



## CRITICAL FOCUS

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### Microscopes and the Amazing School of the Future

*Schools have changed little over the years, and few youngsters learn about the microscope. It is time to replace traditional schooling with a revolutionary new approach.*

Where are the microscopes in our schools? Few schools have them, and occasionally teachers show students what miracles they reveal; but they are not a core feature of the curriculum. They should be. We know that children need to master the three Rs (reading, writing, 'rithmetic) but there should be a fourth. Reading, writing, 'rithmetic..., and rotifers. I'd prefer a more all-embracing term for microscopy, but couldn't think of one starting with R. You might have a better proposal.

Students would go to a pond in springtime and use a microscope to learn a dozen microbes. No watching videos here; it's hands-on experience that the youngsters need. Everyone should understand life for themselves, and this is how we begin to make sense of the secrets of the living world. Most people wouldn't know a living cell if they saw one. Knowing what life is like under the microscope will teach more about health, and hygiene, and nutrition, and the environment..., than any other single subject. It is the syllabus



Boston Latin School was founded to bring the best academic education to the pupils of New England. It was named after the still flourishing Grammar School in Boston, England, the town from which the Puritan pioneers had sailed, and was founded in a town house in 1635. Today's building dates from 1922.

that is the problem. Education has never kept up with the realities of the outside world, so kids learn all about algebra but nothing about running a home. The principal purpose of learning is to acquire the skills you need to be a functioning adult, and that's the one thing you never learn at school.

Education in America was advanced when the Puritan settlers established Boston Latin School almost 400 years ago. They had sailed from Boston, England, and modeled their new school on

the Boston Grammar School in the town from which they'd departed. Both are flourishing to this day. Harvard College followed in 1636 and became one of the finest universities in the world. Written examinations were formalized in 1845 when Horace Mann, a lawyer and state senator, introduced a series of examination papers for Boston Public Schools. The aim was to bring together the best teaching methods in America, so that every student had equal opportunities for educational advance, though the idea was slow to spread.

27. State the law of gravitation, as laid down by NEWTON; and the phenomena from which NEWTON inferred that Jupiter's Satellites are attracted toward Jupiter according to such law.

28. What is meant by the precession of the equinoxes? How is the quantity of such precession ascertained by observation? and what is NEWTON's explanation of its cause?

29. If the Earth moves in an ellipse, the Sun in the focus, then the law of the attraction toward the Sun is according to the inverse square of the distance from the Sun. Required proof.

30. Construct, and find the area of, a curve, the ordinate of which  $= \frac{ax}{\sqrt{a^2 - x^2}}$ ;  $x$  being the abscissa, and  $a$  a given line.

The earliest examination paper that I could locate during my research was this mathematical paper set by the university of Cambridge, England, in the summer of 1808. The level of understanding that 16-year-olds were expected to attain would be hard to match by most academics of today.

In February 1858 at Cambridge university in England, the Local Examinations Syndicate had a similar idea. In response to widespread demand from teachers, they produced the first purpose-built school examinations. The exam papers were taken to the participating centers in locked boxes, the presiding examiners formally attired in their full academic robes. And the examinations were exhausting. Students were faced with papers every morning, each afternoon and every evening for a week.

American school examination papers once posed problems that few educated individuals could tackle today. The Smokey Valley Genealogical Society and Library in Salina, KS, has an example from 1895: "Write a composition of about 150 words and show therein that you understand the practical use of the rules of grammar" was one. The arithmetic paper had this: "District No. 33 has a valuation of \$35,000. What is the necessary levy to carry on school at seven months at \$50 per month and have \$104 for incidentals?" and "Find the interest on \$512.60 for 8 months and 18 days at 7%" and ended with a topic that people regularly say nobody teaches properly today: "Write a Bank Check, a Promissory Note, and a Receipt." They certainly taught it in 1895. There was a paper on orthography, which is just the kind of teaser you now find on social media, posed as if most people wouldn't know the answer: "Use the following correctly in sentences: cite, site, sight, fane, fain, feign, vane, vain, vein, raze, raise, rays." I could probably do that now; I couldn't have done it as an eighth-grade teenager, which was the age group sitting those exams.

The questions back then treated the candidates with respect; many were witty and encouraged the composition of free-thinking prose. "Describe as you

2. Describe carefully the external structure and the mouth apparatus of a snail. To what group does it belong?

3. Give an account of the structure and life-history of one example of the Protozoa.

4. Refer the following animals to their respective groups, giving your reasons in each case:

Rabbit, tortoise, star-fish, bat, crab, caddis-worm.

5. Write a short essay on *one* of the following subjects:

(a) An insect which you have reared yourself;

(b) A bird whose habits you have personally observed.

The Cambridge paper in zoology for 1898 asked for microscopical details, not only of the structure of protozoa, but a detailed knowledge of the life cycle. Students were expected to have an easy familiarity with the microscopical realm, something that present-day youngsters lack.

would to a child," said one example, "the causes of night and day." Here is a question for 16-year-olds in 1894: "What is the essential nature of a breathing organ? Describe any special form of it with which you are acquainted." It's delicious. It is challenging, it requires an understanding of how the body works and is phrased in terms that respect the pupil. There was a lung question exactly 100 years later which is a classic example of dumbing down. In 1994 a crude diagram of the mucus layer in a lung appeared with this question: "What is the job of the mucus?" There is no inducement to write fine literature, and the answer is something you hardly need to go to school to work out for yourself.

## POPULARIZING EXAMINATIONS

Those Cambridge examinations gradually became accepted, until they acquired the status of the national standard for education. Microscopes were becoming popular among the educated classes around that time, and there were many books on sale to guide the amateur user – though microscopes still didn't command much attention in school. Observing the living cell was not considered important for students, though this was an era of rapidly developing scientific knowledge. Microscopes were a familiar sight in middle-class Victorian homes, and George Eliot was among those who would use the microscope as a metaphor in her celebrated novel *Middlemarch*. Jonathan Swift repeatedly referred to microscopes in *Gulliver's Travels*, which had been published back in 1726.

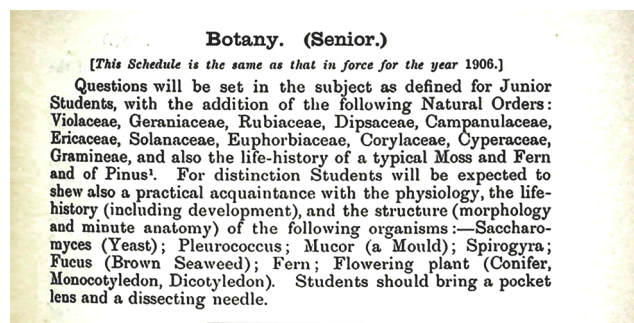
At the time when these Cambridge examinations were being set, the term "cell" had been known for more than 200 years, and the cell theory of life had

been developed and widely discussed by scholars since 1839, the same year in which the Royal Microscopical Society was established. In 1850, at Rugby School in central England, an eminent surgeon named William Sharp established the first classes to be labeled “science.” Yet, although the importance of the living cell was well known, and microscopes were widely understood, they did not feature in education as much as you might expect.

Charles William Eliot, President of Harvard University, proposed a system of common entrance exams for all American colleges and vocational schools in 1890, as part of his ambition to make teaching more rigorous and the results more standardized. If we wind the clock back to the start of scholastic exams, we have a sense of *déjà vu*: these were the topics in Cambridge, England, back in 1858: English, history, geography, geology, Greek, Latin, French, German, physical sciences, political economy, zoology, mathematics, chemistry, arithmetic, drawing, music, and religious knowledge. As American education continued to advance, those same subjects were expected to be available for every student. Were it not for Latin and Greek, those would look like topics for today.

And this is the problem. Today’s schools have changed surprisingly little for centuries, and the semesters are linked to ancient traditions. The Christmas holiday actually emerged from prehistoric pagan celebrations of the winter solstice. That’s why most people decorate their homes with greenery and lights; there is nothing religious about that. The Easter break marked the vernal equinox, and the long summer vacation derived from the time when children could not go to school, for they had to be at home so they could join in helping to bring in the harvest. Those are medieval constraints, yet we live with them today.

School is unnatural. I have long written about it (see *The Times* of London, 1969; <https://brianjford.com/a69-times-gap.pdf>) and most recently pointed out its foibles at an international conference held at Oxford University, England, in April 2024. I pointed out to the delegates that school consists of having a clutch of youngsters of the same age, incarcerated in a room with a middle-aged teacher, with the same bullies, the same frustrated geniuses, the same show-offs, the same rivals, the same successful scholars, and the same teacher’s pets, throughout the turbulent time of the teens. It is unnatural not to mingle and be influenced by role models of disparate ages. In the adult world, if you find yourself confined in a toxic system with mind-numbing managers, you’re free to go and apply for another job – but not if you are in school.



Some intimation of the importance of microscopy may be gleaned from this Cambridge Schedule from 1909. Familiarity with microorganisms from *Saccharomyces* and *Mucor* to *Pleurococcus* and *Spirogyra* was necessary to earn a distinction, though none was a part of the core curriculum.

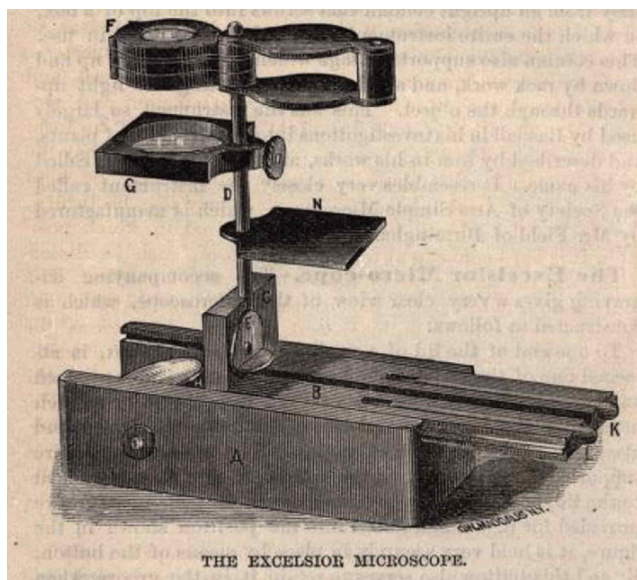
There you are constrained by law within a group of arbitrarily selected contemporaries, praised or persecuted, potentiated or pilloried, purely by the vicissitudes of fate. And you must endure this throughout the tumescent turmoil of teenage, when your mature character is struggling to emerge from the cocooned, untrammelled innocence of childhood.

All schools are socially disruptive. The kids complain that they are often out of bed and dressed when it’s still dark, ready for the early school bus. They hate all the homework; after a full day at school, spending hours each night to complete their assignments intrudes on normal development. Victorian children didn’t have homework – it spread across the West only in the last century. The hidden agenda has become the training of youngsters to work and to accept what’s coming; we’re creating people to be obedient, not free minds that can advance our world.

Classrooms made sense when schools were the only source of instruction for the young. The books they needed to understand the world were found in the classroom, and nowhere else; the person who was experienced in the art of enlightenment was that rare and valued individual, the schoolteacher. They alone had access to the knowledge that children needed, and the facility to make it enticing. Teachers used to be free to teach from life. Not anymore. Now teachers are constrained by the syllabus, while the kids learn from the web. Every fact, every notion, every wild and distorted idea, is all over the Internet. 86% of 4 year-olds in the West use a tablet, and by the age of 15, 90% have a mobile phone. Social media algorithms ensnare our youngsters by creating obsessive discord, aggression, and fear of exclusion, till it dominates their lives.

Mobile phones are their world. Most never use the phone for speech, but hang on its immense comput-





William Withering in England designed a simple microscope which could fold into a fitted wooden case and inspired this greatly improved American design by J.J. Bausch. The Excelsior was patented in 1874 and, costing a mere \$2.95 (less than \$70 today), it brought popular microscopy to a mass audience.

ing capacity to access what the site owners command. Teenagers become anxious, once known as a warning mechanism we evolved to safeguard us in a troubled world; but now designated as a disease. Generalized Anxiety Disorder (GAD) is now regarded as something requiring costly treatment. One-fifth of American schoolchildren are now noted as having this medical condition. And they're not alone. As the trend to pathologize each human response took hold in Britain, by 2017, 1 child in 9 was diagnosed with a mental disorder; currently it's one-fifth, just the same as the states. This trend is everywhere.

## CHANGING ROLE OF SCHOOL

School has become a state-funded baby-sitting service for working parents. Universities are closeted, constrained, and costly. Neither indulge in education. That term derives from the Latin *educere*, to draw out, to help flourish. But current educational establishments aim, instead, to train the brain. Education and training are treated like synonyms, but they're not. Whereas "education" connotes the liberation of potential, "training" originates from the Norman French verb *trahiner*, to drag along behind you. A steam locomotive pulling its train derives from that root, so does the train that a bride tows in her wake. The Norman

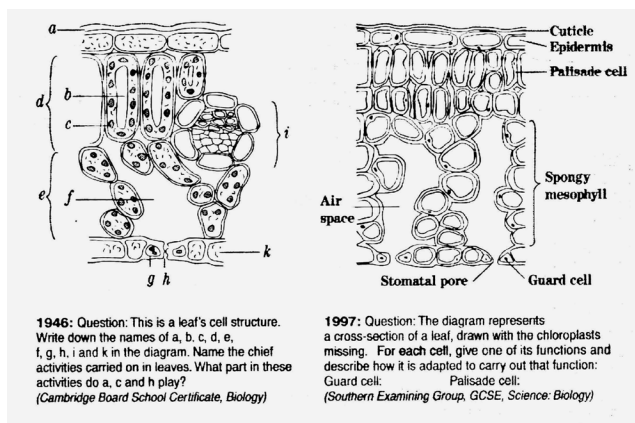
French dictionary exemplifies the disparity: training is defined thus: "To pull, drag (along the ground) ... [or] dragging a person behind a horse or on a wooden frame as a form of torture." That is how we teach today. Challenging orthodoxies is seen as an affront to establishment values. In Britain, outrageous opinions or contentious conclusions can have people blocked from social media, and even hauled before a court for indulging in hate speech.

Instead of embracing the stunning new world that is unfolding before us, we are still clinging to an educational establishment devised centuries ago. We have 21st century youngsters being taught by 20th century teachers using 19th century disciplines in an 18th century environment derived from the 17th century schoolroom based on 16th century semesters corresponding to 15th century religious traditions, and the child labor of the 14th century. School is now irrelevant to modern education, which is why a quarter of American children are known to be "chronically absent" from school. They just won't go.

There is no limit to the trendy alternatives available to parents. Maria Montessori first introduced mixed-aged infant classrooms in 1907, and almost 60 school districts now have Montessori schools for little children. There have also been programs of flipped learning for teenagers, where pupils study a subject from texts or video lessons at home in the evenings, and then apply their knowledge in the classroom on the next day. Blended learning is a subject in which I was immersed for a few years, researching as a Fellow of the Open University in England. It admits online resources in combination with in-person interaction, though is still an offshoot of conventional training. The talk of having youngsters use their minds to problem-solve, and indulge in critical thinking, looks good on paper though there is a problem – this trend has been to replace learning with abstract idealism, so nobody is taught how to think.

Kids aren't encouraged to speak their minds, either, for there is no free speech in an age of conformity. No-one can be criticized. Competition is discouraged, lest those who don't win feel left out. Those bullying youngsters demand the teacher's undivided attention, while the high-flyers are held back and frustrated. Even abject failures must be said to succeed.

The quest to show that everybody is successful has led to progressive dumbing down. During my research in Cambridge, I compared two questions on microscopical images, one from 1946, the other from more than 50 years later. The latter question, from 1997, had a diagram of a leaf in cross section. Every



How examination standards in school microscopy plummeted in 50 years. The 1946 question had pupils identify 10 discrete components within this microscopical section of an angiosperm leaf (left). Within 50 years, the tissues were helpfully identified for the candidate, who had only to mention the function of two (right).

part was labelled with its name, from the cuticle down through the mesophyll to the stomata ... the question was: what does a palisade cell (and a stomatal guard cell) do? Pupils had to note their function. Just that. The leaf section in the 1947 paper had each structure anonymized by a letter, from a (the cuticle) to k (the lower epidermis). Candidates were expected to identify all the 11 anatomical features – the same that were helpfully spelt out in full 50 years later. Three were selected for pupils to discuss. Over the years, the knowledge each youngster needed to understand to pass an exam was slashed to a tiny proportion of what it was a generation before. The student's knowledge of microscopical structure needed to pass an examination had shrunk by 90% in just 50 years.

## WHEN MICROSCOPES WERE POPULAR

These days, popular books on the microscopical world are rare, and the videos on YouTube are a mixed bunch – most are fakes or mistakes. In Victorian England such books were much more popular. The educated classes were expected to be conversant with the latest discoveries. In 1857, a prominent Irish scientist, the honorable Mrs. Mary Ward – so dignified because she was the granddaughter of Viscount Lorton – published *Sketches with the Microscope*. It was instantly successful and was republished as *World of Wonders Revealed by the Microscope* in 1858, the same year as those first Cambridge examinations. She then wrote *The Microscope*, a popular guide to the subject, in 1865.

One of the earliest great works on popular microscopy was written and published in the USA. Entitled



The Model B microscope became the leading research instrument manufactured in the US when Robert Tolles and Charles Stodder started production at their Boston Optical Works in 1870. They claimed that American technical skills meant they could match anything produced in Great Britain or Europe.

*The Microscopist, or a Complete Manual on the Use of the Microscope* its author was Joseph Henry Wythes, born in Manchester, England, and a citizen of the states since the age of 10 (when he dropped the final "s" from his father's surname). His book was first published in 1851 in Philadelphia and was reissued in four editions until 1880. Meanwhile, John Phin published *Practical Hints on the Selection and use of the Microscope* in New York in 1877. He illustrated several instruments made in America, including the Excelsior Microscope. It folded into a small wooden box and was patented in America in 1874. At \$2.95 (less than \$70 today) it brought microscopy to the potential mass market.

Microscopes made in America were popularized by Charles A. Spencer who published his first catalogue in 1838, a year before the foundation of the Royal Microscopical Society in England. As microscope design developed in Europe, America provided a swift

counterpoint when Robert Tolles, a lens maker, and Charles Stodder, a designer, opened Boston Optical Works in 1867. They began the manufacture of their excellent B Model microscope in 1870 and then announced their student microscope which, they emphasized, had workmanship "superior to that of any instruments of the class made in Europe." It sold for \$28 (about \$650 today) and became popular with medical practitioners, in universities and also in schools. Then in 1876 in Paterson NJ, the George Wale company patented their New Working Microscope and introduced a number of new technical refinements.

This was the time when the quest for scientific knowledge, and the popularity of microscopical investigation, was everywhere apparent in the US. The State Microscopical Society of Illinois emerged from the inaugural meeting of the Chicago Microscopical Club in December 1868 and by 1877 the New York Microscopical Society had been announced, with the American Microscopical Society starting a year later. Popular interest in microscopy was everywhere apparent – a contrast with the lack of popular information available today and the lack of general interest in the subject.

## HOW LITTLE DO YOUNGSTERS KNOW?

Pupils in the late 1800s were expected to be able to draw a map of the states, to trace the course of the major rivers, to enter the mountain ranges, to indicate the great cities. Today such scholarship is extinct. The results of our failure to educate, just as I predicted, are everywhere evident. The equivalent of the great politicians and wise, philanthropic business leaders of the past are hard to find today. Parents are berated for failing to feed their children properly yet, in school, nobody learns how to raise children, cook a meal, or run a home. They say people don't behave properly on vacation, or in the theater, or when traveling by plane. Yet nobody has learnt these things. Youngsters need to know how to change a baby, book a vacation, launder clothes, assemble a wardrobe, plant a hedge, bath a child, choose a career, change a tire, build a wall, make jam, fit a kitchen, or wire a plug. Instead, they are taught Shakespeare and algebra, neither of which are of practical benefit to their adult lives.

## A MICROSCOPE IN EVERY SCHOOL

We will only understand life, and living, when we can instill in every youngster an awareness of the microscopical world. It's easy to complain about the situation, but I felt we should do something about it.

Children needed access to microscopes. In Britain, the Royal Microscopical Society had a long-running campaign to have a microscope in every school. It was a great idea, though harder to put into practice. Then, digital microscopes appeared and in 2002 I embarked on a project with the National Endowment for Science, Technology and the Arts in London (NESTA) to donate a QX3 digital microscope to every public school in England. The innovative software produced usable images at magnifications of 10×, 60× and 200×.

Digital microscopes are everywhere now, but some 20 years ago they were largely unheard-of, and they proved to be the perfect introduction to the microscopic world for children. Once the scheme had been agreed, their CEO Jeremy Newton asked if I should produce a user's handbook. NESTA gave me a couple of the instruments and I put forward a proposal for the production schedule, and the cost of publishing the brochure. This was such an exciting project; not only were we going to give a microscope to every state school in England, but this was also a chance to introduce young users to the burgeoning world of digital microscopy. It was the first in the world. Said Jeremy: "I will give you our approval for this by Wednesday, at the latest. You will need to respond immediately." Everything looked promising.

Except that nothing happened. Wednesday passed, and Thursday; I was on the point of leaving to join a voyage around the Caribbean at the weekend as their guest speaker, but NESTA remained silent. Not a word. I flew to Bridgetown, Barbados, convinced that the hoped-for approval for my microscope manual was never going to materialize. I was wrong; it did come, though days later than promised. My wife Jan had checked the mail, and there was a letter setting out the details of the project. She immediately telephoned the agent who'd booked me for the trip, an amiable and avuncular character named Peter Rushton, and asked for the ship's contact details. Rushton had no idea. He was accustomed to shuffling around requests for me to speak, and aligning those with dates when I was free; but – once you were safely aboard – he had no idea how to make contact.

These days we take WhatsApp and email for granted, but a couple of decades ago few people had embraced the new technologies. I was first on email in 1993 and had my web site from 1996; but the vessel on which I was traveling had no such state-of-the-art refinements. At our local library, Jan was able to locate published listings for the ship, and eventually its fax number. The kind librarian faxed over the document, which was delivered in an envelope to my suite.



So there I had all the details I needed, but no obvious means to respond in writing. I prepared my acceptance on the laptop, then headed ashore. We had docked at Tortola, in the Virgin Islands, and I went across the island to Cane Garden Bay. Perched up among the coconut palm trees, was a little office like a treehouse with shutters to keep out the glare of sunlight and there, typing away on the keyboard of an old IBM computer, was a cheery local woman who greeted me with a broad smile. I wanted to access my email? Sure, she said, and sat me down on the chair. Within minutes I had sent the documents back to base; they were printed out, popped in an envelope, and mailed over to NESTA in London. So Jeremy had his prompt response, just as he wanted, and to this day he has no idea of the contorted procedures that went on just to deal with what, in the modern world, would become a simple matter of routine.

The format of the manual would be a 36-page booklet printed on glossy paper. I knew it would be best to commission a graphic designer to give the manual a professional appearance, so I brought in an artist named Stephen Lambert to do the job. Mike Urban, who ran a successful local printing company, would handle the production. Meanwhile, I would be carrying out experiments with the QX3 microscope and deciding on the contents. The young microscopists would see familiar objects in a fresh, new light. They would need some history to set the background; and needed to know how to prepare specimens for microscopical scrutiny. Children love to know tricks that elude their elders, so there would be a section on the Easter-eggs hidden in the software – the secret messages that could be revealed, if only you knew how. Practical observations would feature too; how to detect forged documents, study pond-life, identify pests and peruse plants.

I would show the young enthusiasts how to make a timelapse movie of germinating seeds, how to turn the microscope on themselves, and how to service the instrument so it always gave the best results. They would discover, in closeup detail, the captivating development of a young frog from the fresh spawn; see coins, paper currency, liquid crystals and computer monitors in vivid closeup, and learn how their observations would compare with the pioneers from the earliest days of microscopy. For the first time, I published how the poisonous spines on a stinging nettle leaf that they would see, would compare with the first ever illustration published by Robert Hooke in 1665. I showed them how modern cloth under their school microscope would match the original Hooke drawings.



The user's manual for the QX3 took the young scientist through the lens to capture the splendor of the microscopic world. It was also translated for a Welsh language edition, so becoming the first science schoolbook ever to be published in that ancient language.

And they were briefly introduced to the instruments used by Antony van Leeuwenhoek, who first revealed microbes, and Robert Brown, who studied plant cells and bequeathed to us the notion of the nucleus.

The booklet was hailed with excitement by NESTA, and by the teachers who were presented with a copy along with the QX3 microscope. The topic came up for discussion one day in Wales, when I was attending an event at Cardiff University, where I have been a Fellow since 1986. Why was the scheme only for English schools? My scientist chums were wondering about a Welsh edition. Welsh is actually an original language of Britain. When the Romans came 2,000 years ago they imported Latin, and the English we know today derived from the Scandinavian, Dutch, and Germanic tongues spoken by waves of later invaders – the Anglo-Saxons, Vikings and the Normans. These occupying forces drove the indigenous people out to the West, and they clung onto their original civilizations in Wales and Cornwall.

## ANCIENT LANGUAGES IN A SCIENTIFIC WORLD

The English made it unlawful to speak Welsh when they conquered the country, just as the US made it illegal to speak the native language when they took over Hawaii. Fifty years ago, relatively few spoke Welsh, but a growing sense of national identity led to bombs being detonated during protests in the 1960s and 1970s, and the media attention that was focused on these events eventually encouraged officialdom to take the language more seriously. Now it's everywhere; elec-

tricity, gas and city tax bills are all produced in Welsh and English. Road signs are bilingual, with complex Welsh directions confusing the bulk of English-speaking drivers. In my early days I often broadcast for the BBC from their Cardiff studios, and nobody (literally, no-one at all) spoke Welsh. Now it's obligatory, and you hear the language everywhere.

Because Welsh is so ancient it lacks modern words. This is why there were no science books anywhere in the language, and my digital microscope manual would be the first science schoolbook ever to be published in Welsh. I was fortunate to know Huw Roberts, a scholar of the language well versed in science. Although an entreaty "to use the" microscope was easy enough (it's Defnyddio'r) new coinages were needed for digital (Digidol) and microscope (Microsgop). The first section, How Microscopes Began, became Sut Dechreuodd Microsgopau, and Huw went on to translate all the text into mellifluous, flowing Welsh. Schools loved it. I did, too. It meant that the first science book that children learning Welsh would encounter was one about microscopes.

Like many official bodies in America and Britain, no attempt was made to find out how the project worked in practice. There are no figures to show how many schools used the microscope, or how many children liked the guide. When I visited schools, I was told that it was a success; I had many messages from users who thought it an excellent idea; there were encouraging reports in the daily press, and I have since been told (by a handful of people) that this was what triggered their interest in microscopy.

Catching them young was always the answer. American schoolteachers had been keen on science from the start. Benjamin Franklin had advocated the teaching of scientific ideas in the late 1700s, a proposal that became part of Thomas Mann's "Common School Movement" between 1830 and 1872. It brought an emphasis on understanding science to public schools across America.

By 1893, the Committee of Ten, established by the National Education Association (NEA) had set out to standardize learning, with biology, chemistry and physics as fundamental subjects that every child should learn. Charles Elliott, the new president of Harvard University, published a call to arms in 1869 with articles in the *Atlantic Monthly* which bemoaned the paucity of targeted education. He proclaimed that American scholars were "fighting a wilderness, physical and moral" and he pioneered the move towards laboratory-based learning so that practical science was familiar to every child. Then, in the early years of the

twentieth century, John Dewey championed the teaching of inquiry-based learning in science. Much of this impetus has since been lost.

Some Victorians did recognize the benefits of an early introduction to microscopy. Smith & Beck of London began the mass production of their Student's Microscope in the 1850s and Cheltenham Ladies' College soon launched a course which taught their students how to use microscopes routinely and showed how to prepare botanical and zoological specimens. Manchester Grammar School added microscopy to their curriculum, and students were instructed on the preparation of mounted slides. As interest in science continued rapidly to grow, the British Association for the Advancement of Science, which had been founded in 1851, published a report in 1867 which called for the teaching of pure science to develop the "scientific habit of mind." Microscopes were familiar to students, and to their parents. Nothing like this has survived into the present era, when the living cell plays such an important part in modern medicine and in the quest to understand life.

Science teaching across the states has traditionally relied on guidance, rather than a Federally imposed syllabus, and after the Victorian public fascination with science began to wane, science teaching in every state drifted in a different direction, with little emphasis on microscopy. Some order was introduced by President Lyndon B. Johnson's Elementary and Secondary Education Act (ESEA) which became law in 1965. That same year saw the introduction of the Head Start Program, designed to fit little children for their lives as scholars.

The words were fine, but the reality was a disappointment and in 1983 the National Commission on Excellence in Education published a detailed report with an uncompromising title: *Nation at Risk*. It recognized falling academic standards, emphasized that American schools were dropping behind those of other nations, and pointed out that too many school leavers lacked the skills of literacy and numeracy to succeed in the outside world. The authors were uncompromisingly critical and stated: "If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war." It was a call to arms, and it did draw public attention to the perceived failures in American education.

There were some successes following the report's publication. Scores published by the National Assessment of Educational Progress (NAEP) showed a discernible upward trend in math and reading, though



standards still fell below those in other competing nations. Doubts continued to be expressed over the preparedness of school leavers for life in the college environment, and one lasting after-effect was the increased reliance on simply passing exams. "Teaching to the Test" became a buzzword; it was an unforeseen side-effect that lingers to this day. Ticking boxes on multiple-choice examination papers does not allow self-expression nor original thought. Notions of preparing students for adult life were scant; and nobody had to see down a microscope to consider themselves equipped for an understanding of life.

### THE PRESENT IN THE PAST

In a recent column (see: "My, How Things Change," *The Microscope*, Vol. 71:1, pp. 30-42, 2024; <https://doi.org/10.59082/LIOA1075>) we explored the long history of science and its effect on popular culture. Readers were surprised to realize how much of today's advanced technology had vintage origins – a transparent automobile, flying jet airplanes, a working computer, scheduled transatlantic flights ... all before World War II? Yet we seem rooted in the sense that everything has happened recently.

In deciding which sciences to teach, states are encouraged to conform to the Common Core State Standards (CCSS) an initiative which proposes educational norms for English and mathematics. We know that high school students, preparing for higher education, can go through College Board Programs, and there is the Next Generation Science Standards (NGSS) to help all students improve their understanding of science and technology, engineering and math. Yet still matters are in decline.

Thirty years ago, I first published my concerns and was interviewed about the problem on television. My serious reservations about the deterioration of education were reported in the press. Geraldine Hackett, an education correspondent, revealed that examination boards were being instructed to mark papers more generously. I showed that the number of British 16-year-olds gaining the top grades almost doubled in the space of a dozen years. In the US the proportion of students being granted an A-grade rose from 15% in 1940 to around 50% now. Meanwhile, definitions were upgraded to compensate in the way that "pupils" were called "students" instead, the aspirational term that used to mark out those who achieved a place at college. We have little children who "graduate" from school, and even juniors wear gowns to confer a spurious sense of success. We have inflated the terms, while



Granddaughter Lucy, when aged 9, took to using the QX3 digital microscope instinctually. She later became a superbly intuitive amateur photographer and earned a first-class honors university degree in sociology while running her family home (with two exuberant sons) and studying whenever she could.

degrading the reality.

It is said that half of the undergraduates in Western universities were not academically fit to be there. The official government statistics for America confidently claim that 100% of young adults can read and write. That's not true. Academic analyses have shown for years that at least one-fifth can't, after all those years in school. In Britain, former Prime Minister Rishi Sunak admitted that a quarter of school leavers cannot read or write properly. Our schools have failed, and we should face the fact. Youngsters do not get their information from school, but from TikTok, YouTube, and Instagram. Everybody, no matter how young, has instant access to everything online from making meringues to barbaric beheadings; from soft drugs to hard pornography and once seen, such sights cannot be unseen.

Many of the videos on social media are, simply, lies. Treatments and cures, gadgets and gifts; there are air-headed influencers paid to beguile the young with fictions fabricated to ensnare their loyalties. Conspiracies abound, lurking between the Asian child prodigies and the American enthusiasts with something sensible to say. The familiar world which we all knew is dead. In its place is a free-for-all of fakery and fancy. You will find graphs and memes, videos and photographs, all created with professional flair, and a great proportion are simply fake, invented to prove a point that, in the real world, doesn't exist. Our future is far more at risk than we realize.

## FACING A FACT-FREE DIET

In this online universe facts no longer matter (see: "Facing a Fact-Free Future," *Laboratory News*, December 8, 2024; <https://www.labnews.co.uk/article/2096581>). The abandonment of fact-checking by Meta across Facebook, Instagram, and Threads gave free range to every misinformed campaigner to insist they're the ones who are right. Young minds – old ones, too – are being marinated in an online swamp of confusion, dishonesty, opportunism and profiteering. We are being threatened by digital automation masquerading as artificial intelligence (as I've said before, A.I. has no more intelligence than a sack of soap) but it's social media that's the real threat to our scientific society. Online influencers and bloggers tell me that there's one reason above all why they adore social media – there's no editor standing in your way. You can say whatever you like. You think it? Post it.

The young accept influencers as part of the modern fabric of everyday life. They're something that would have been unacceptable – indeed, probably unlawful – a decade ago. Back then, if you wanted to promote a paid-for proposition, it would likely be in a newspaper advertisement or a television commercial. In print it would be headed Advertiser's Announcement and on TV it would pop up in a clearly identifiable advertising break. Now the novel notions, or the product of the month, emerge online from influencers, who are remunerated with free goods, wads of cash or luxury holidays to dubious destinations like North Korea or Dubai in return for beguiling their docile followers into forking out money to do the same. The Taliban will give you a riotous time in Afghanistan, if you can convince them you'll positively promote their politics back home.

Social media will spell the end of the scientific society we knew. A single ridiculous notion, or a wild and deranged individual, can go viral (nobody can ever discover why – it's like that fluttering butterfly's wing and the typhoon) and everybody knows of it within days. Vaccines? Measles vaccines exist only to make a profit for the drug cartels. Tens of millions of young parents have been taken in by this, so beautiful little babies are once again being maimed by this dreadful disease. Thanks to the MMR vaccine, the US was declared measles-free in the year 2000 but, thanks to those anti-vaxxers, the disease has re-emerged – another triumph for social media.

Observe those contrails from high-flying jet aircraft, weaving across the sky like skeins of silk? Millions of people are convinced they're chemtrails –

clouds of poison released to control the people beneath. You can point out the facts; that nobody has ever seen anyone pouring such weird chemicals into aircraft, or that – even if they did – they'd poison the perpetrators as well as the population, adding that any such spray would come to ground hundreds, or likely thousands, of miles distant ... no matter. It's powerful forces intent on controlling the world, in spite of anything you claim. It says so on social media, so it must be right.

The sheer ignorance of so many social media devotees is extraordinary. We used to joke about the Flat Earth Society, which closed down in 1971 after space travel had finally convinced even the most ardent sceptic that the earth was, without doubt, a spheroidal planet. Since then, the unchaperoned machinations of the Internet have brought every crank out of the shadows and into the glittering foreground. Thousands of posts on social media now insist that the earth is flat (it must be, since the horizon is a straight line) and does not rotate (it can't, or a helicopter flying straight up and down would land somewhere else).

The controversy over global warming has hundreds of thousands of people convinced that the climate isn't changing at all. Political statements, claims about health treatments, basic data and information of all sorts – social media promotes so many groundless claims that we no longer know what is fact and what is fiction.

## MICROSCOPY ONLINE IS A DISASTER

There are websites purporting to demonstrate how microscopical specimens are examined which show that the operators have no idea how to prepare a specimen, no concept of how to examine it, little understanding of what they observe, and – in many cases – a liberal squirt of a nematode culture has been added to convey the impression of contamination when none exists.

The result of all this confusion is that the news channels now have a department to verify reality, something unthinkable a decade ago. It seems so promising, until you reflect that few people under 35 have the least interest in television news. Top news programs like Good Morning America on ABC, NBC's Today and CBS Mornings have audiences topping 2 million middle-aged viewers. That's nothing. A soccer player of whom you have likely never heard, Cristiano Ronaldo, has a billion. His online audience on Instagram alone is over 628 million, mostly people in their twenties.

Social media has such a vast reach that it has made

school teaching irrelevant. Youngsters sense this; the number of children noted as chronically absent from school has doubled in the past eight years from some 15 to 30%. Schools are closing down. A thousand public schools shut every year; once the center of community life, they are currently of dwindling importance. This is partly due to fiscal constraints since the covid pandemic, but it is mainly the result of falling enrollment as fewer children are being born, and many of them dislike going to school. The birth rate in America has halved in the last 50 years. To maintain a population, we need about 2.1 children born to each woman; currently it is 1.7 so the current population is ageing and dying out. Immigrants will more than make up the difference, though not enough to prevent the loss of thousands of community schools. The drop to 1.7 seems disturbing but it is far worse in South Korea where the birth rate is currently 0.72 children per woman. Most young couples want their careers, and a luxurious lifestyle; so there simply isn't time for babies. Within 25 years, it is projected that there will be more 90-year-olds surviving each year in South Korea than there will be babies being born.

## FACING THE FUTURE

Most of what young adults know has nothing to do with school. They learn for themselves from what they see online. Swedish schools actually turned away from using textbooks to using online resources in 2009 and are now spending \$100 million turning back the clock and reintroducing textbooks – but that's not the answer. We need to leap forward, not lurch back. We need an educational revolution. I would like to institute schools as didactic communities where pupils of any age would interact with teachers who covered special topics – and not just the classical subjects – but life skills of every kind. Why wait till you are at college to study medicine, economics or law? Like familiarity with the microscopic world, we should start children on those before they are 10.

You would find teenage mathematical prodigies helping younger children, senior baseball players coaching the eager tyro, gifted teenage designers enlightening those aspiring to embark on a career in graphic art. A lamp needing to be fixed? Rooms that require organizing? A broken zipper in a favorite jacket? Pictures to frame, and hang? Paintwork that needs attention? The youngsters would learn to do it all. In Japan, the school pupils clean their own classrooms; we should too. Wherever you live, you need to learn how to maintain your space. Ordering supplies for



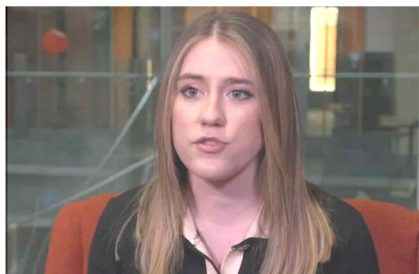
Some 30 years ago I was interviewed on television on my proposal for more inspirational teaching, and said we should have school classes on being a stand-up comedian, choosing a home or organizing a pop concert. The Sky TV interviewer Laurie Mayer ended by saying: "Brian, I hope you get your school soon."

classes? Arranging the annual fayre? Designing posters, or publishing brochures? Organizing celebratory meals, repairing a car, or sowing seed to make good the playing field? Those, and so many others, are tasks the youngsters would love to embrace. Rather than banning their smartphones from the classroom, youngsters must learn how to use them for the best. Teenagers browse their phones all day, hoping that a post will reach a million subscribers, and they'll suddenly start making money like magic. They need to learn to ration their browsing (those subscribers will accumulate during the day, and you can check when school ends to see where you got). Smartphones are important in educating the young; many learn to spell through using their phones, so this can only increase literacy.

And there will be no more multiple-choice exam papers. Students will show their prowess as they progress, and can certainly sit examinations that are friendly, demanding, empowering and fun – examinations that have them writing enticing prose and creating fresh ideas. Scholars often say that children don't like sitting exams, but of course they do. Trivial Pursuit (exam questions for general knowledge set out as a board game) roared to the top of the charts. Poki.com is one of the innumerable sites featuring quizzes, and quiz books remain highly popular. Children have an imperative to learn – they just need to be enlightened and educated in a way that embraces neurodivergence, respects their personalities, their idiosyncrasies, and their achievements. It's the right environment they need.



Meet the anti-disinformation star who lied on  
her résumé



Marianna Spring (BBC)

**O**h dear. Could things get any worse for the fledgling BBC Verify, launched to combat the scourge of fake news? The fact-checking service has already faced criticism for failing to spot the BBC's own blunders — such as the Corporation's misfired reporting on Nigel Farage and Coultis. Now though it looks like the service's star reporter could be in a bit of hot water.

Factual reports are now verified by a new department at the BBC, and the reporter was announced as Ms. Marianna Spring. It soon transpired that her own resume could not be verified. She claimed to have worked with a senior correspondent whom she'd only met in passing. Take care with verification.

Schools need to become interactive social centers, sources of security, places to which teenagers long to return. There they will acquire the essential skills they need. And — from dye-sublimation printers to scanning electron microscopes, and from weaving looms to photographic studios — the equipment to launch their enticing new lives would be at hand. Chances are that a pensioner with a broken timepiece, or a child with a wounded fledgling they found on the sidewalk, could find the answer from the youngsters at one of Brian's new schools. They would all know how to scan the night skies with a reflecting telescope, how to culture microbes, and just what life is like under the microscope. These would be children with liberated minds, not brains entrained in conformity.

## CAREERS IN A VIDEO LIBRARY

This is a serious issue. And I have a solution. There should be a section on sites like YouTube, Instagram or TikTok with half-hour movies exemplifying every job in the states. The entire story should be summarized in the first thirty seconds, so that browsers would quickly know whether the idea appealed to their ambitions and abilities. For decades people have assured youngsters that you can do anything you want if you fix your mind on it, which is (as we all know) nonsense. Kids don't know what they want to do because they have no idea what's on offer. My World of Work videos

would have everything that's available linked to keyword searches. What does it take to be a refuse recycler or a television weather forecaster; carving driftwood into art, nurturing the elderly incapacitated individual, how to thatch a roof, make handbags, care for exotic creatures in a pet refuge or lay roads or runways; to command a platoon, run a successful house and home, take videos with drones, work in a ship's engine room, serve in a store, manage a refinery, dig pits, run a hiking trail or analyze traces from a murder site and come up with the killer?

A huge number of youngsters sincerely believe that they will make millions after becoming famous as online influencers, by making videos at home after getting up in the afternoon. Some may — but finding a satisfying lifestyle matters more than making millions, and they'd need some kind of remunerative occupation to keep those finances running until their online activities kick in and make a profit.

There is also the question of truth: my new schools would be the place where you can ascertain whether some online resource is real, or fake. Even here you must be careful; many rely on the BBC as an objective resource, but even their head of disinformation and social media, Ms. Marianna Spring (whose job it is to ensure that every fact is factual) falsified her resume. At one time she was briefly a stringer in Moscow, and she claimed to have worked closely with the BBC's correspondent Sarah Rainsford. She never did. They may have exchanged nods in the corridor, but the statement is untrue. So — when checking the basis for facts in any story — the new school staff must be careful.

Bringing home the realities of life under the microscope is something every school needs to introduce today, then I want tomorrow's fired-up youngsters to discover how to deal with the world and, yes — learn about the contentment, loyalty, altruism, and peace, that will guide them through their diverting and disturbing digital destiny. For the first time in history, tomorrow is here, today.

So what would you call this new approach to schooling? That's fairly obvious. With a microscope to hand in every room, and with students learning how to look at life with an eye on the realities that only the microscope can provide. That's what this column has always done, and there's your name: Critical Focus schooling. It's what we have needed all along. ■