposed to be models of propriety, intellectualism, and kindness. The teacher 'must needs be watchful, careful, dexterous, introspective, planning his praise and blame, and manipulating the minds under him with the skill of a Jesuit, while, at the same time, preserving a contagious cheerful openness that must defy youthful scrutiny – a difficult combination.'[22] Wells did not forget 'what disadvantages headmasters labour in the struggle for reform', insisting that the pre-eminence of the classics made progress difficult.[23] He warned against teachers being too 'practical', and encouraged the use of theory and imagination.[24] Broadening the schoolmaster's outlook would create broader knowledge in the pupils.

Wells despaired of the pedagogy that resulted from the weight given to examinations. A central concern was that the examinations forced standardised approaches to science: 'examinations, for good or evil, are the preponderating influence in the determination of what shall and what shall not be actually taught in schools.'[25] Wells was distressed that teachers were forced to spend time teaching pupils to do the meaningless tasks that he called 'dodges', such as extracting unharmed the tiny ovary of an earthworm, or finding the tenth branch of a rabbit nerve.[26] The practical portion of the examinations for biology featured a set of equipment, specific instructions and tasks that could be easily observed by the examiner. Thus, even laboratory experiments, which could be a source of discovery, emphasised rote learning, rather than exploration.

In addition to such detailed and non-contextual work, science students studied 'model answers' to questions set by examiners. This practice did a disservice to original thinking, and Wells worried that the method itself

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[21] H. G. Wells, 'The Sins of the Secondary Schoolmaster I: His Technical Incapacity', *Pall Mall Gazette*, 28 November 1894, 1-2.
[22] H. G. Wells, 'A Plea for the Study of the Teacher', *The Journal of Education*, 14 (January 1892), 29-30 (29).
[23] Wells (as An Outsider), 'On Certain Defects', 671.
[24] H. G. Wells, 'Against Being Too Practical in Teaching', *Science and Art* (June 1893), 60.
[25] Wells, 'School Zoology', 400.
[26] H. G. Wells, 'On the True Lever of Education', *Educational Review* (November 1892), 380-5 (384).

discredited science in the eyes of educated people.[27] It amounted to a rehashing of previous information, similar to the study of the classics. However, Wells admitted that good examiners, educated in pedagogical methods as well as scientific thinking, could create meaningful examinations. The problem was that they did not. Examiners had no understanding of the philosophy of teaching; they were 'innocent of educational ideals'.[28] The tests they devised assessed what would today be called 'data retention', rather than knowledge.

For students like Wells himself, it was almost impossible to study for such examinations and still engage with the subject deeply. He was particularly disturbed by the practice of 'cram', which prevented the application of scientific principles to larger issues. He described it as 'Mental engorgement, learning without digestion; this is the true meaning of "cram".'[29] Cramming facts was a necessary, but not sufficient, method for developing scientific thinking, and criticism of cramming infuses much of Wells's science teaching writing. Textbooks were no solution: 'the mere rote learning of a text-book, however well written, cannot be science at all.'[30] The idea of stuffing one's students, or oneself, with facts, was both the result of the examination system and the antithesis of scientific learning.

Wells was not alone in his distaste for cram: the word itself was used by many writers, in both education and politics, as the embodiment of everything that was wrong with the educational system. Opponents of the University of London, many of whom objected to its existence as a purely examining body without a teaching faculty, sneered that external students would simply cram for examinations.[31] Such perspectives appeared in the press and influenced the development of educational policy. A later debate in the *Saturday Review* began with an editorial (presumably by editor Frank Harris) entitled 'The Duke and the Crammers' (1895). A reorganisation of the University of London was proposed by the Duke of Devonshire, but the

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[27] Wells, 'Science, in School and After School', 525-6.

[28] H. G. Wells (unsigned), 'Science Notes', *The Journal of Education* (April 1894), 198-9 (199).

[29] H. G. Wells, 'What Is Cram?', *The University Correspondent* (March 1893), 10.

[30] H. G. Wells, 'The College of Preceptors Science Examinations', *The Educational Times*, 371 (1892), 140.

[31] The issue of cram was but a small portion of the controversy concerning the 'Gresham Scheme', which in 1892 proposed to reorganise the University of London. Two Royal Commissions would consider the problem over the next several years. For Wells's own overview of the failure of the initial scheme, see H. G. Wells, 'The University for London', *The University Correspondent* (April 1892), 19-20.

editor noted the 'facts' that the Duke had to face, including 'that London, with all its splendid equipment of museums, libraries, and hospitals, is still without any true University; that its so-called University is a mere Board of Examinations, the happy hunting-ground of the crammer.'[32] A reminder to readers that such crammers 'fattened' themselves on the weaknesses of the examination system angered Wells. In his reply, Wells implied that it was delusional to presume that the standard Oxbridge system of education was any better, or any less prone to cram. He wrote that during his three years at South Kensington, 'save for a rare "good morning", I never spoke to my professors', and that personal instruction there was taught by men 'not a whit above the "crammers", and in many cases the College instructors eke out their incomes by "cramming" of an evening.'[33] Formal schooling did not prevent such practices, even when an institution wrote its own examinations. Wells noted similar experiences at other institutions, and defended the University of London as no worse than the teaching universities.

Tutoring by correspondence

The contradiction between Wells's philosophy of deep education and the type of study required to pass examinations came to the fore when he became a biology tutor by correspondence. In 1890, as Wells began his tirade in educational periodicals against poor science education, he was contacted by William Briggs, founder of the University Correspondence College (UCC). Wells wrote excitedly to his friend, A. T. Simmons: 'Entirely Unexpected Improvement [...]. Mysterious Communication from a person of the name of Briggs requesting the honour of an interview at Cambridge & offering the company His Fare there & back.'[34] As one of the first distance education entities designed to teach academic subjects by post, the UCC focused exclusively on tutoring students to pass the University of London examinations. Established in the city of Cambridge purely to take advantage of the university's name, the UCC grew to offer both resident and correspondence classes. For the sciences, Briggs obtained laboratory space in London, and Wells would both teach there and mark papers submitted by

[32] 'The Duke and the Crammers', *The Saturday Review of Politics, Literature, Science and Art*, 7 December 1895, 755.
[33] H. G. Wells, 'The Threatened University: To the Editor of the *Saturday Review*', *The Saturday Review of Politics, Literature, Science and Art*, 10 December 1895, 803-5 (805).
[34] Letter, H. G. Wells to A. T. Simmons, ca. Spring 1890, in *The Correspondence of H. G. Wells*, 144.

post. It was Briggs who pushed Wells to finish his Bachelor of Science at the University of London, because Briggs liked to advertise the quality of his tutors. Wells obtained his degree in that same year, with a first in Zoology, which pleased Briggs and earned Wells a rise in pay.

Wells described the University Correspondence College as 'an institution which I still think one of the queerest outgrowths of the disorderly educational fermentations of that time'.[35] He knew the problems his far-flung students would encounter with the passing of examinations, because in a sense he had always been a distance education student. He also understood the goals of such a venture. In his autobiography, he wrote that the work of William Briggs

> was at once preposterous and necessary [...]. The ambitious new outsider had to be standardized – because for a time there was no other way of dealing with him. At that early stage in the popularization of education and the enlargement of the educational field, it is hard to see how the stimulus and rough direction of these far flung Education Department, school certificate and University of London examinations could have been dispensed with. It was the only way of getting any rapid diffusion of learning at all. Quality had to come later.[36]

Despite his criticism of rote learning, Wells found himself in a position of foisting it on others. His job was to create and send materials for students to work on, receive and mark their work, then return it by post with his commentary. Since the intent of distance study was to pass the examinations, learning remotely created an environment unusually conducive to the cramming of disconnected scientific facts. This challenged Wells's views of science and science teaching.

The textbook

During the years he worked for Briggs in the early 1890s, Wells was forced to adapt his distaste for 'cram' into a cogent method of distance education. Ultimately, in despair at the lack of good textbooks on zoology and botany, he channelled his energy into creating his own. In an 1892 article, 'The Use and Abuse of the Text-book', Wells stated: 'Beyond all question, the most difficult, and even dangerous, piece of apparatus to handle in class teaching is the textbook. Its use is as hard to learn as that of a bicycle; its abuse is as

[35] H. G. Wells, *Experiment in Autobiography*, in 2 vols. (London: Gollancz, 1934), I, 335.
[36] Ibid., 340-1.

immediate and frequent as that of strong drink.'[37] Wells made it clear that the best education was to be had from a good teacher, and that with a good instructor the textbook should always be 'subordinate to the teacher'. Even while he was sending papers back and forth with his far-flung students, he wrote:

> The teacher's work it is, to build up the *ideas* of the science in the minds of his pupils [...] if it were not so, there is no reason why a teacher in London should not send off lessons to the whole of England, to be read aloud by the best reader among his pupils to the rest of the class assembled.[38]

Teaching by correspondence, Wells declared, required a shift in pedagogical emphasis. Books for the 'unguided student' must be different from classroom texts. They should be 'explicit, luminous, readable, and attractive, with diagrams as well as figures, and persuasion as well as facts'.[39]

The textbook Wells produced was designed for his correspondence students. It was published in a small format, clearly intended for portability, to be carried to work and studied as one could. It featured fold-out drawings (in the first edition drawn by Wells, and in later editions better drawn by Amy Catherine Wells, his wife). While full of the facts necessary for passing the University of London exams, the book was carefully designed to promote knowledge, rather than memorisation. Wells wrote in his preface to Part I 'Vertebrata' that the London examinations lent themselves easily to the study of comparative anatomy, which he believed to be the best method of instruction. Such comparisons resulted in deeper knowledge. He confidently concluded: 'That chaotic and breathless cramming of terms misunderstood, tabulated statements, formulated "tips," and lists of names, in which so many students, in spite of advice, waste their youth is, I sincerely hope, as impossible with this book as it is useless for the purposes of a London candidate.'[40] Wells achieved this goal through careful construction of organisation and language, and made a deliberate effort to put facts in context and avoid mere memorisation. While not a poetical work by any means, his textbook compares favourably to other publications of the day. T. H. Huxley's own *Manual of the Anatomy of Vertebrated Animals* (1872),

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[37] H. G. Wells, 'The Use and Abuse of the Text-Book', *Science and Art* (June 1892), 50-2 (50).
[38] Ibid., 51.
[39] Ibid.
[40] H. G. Wells, *Text-book of Biology*, intro. G. B. Howes. Part I 'Vertebrata' (London: Clive, 1893), ix.

for example, contained a lengthy recitation of facts, with a number of things pointed out as salient but rarely explained within a larger context.[41] The word 'evolution' did not appear in Huxley's book, and scientific theory is secondary when it appears at all. Wells's textbook, by contrast, is more concise (even in its title), organised to lead students through ideas in logical sequence, and makes comparisons more obvious in order to enhance the study of biology as a discipline. It also contains vivid writing, for example about the head shape of vertebrates:

> We may note that in types which swim through the water, the neck does not appear – in the fish and frog, for instance – and the head simply widens out as one passes back to the body. The high resistance offered by water necessitates this tendency to a cigar or ship outline, just as it has determined the cigar shape of the ordinary fish torpedo.[42]

Connections to theory and exhortations to engage in direct observation provide students with an instructor's voice:

> Before proceeding to the comparison of the mammalian skull with this, we would strongly recommend the student thoroughly master this portion of the work, and in no way can he do this more thoroughly and quickly than by taking a parboiled frog, picking off the skin, muscle, and connective tissue from its skull, and making out the various bones with the help of our diagrams.[43]

In his introduction to the book, G. B. Howes, who was T. H. Huxley's colleague, noted that although many people disparaged books intended for examinations, Wells had achieved an emphasis on the laws of nature, as generalisations based on observation, rather than mere details. Howes observed:

> Mr. Wells has kept these precepts constantly in mind in the preparation of his work, and in the formulation of his plans for its future extension, thereby enhancing the value of the book itself, and at the same time, discouraging the system of pure cram, which is alien to the discipline of biological science.[44]

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[41] T. H. Huxley, *A Manual of the Anatomy of Vertebrated Animals* (New York: Appleton, 1872).
[42] Wells, *Text-book*, 2.
[43] Ibid., 73.
[44] G. B. Howes, 'Introduction', in Wells, *Text-book of Biology*, iii-v (v).

Of particular interest regarding direct observation of nature was the last portion of the book: the Syllabus of Practical Work. Here, Wells provided instructions for a tabletop laboratory, complete with lists of supplies needed: forceps ('which must hold firmly, and meet truly at the points'), scalpels, scissors, a dish ('an ordinary pie dish will do') for dissecting. Students could order rabbits, dogfish, and frogs from suppliers (Wells recommended Sinel in Jersey or Bolton in Malvern) or catch them in the wild, then dissect their specimens and draw them at the kitchen table.[45]

Thus, within the textbook, Wells synthesised his own experience with education as self-study and the pedagogical understandings he had developed as a student and teacher. He was driven to create the textbook, not only to earn extra money and fill in a gap for his students, but also to rectify scientific education more generally. His book was popular, remaining in print for thirty years. Although not as famous as *The Time Machine*, Wells's *Text-book of Biology* mitigated some of the difficulties inherent in teaching science by distance education. Even more importantly, it helped to continue the democratisation of opportunity so important to members of Wells's own social class, expanding the scope of Victorian higher education.

It is evident that Wells's early writings demonstrate a mature and informed understanding of the challenges and opportunities of late Victorian education in Britain. Connecting his life experiences to his prolific early writings on science education highlights the conundrums of the era: how to introduce science into the curriculum, provide opportunities for the lower middle class to obtain university-level degrees, and inculcate the values of scientific thinking into society. Even before he became a novelist, Wells's extensive background as both a student and teacher enabled him to take an active role in ongoing public debates, and he did so with zeal. One of his most overlooked publications, his textbook, provides evidence for his resolution of the battle between cram and true learning. The years between 1870 and 1890, from the beginnings of payment by results to the end of the Science and Art Department grant system, were unprecedented in providing opportunities for the lower middle class. They created an environment where Wells could establish his career as a writer, educationalist and social commentator.

[45] He also detailed some of these in 'Biology for the Intermediate Science and Preliminary Scientific Examinations: Hints for Practical Work', *The University Correspondent* (February 1893), 4-5.