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Science Education Without Pressure  
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ABSTRACT: The traditional, dogmatic educational system was reinforced by the addition of science instruction to its curriculum. Three errors are reinforced by this move and the subsequent split of the system into streams. a) Pressure is confused with coercion, b) Interactive study is confused with assigned exercises and with self-instruction, and c) Aptitude (disposition) is confused with talent (ability). Reform must begin in the public educational system, at least until experimental schooling becomes the norm; yet research must now repudiate traditional views and develop the theory of, and the tools for, free interactive study, aiming at imparting universal literacy, including science literacy.

### *Psychology*

#### *Mental Damage*

We owe to Sigmund Freud the knowledge that pressure put on the young may cause much irreparable damage, at times quite incapacitating. He said, the harm is not fully avoidable, perhaps it is better not fully avoided, since with no neurosis there is no civilization, but it should not be incapacitating; if it is, then it calls for psychotherapy. The 1956 International Psychoanalytic Association meeting in Jerusalem, in which his 100th birthday was celebrated, utterly ignored this counsel of his. His daughter and successor Anna asked there, how come his discovery failed to bring about the expected Utopia?

The implementation of Freud's insight demands very little: suffice it to inform parents of the lasting harm caused by impatience, especially in early infancy, for example, during toilet training. Much has already been achieved this way; in the civilized world obstacles to Freud's Utopia have greatly declined, and with much benign effect. In the meantime we have given up on the very idea of Utopia. This change is largely due to the influence of Karl Popper, who said, no perfection is possible, only

improvement is; the elimination of all error and prejudice is thus also not possible, although their reduction is. Moreover, the promise of Heaven on Earth is dangerous, as it boosts fanaticism. Responsible people should accept some criticism and even seek it, so as to reduce error and prejudice. But we cannot avoid all error and all prejudice in any specific domain, not even in science, let alone in education.

The elimination of force is impossible, and the same goes for pressure: there is no society without some measure of coercion or another; yet it is imperative to try to reduce them and more so to reduce their ill effects. This holds in general, but its discussion here will be confined to schooling, especially to the import of pressure for the acquisition of scientific knowledge and technical skills.

The law specifies and controls the permissible use of force, and the discussion of this item belongs to the literature on young offenders, here to be ignored as much as possible for want of space. The situation is very different regarding pressure. It is always taken for granted that whenever possible the use of pressure on children is preferable to the use of force on them. Freud's influence has not begun to show its efficacy as far as schooling is concerned, simply because the alternative to pressure is force, and the use of force is taken to be too cruel. Anna Freud did not even notice the possible influence of her father on schools, because young offenders are not infants, and Freud talked only on the damage caused to infants, usually related to infant sexuality; her own concern was more centered on infants than his. The damage to be discussed here is the one caused in schools and more so at home, but by schooling, by the methods of pressure applied for the purpose of advancing education, especially the expression of the idea that to earn parental love and approval one must excel in school. This is not to discuss the way this idea is expressed, as it can be expressed in all sorts of ways, more explicitly or more by subtle implication. Nor is this to say that the idea is true, as it is patently not true: love of offspring (or its absence) seldom depends on grades or on other manifestations of success, and then hardly ever before maturity. It is simply the fact that

in ordinary modern circumstances parents often put pressure on their offspring to do well in school – for their own good, of course – and in order to do this they use the main means of pressure available to them, namely condition their expression of parental love (and appreciation and support, and whatever else is in demand) on success in school, whatever this may mean. (Often parents neither know nor care to know how success in school is achieved; they only want to see evidence of it.)

As far as schools are concerned, it is taken for granted in modern society that parents and teachers are allowed to use pressure whenever necessary; they are also allowed to decide that it is always necessary. So pressure and need are constantly on the rise: school causes and mounts the need; the home is helpless; then things go wrong, some safety-valve is opened, and then it is back to the starting point. No progress.

Let me refer briefly and in passing to one basic justification of the pressure examined in this essay. I will not discuss it at length as it relates closely to the use of force, which use will be overlooked here. The use of pressure by parents and teachers is silently but insistently justified as preferable to the use of force (“these brats are forcing us to call the police, but we are not going to do that”): as the use of force necessarily involves the law, it brands its targets as young offenders and thus leaves on them stigmata for life. This justification is facile: police record is at times worse than the irreparable damage to mental well-being. A simple case in point is adolescent suicide. This case is not noticed in this context because adolescent suicide is dismissed as hardly predictable, and so as an accident of sorts; for, were it predicted we would naturally do all we could in order to prevent it. This dismissal is an error: even were every specific case of suicide an accident, the general case is not merely accidental and it should not be considered as such, not as long as the rate of adolescent suicide can be reduced. And it can: by reducing educational pressure. This is empirically easy to corroborate: in Japan, where educational pressure on adolescents is maximal, so is the rate of adolescent suicide, and in obvious correlation

to the failure to achieve. Moreover, the damage is not confined to cases of suicide: suicide indicates a very high level of suffering, but suffering damage just below the level of suicide is even more common. Yet the idea that pressure is reducible across the board is deemed Utopian. This is a serious error: though admittedly the full elimination of all coercion is Utopian, much can be done to reduce it. This essay is an attempt to show that most of the educational pressure justified as unavoidable is avoidable with ease, and also that reducing it drastically is both possible and educationally very beneficial.

### *Motivation*

Traditionalists value pressure; rationalists or radicals disparage it. Both are reticent about the proper amount of pressure required or permitted. The matter invites public debate in respect of the democratic right of both parties to misjudge and to dissent. Since classical, radical rationalism is not sufficiently tolerant of dissent and of error, it has to be replaced with some newer, more democratic, reformist version of rationalism. It is known as critical rationalism and it is the replacement of the classical demand for proof by the more modest and common sense demand for the elimination of some errors.

In line with this we may begin with the following ruling. Before we open the debate on what degrees of the kinds of educational pressure are permissible, we may already deem imperative some /measures of reduction of pressure. At least excessive measures should be banned; and crude means of pressure should also be banned as leading to excess. The most excessive and crude is the drive for excellence: you are worthless unless you achieve. This is the target of the present essay, which is thus merely preliminary. The drive for excellence is wrong both as to ends and as to means. Its end is to win trophies, regardless of what they represent; it is thus not conducive to the development of independent thinking which is the end of all reasonable science education. Its means are exclusively cruel and invite preventive measures such as Gloria Steinem's drive for the humane and democratic idea that worth is independent of achievement. This is good for public

mental health, mental hygiene, and preventive psychotherapy. It is also good for healthy education as it promotes a reasonable attitude to learning as conducive to healthy ego growth. The pressure to achieve is supported by realism: current technology demands a large supply of new cadres of experts; this cannot be achieved without effort, and the effort demands direct pressure, especially on the young, since, come what may, they will not exert effort unless coerced. This is an error. Even were it true, it would invite experiments and careful measurements aimed at minimizing pressure to meet prescribed targets. As no one advocates this activity, the alleged justification that invites it is but an excuse; it is an observation that is not taken seriously even by those who suggest it: they suggest it only in order to brush off criticism, and then they forget it. Some coercion is required, but not the pressure to excel.

There are less harmful means to exert pressure: financial incentives, in particular. Increased demand for technologists should raise their income and thus the demand for technological training. If the market mechanism needs boosting, then governments might guarantee students' loans, offer tax exemptions and use other standard economic incentives. This will also improve technological training and the quality of work of technologists, as much of their training, perhaps also most of it, may be done in the workplace (as noted by David Budworth, *Public Science, Private Views*, 1981). The argument from the need for new blood for technology has different implications for people concerned with it as a challenge for politics and for political economy than for education and for the concern for the quality of life of technologists; the services of teachers should not be used to reduce the challenge to economic planners. The argument from the need of the economy for new technologists is valid; it should be used not as an excuse for the use of poor educational measures, but as an incentive to improve education so as to meet new needs.

It is indeed politically important that the average citizen acquire both some measure of discipline and certain skills, and education is explicitly

put in charge of these needs. This does not hold for the idea that science students have a special need for coercion; and so it is no accident that this idea is not an explicit part of task of the education system but a part of its less enlightened folklore that surrounds it, and used to its detriment. Were the demand for excellence allowable, it would not justify putting pressure in order to attain it; were putting pressure in order to attain excellence allowable, it would not justify using as means for pressure the demand to justify one's existence. It is distinctly undemocratic to demand to justify existence, in any way and for any purpose whatsoever: at most this demand depicts the transition from traditional values to democratic values. Modernization allows escape from traditional misery, but the escape may cost super-human efforts; as long as the effort which a measure requires for success is too great, then, by definition, the measure is available only to few individuals. Reactionaries misuse the fact that a few have escaped misery as proof that those who have failed to escape the misery have only themselves to blame, so as to justify absurd accusations and scorn for them, on the cruel supposition that these accusation and scorn permit mounting needless pressure on all for the alleged good of a few who escape the misery which the system imposes on the majority. It is not essential for the argument offered here to observe that the few who succeed to escape the common misery are also unhappy victims of the system; yet this observation is true: their excessive efforts often cause irreparable damage. Hence, those heartlessly care only for the most promising students, and who recommend putting pressure on them for their own good, are cruel even to them. The famous example here is Jack London's quasi-autobiographic novel *Martin Eden*, whose hero escapes the hardship of the system by talent and determination, only to lose thereby the common joys of life and be thus driven to suicide. The most one can assert in favor of coercion is that though it is harmful to every member of society, it is needed for the good of society as a whole. This assertion is also false. Pressure may have had its use for society in the early days of modernization, so that even though it has caused untold damage to individuals who suffered from it, it may have been

justifiable socially. I do not know and I cannot discuss this. Yet even so, it has clearly outlived its uses. It survives nonetheless, partly because of conservatism, partly because its ill effects are not sufficiently noticed. This invites public discussion. Partly it survives nonetheless because pressure is too readily tolerated.

This invites careful deliberations and plans for public exposure of cruelty and for more reasonable alternatives to it. The targets are two empirically refuted dogmas. First, allegedly children are "naturally" lazy so that unless they are coerced they stay inactive to the detriment of society. Second, allegedly the way to prevent this is to condition one motive on another: if you want my love and respect you must excel. This promotes chronic deficiency of self-esteem. It also promotes neurosis: rationing food causes in the hungry anger or hatred; rationing love causes this way the love-hate that is emotionally harmful. Thus, even if coercion is needed for society as a whole, we need coercion measures that are less harmful than those who perpetrate neurosis among the educated. This is not so new: people who are within the education system and not too insensitive to human suffering are not surprised by all this. They even try to alleviate the pain. The outcome of their efforts is a compromise: they still do not recommend to allow youths to follow their own bent; they still do not even suggest to query what that bent is; but they do suggest to offer them scant choice, to use aptitude tests to fit them to programs to adjust to. And at times this compromise is implemented; indeed it is increasingly popular in the modern world. Yet it is quite unsatisfactory, first and foremost because it is manipulative. Manipulators are less harmful when met with hostility, as using friendly means is betrayal: the friendlier the manipulators, the greater the harm caused by the discovery of their betrayal. They must be exposed: they young have a right to know their rights. This is why the modern reforms ever so often improve matters on the surface yet they also cause much deeper harm. Reform must be open and democratic and directed at converting the students to meet their tasks.

*Instruction Versus Interaction*

Interactive learning is the alternative here recommended. It was invented in ancient Greece, no less, but it was repeatedly ousted by traditional, dogmatic schooling. It was practiced in traditional Jewish schools in a compromise version where the dogmatic framework allowed free interaction within it. The modern world forced it out even of much traditional Jewish teaching. It has survived only in pockets of western education, Jewish, Franciscan, and other.

Recently the interactive technique entered in a big way through the back-door; its success is that of computer programmers, not of teachers, as programmers interact with the young mainly out of school, and teachers still interact with their charges only marginally. The traditional, dogmatic model of instruction separates donor and recipient as active and passive respectively. Were this true, teachers would be replaceable with recorded messages. Thus, to prove their not being so replaceable, they mention their interaction with their pupils. They hardly do: lecturers are not interactive, and are easily replaceable by video-tapes. The tapes may easily be of better quality than the lectures in the average school. Teachers object to this, saying that during lectures they receive some impression as to the reception, though their recipients' output is both minimal and counter-intended. They monitor minimally, and so they still are replaceable by machines, though not as satisfactorily: the computerized monitors which are increasingly installed in hospitals, for instance, are supplemented with human monitors. Were teachers serious in their claim that they function as monitors, then it would be advisable for schools to improve by installing videos plus monitoring stations. This discussion wrongly suggests that teachers discharge their interactive function as monitors of attention. This is too much and too little. Too much, as some pupils are beyond monitoring: attending class under duress, they occupy classroom back-seats, where they entertain themselves as best they can with minimal disruption of discipline. Monitoring is also too little, being much less than proper interaction. Does it matter? Surely they all do notice each other's facial expression,

at times even exchange a smile. Does this help teaching? Is there evidence that stern demeanor is a more useful teaching aid than a smile? No one cares: the basis of nasty looks is untainted misanthropy. Teachers are not trained for interactive teaching; so they are unfairly beaten by faceless, cheap, interactive, cheerfully illustrated computer programs. In order to make room for interactive instruction the traditional division of the classroom into utterly active donors and the utterly passive recipients has to be superseded and replaced with a more human idea of learning. This division makes human instruction worse than the poorest interactive computer program. It is rendered absurd by even simpler modern means: it allows the education system to have teachers monitor in class their charges as they attend to an educational television program but not pupils sitting at home with earphones listening to the same program on a cassette at their own pace. It must be officially acknowledged that the placement of education in the classroom with active donors and passive recipient is an error, so as to allow clear and undisturbed entry into the classroom of modern means of instruction, especially the computer and the information highways and the diverse computer programs as a major tool for interactive study of independent students among themselves and with instructors whose services they may make reasonable use of.

This acknowledgment of the need for a radical change from the passive to the active stance of the student is urgently needed, but it is not easy to procure even though it is repeatedly said that instructors cannot be replaced by machines just because students are active and not passive. That teachers find themselves threatened with replacement by machines is understandable. Like other victims of technological progress, they deserve legal guarantees for full compensation. This is not done, though it is very easy to do as replacing some teaching roles with machines should enable the system to reduce teachers' workload, if not to the level of university teachers, then to something comparable. The result will be very beneficial and immediate: teachers will have time to improve their minds and to devise new educational techniques. They would rapidly alter their position from hostility to computers and fear of them to

an enthusiastic support of them. So we should not complain about teachers who erroneously deny that machines can takeover any of the functions that they are now in charge of, even though this denial is refuted. What is it exactly? If no more than that teachers satisfy pupils' need for adult company, then they could be replaced by baby-sitters. They should do better than that. What? This question is ignored though it is very important to answer it, as at least three further questions or clusters of questions should follow the answer, no matter what the answer may be. First, are the functions we expect of teachers the right ones? How do we judge this? How can this be put on the public agenda? How can this be improved? Second, do teachers perform the tasks expected of them? Can this performance be measured? Can it be improved? Third, what part of the task can be computerized, and should it be? Under what conditions? Here is much room for much needed deliberation that is initially blocked by the justified fears that must first be attended to. This discussion irks most of those who should seriously investigate it. They are annoyed and declare that it is conducted in oversight of obvious, significant facts. These facts are that interactions do occur in the classroom, no matter how much passivity is demanded of its participants, and more so in training, due to the obvious, interactive character of all training as such. Yet pupils have no input into the initiation and design of their own training programs; they are supposed to learn prescribed moves with the least deviations; this minimizes interaction. When schools accept interactions, they do so only most reluctantly. And then, when under threat, they boast of the interactions that they have failed to suppress. This is even unfair to traditional education and its theory, as for some reasons these regularly overlook and even oppose interaction.

### *The Core Curriculum of Education*

The motivation behind traditional educational theory is the conservatism that is the thesis that tradition must be maintained at all cost. The excuse for this thesis is simple: school should impart those means that will enable the next generation and cajole it to perform its duties not

worse than its predecessor. Assume that this pertains mainly to the transmission of knowledge, and the whole traditional education theory unfold on its three branches, curriculum, didactic, and motivation. (It is important to note that traditional education does not simply neglect attitudes to life, skill, and useful information; perhaps no single item is as important in all of these respects as sex education, yet traditional education passes over this item in determined silence. Traditional educationists were unaware of it; their traditionalist followers who have to address themselves to it openly oppose it. For, the role of education was traditionally aimed at serving society, not its individual members. Once the quality of life of the citizen is taken to be a goal of education, the traditional educational theory has to be radically revised.)

Studies of curriculum options are modern, as the traditional motive was to keep it unchanged. Science joined the curriculum, after the American and French revolutions secularized schools. It was a radical change that required rethinking. Yet only one relatively new idea was allowed, one that still takes the concern of education to be society, not its individual members: rates of entrance of engineers to the market should exceed the rate of exit by the growth rate of the profession. This criterion comes from an inconsistent philosophical background: it is still traditionalist but it allows for progress. This inconsistency can be ironed out, of course, at the cost of becoming very unimaginative; it breaks down when applied to research scientists and to artists, as the demand for their service is too elastic for conservative long-term planning. Also, planning education for one sector of the economy is useless. Investment in the reform of education in general and of the universities in particular may bear startling results. But most educators do not want to see startling results, not even for the better. For these have a price: they require the restriction of the compulsory part of the curriculum to the minimum and to leaving most of it open to considerations of social needs and personal inclinations.

Didactic determines the right speed for transmitting knowledge, on the added assumption that the student population is homogenous and

passive. Didactic practice is based not on theory but on trial and error; yet it rejects this method by fixing all moves in the learning process. It decrees the following maxims: the proper speed of learning should be not so small as to bore and reduce attention, and not so fast as to allow for error. Were this so, then top grades could be secured without trial and error which can be done, but only at the cost of chronic paralysis, at the cost of the atrophy of the emotional and intellectual ability to choose. This is the crux: traditionalism gives priority to individual obedience to the system for the sake of preservation society; democracy gives priority to individual choice for the sake of personal independence. This is a clash that paralyzes the practice of teaching and that will be overcome only by the revolutionizing of didactic theory. It is thus less surprising than it seems that author Michael Crichton who is so modern in his outlook nevertheless opposes the use of the information highways in education: he has showed that the pupils who use the Internet are prone to err and that their teachers are not qualified to correct their errors or even notice them. This is true. He concluded that we should stick to traditional methods of instruction. This conclusion does not follow from his finding: it follows from the premise of traditional didactic theory. This premise is that as long as teachers follow their prescribed course they are free of error, and then they can fully control their charges, and they can thus prevent them from committing any error. To this the right response is a quotation from Bernard Shaw. He said, "even I make mistakes." Full control of anyone other than oneself is wrong; not even parents should fully control their offspring, nor teachers. Though Crichton's conclusion is erroneous, his observation is important: pupils who use the Internet raise thereby new issues and this radically alters the role and conduct of their teachers. The Internet is the lowest means of internet working. When pupils who are eccentric in any way, not to say rebellious, will learn to create their own internet works (such as tcp/ip), the world will be a different place. It is foolish to fight progress: it is easier and wiser to join it and to save it from its worst shortcomings. This needs a new, imaginative didactic.

Finally, motivation. It is motivated by the wish to find the best ways to deceive pupils into thinking that it is in their interest to study. Study is in their interest, but it is assumed that they cannot comprehend this truth: they must be deceived. Since such attitudes are rendered increasingly illegal in democratic societies, it is no surprise that it is an item in educational theory that is on the decline. In any case, in higher education good grades are deemed sufficient motives. This has two undesirable consequences. One: this way the end of exams is also the end of all learning. Two: the correlation decreases between achieving grades and what they should stand for. Complaints about poor grades should lead to repeated, improved exams; this is out of question: I was myself censured heavily for doing it. So complaints lead to threats of litigation: a shyster visits a pencil-pusher who summons a professor demanding explanations. One cannot blame lawyers who throw in allegations of misconduct then, usually of excessive pressure: these allegations are always valid anyway. Vocational training foregoes much of this. Kids in poor districts know that the acquisition of some ability to use the school lathe or computer will soon yield economic assets. Access to it is often blocked in many ways, both bureaucratic and educational, at times even emotional. In frustration kids vandalize it; this is explained by some misanthropic idea which, together with the high prestige of science, prevent science education from emulating the better vocational training and so it also prevents the reform of vocational training across the board. It also block this way the study of the role of teachers, since the wonderful achievements of patient and concerned vocational teachers may vanish in a flash. This should be studied and lead to reforms. One of these should be to use machines whenever possible so as to notice the dedicated vocational teachers and give all teachers the chance to breathe. The motivation to replace teachers with machines is strong, but it is blocked by the just fear of damage to pupils and more so of unemployment to teachers. The situation invites the realization that democracy does not sit well with traditional education theory and that reforming theory is important. It requires some good will and much common sense.

*Experimental Psychology and Self-instruction*

The central classical premises about learning are obviously false as it is that instruction or self-instruction are identical in principle: both are the acquisition of knowledge by association. Babies-in-arms and adults presumably learn the same way; the animals employed in psychology laboratories too. Only ability was declared variable. As individuals with the same abilities showed different learning records, this led to the view that difference between pupils with equal abilities depends on the difference in aptitudes, a nebulous quality that is outrageously alleged to be measurable. The traditional view of learning as one process, of association, remains popular. Associationism deprives learners of their freedom, and then aptitude degenerates into talent; talent then splits into different branches, so that we allow one individual to have scientific talents and another to have artistic ones; and then technology goes with science rather than with art; the Greek word *techne* is initially synonymous with the Latin word *ars*. Variation in talent are recognized, but not in initial desires to learn, as this introduces variety of individuals and their interests into the picture in which only association determines knowledge. And so we invest enormous efforts in attempts to coerce pupils to study not what they wish but what will hopefully get them good grades and thus prosperous life.

Associationism led to the two experiment in educational reform that western society saw in recent decades, both unbelievably clumsy and unprepared: it ignores the difference between instruction and self-instruction, and thus the two experiments were doomed to fail from the start. They are the teaching of literacy without the alphabet and the application of the discovery method, so-called. It is not a method but an expectation from talented pupils to attain alone results of centuries of unusual endeavors. The programs were meant to encourage some sort of self-instruction, which still bewitches reformers, as it is still the misguided rationalist ideal. In the Age of Reason all instruction was declared evil. This appealed only to literate adults, of course, and so radicals enjoyed illicit benefits from traditional schools. Consequently,

associationism was not contested. As long as associationism ruled, educational reform was excluded; it is still the enemy of science and of science education; its being still the official philosophy of science makes the task still inaccessible. Nor is it useful to refute associationism, as it is already well refuted. This is the sole significant result of a century of laboratory research in psychology.

These laboratories were sites where the new discipline grew: learning theory or the psychology of learning. It began with studies of self-instruction, in denial of the distinction between it and proper instruction. (Even Pavlov was ignorant of this distinction, known to all ordinary dog-lovers.) Subjects were tested for their ability to perform some assigned tasks. This is of a questionable use, as it is an artificial hybrid between instruction and self-instruction. Of course, the hybrid itself is not new, as it occurs regularly in the classroom, and more so in homework. Except that teachers exhibit and explain performances of normal tasks before pupils are told to repeat them; not so in learning experiments; most exercises there cannot be explained, because they are designed to make no sense (memorizing meaningless polysyllables, getting through odd mazes, solving pointless puzzles, and playing newly devised games). The experiments are designed to make no sense to the tested, as if to test the grasp of a senseless task and of associated memories. (Kipling boosted silly memorizing as good for spies and was joined professional spy Baden-Powell; boy-scouts are still victims of this nonsense.)

For a pure case of instruction the subject should be asleep, as in instruction during hypnotic sessions. This proved extremely limited, yet researchers cannot let go of it, as the ideal of pure instruction is too strong. So hypnosis is joined by psychedelic drugs and still came to naught. Repeated efforts despite failures are rooted in the failure to eliminate the error of viewing instruction as purely passive. Purely active cases of self-instruction are also impossible. The almost pure cases are invention and discovery. Hence the discovery method. As the classical basic idea about learning was the associationist denial of any difference between instruction and self-instruction, and babes-in-arms were seen

as utterly passive ideal students, conservatives saw them ideal recipients and rationalist radicals saw them as ideal researchers: they learn from the best teacher, fresh from the hand of nature, to use the gracious radical expression. Though radicalism excelled in encouraging self-instruction, it was too close to tradition. So learning by heart through repetition and boring exercises remains the norm; it is harmful in general; in science studies it is deadly. Albert Einstein's protest against it is taken as a joke in good-nature.

Agreement between traditionalist and radical educationists is amazing, and their shared associationism explains it. Still, disagreement should not be overlooked, as it is very deep: the one mistrust humans and trusts tradition; the other reverses attitudes; the one demands instruction and the other demands self-instruction. Traditionalists appeal to a set curriculum; radicals opposed it and suggest that students should be free to set it as they wish. Tradition won all the way at the cost of allowing vocational training and science and omitting classical languages. Aversion to the set curriculum refuses to leave the stage: it is common to John Locke and to Paul Goodman, the titles of whose books, *Compulsory Miseducation* and *Growing Up Absurd*, made him a hero in the 1960s. He advocated closing schools: kids learn more from chats with elderly people sitting on benches in nearby parks, he said. His criticism is valid, but his counsel is not educational; it is utopian anarchism. The addition of science to the set curriculum created a new concept of science as the set of dogmas fixed by leading scientists. This hybrid between religion and science was invented by Michael Polanyi; it is known as Thomas S. Kuhn's theory of the paradigm; the word "paradigm" denotes dogma received in a specific time and subject. Both Polanyi and Kuhn recommended scientific education to be dogmatic and conducted under pressure. The traditionalism of Polanyi and Kuhn is of a new breed. As they did not defend it by associationism; they had no learning theory and they insisted that they do not need any, since obedience to science teachers should suffice no matter on what theory one might justify these teacher's conduct: they had some personal knowledge of what they should teach. But then who is the better science

teacher? They are, they said, the leaders of their scientific discipline. This is well and good when things go well within the discipline, where the leadership is properly and democratically elected; but, still democratically, in bad times leaders invite critical assessment, not blind following. And then much depends on what we take to be the right ends and the right means of scientific education. And so associationism is still discussed in the literature on learning, especially in these days when the popularity of connectionism is increasing, as it is the new concept of artificial intelligence and of learning machines that uses a version of associationism. It should therefore be stressed here that the associationism of this trend is different from the traditional one. Traditional associationism finds problematic not the storage and the retrieval of information, only its retention; this justifies hammering information in repeatedly, especially learning by heart. The associationism of the connectionist school is probably unrelated to education, but if it is, then this will be manifest only after the classical version of associationism is rejected as quite inadequate, and when it will be acknowledged that no matter how knowledge is acquired, the ability to retain and retrieve it has to be taken into account: repetition and learning by heart alone will not settle matters. If J.J. Gibson is right, then the way to facilitate information retrieval is to discuss its import. This is a wonderful idea. Learning by rote must be relinquished. New techniques of interactive learning will have to replace it. For to do this well, the aim of education will have to be decided first. And so the philosophy of education still must decide between the democratic egalitarianism and the conservative drive for excellence.

### *Sociology*

#### *Schools Besieged*

The two demands, for equality and for excellence, compete for resources. Since by definition excellence is rare, failure is irresponsibly built in. This is masked by grading on a curve, now compulsory in universities too. This rests on the inbuilt assumption that all classes are average. It forces local standard deviations to vanish and national ones

to spread; it forces local averages to stay put, and national ones to plunge. The drive for excellence caused specialization from an early age. The extreme was the British egalitarian-elitist eleven-plus program that failed miserably. Even the change to streams proved disastrous. This is particularly manifest when one notices the two kinds of division into streams, to the upper and lower classes, once ascribed and once achieved. The achievement is of future experts in the hard sciences, the soft sciences, in other intellectual ventures, and then workers, skilled and unskilled. And this was the plan of the Utopian British Labor Party. It is hardly surprising that there was no correlation between grades and achievements. There still is none anywhere except where decreed by law, as in medicine and in the law. There entrance is limited, usually by obviously worthless criteria, so that the quality of entering students is average; a small, often predetermined portion of the admitted drop out, and them almost all pass the exams after memorizing the standard text well enough. Grades are then necessary and sufficient for qualification. There is a need for much more freedom of choice in all schools. For this what is needed most is good minimal introductions to every subject, to enable everyone to acquire literacy in each.

Literacy is a relative concept, and so literacy on many levels is needed. The programs needed are scarcely available, and developing them is not encouraged. Some were developed by dedicated people, such as Caleb Gattegno. Other, computer-related in particular, are developed for the open market, as are some mildly interactive language-courses. The pace will increase after a revolt will occur, when people will refuse to go to boring lectures come what may. Professors know that most students hardly benefit from a course, that soon after exams almost all forget almost all of its content. They hope that the damages are outweighed by rewards. No evidence for that: education has practically no research and few experiments. Not even such a simple, easily available and wonderful measure as updating the standard calculus textbook to apply the tremendous innovations of Abraham Robinson that are available for decades. And this is the matter of higher mathematical education. A

student who discovers Robinson does well. For this literacy is required for beginners, not only for experts.

Scientific literacy is hardly ever taught; at best good professors hope that their students will somehow come to possess it at the end of their studies. The popularity of the concept of scientific literacy is an outgrowth of the popularity of the concept of computer literacy. Training for the skill of science literacy should oust traditional science teaching. This teaching is already deeply entrenched, ever since the rise of the technical universities, where science was taught as a tool for developing skills but not as a part of training. Soon universities opened schools of engineering modeled after these technical universities, which, in turn, opened some departments of the arts. Fine art schools started offering academic degrees and opened some departments for arts and letters and even for science and technology. Intellectuals won prestige as a class; membership in it is the holding of some academic degree, at times of unknown worth. Post-secondary schools are emulating the academy in the hope to get accreditation. This way the university is regaining its medieval hegemony. Red Alert: the new Middle Ages are upon us. The paradox is that it is the demand for technology that has intensified science teaching. Demand for science education is voiced by representatives of society who consult experts. Deviants who might think differently from the experts meet with hostility, particularly in education. With the tremendous advances in ever so many fields, stagnation in education is becoming an increasingly crowded bottleneck.

### *Schools Without Walls*

The ideal of a learning society is ubiquitous. Working it out is a real challenge. Margaret Mead extended a model of it in a preliterate society; she described Samoa as a primitive Utopia that all might envy. (In the appendix to her book, though, Samoa is an unhappy region under foreign rule.) Though poor, its inhabitants lived happily in social integration, reflected in diverse aspects of life, including education. In each stage of growth there, one is surrounded by slightly older caring individuals, and by slightly younger ones in one's charge. With no conflict between

generations, education becomes simply an aspect of the care system. Unfortunately, the aspects of Mead's study that drew attention most are the piquant ones, on which she proves gullible to the extreme. Yet her view on education is more interesting and more encompassing. She combined educational theory and practice as one, with no clear division between learning and doing, between instructor and instructed, between infants, youths and adults: life is/should be natural apprenticeship. As an image of Samoa this is very thin; as an ideal it spoke to her readers, general and professional alike, and it still speaks to me. Her description is instructive: her model allows for no break between the acquisition of one's first language and all other things one learns during one's life. This may sound too ideal, but not by Piaget's view: the acquisition of one's first language he deemed the most difficult part of one's whole education. Many educators, especially the great teacher Caleb Gattegno, have expressed the wish that schools would follow it. Whether Gattegno had the success he claimed or not, his ideal clearly was that at any age education should be modeled after the education of infants. Mead was in error, and maybe Gattegno was too, but at least we can comprehend their idea.

Traditional education was meant to transmit knowledge from teacher to pupil; the radical, rationalist of the 18th century, aimed at self-education; today's ideal is of *natural*, interactive education; it leaves everyone as much in charge of their own education as possible, within a learning environment where help and support is available upon request. (This is how compulsory education should be practiced: the learning environment should be compulsory, and some minimal learning too, to be specified by law; but as much of learning should be natural as possible.) This is a common ideal. It is not simple. For one thing, schoolchildren may need, and ask for, more than the adults in their society possess. Jokes abound about the admittedly comic situation in which parents get in touch with other parents in search for help in the preparation of their children's homework. Some schools which claim to be trying out new ideas ask parents explicitly not to help their children. Gattegno was well aware that a great difficulty hides here: though children readily pick up the spoken

language, though with much aid, the same does not hold so much for literacy, arithmetic, and second language after the age of eleven or so. He spent much time in attempts to find ways to overcome this difficulty. He claimed to have had success, that his classes acquired these skills naturally. I do not know if this is true, and it should be investigated, because his method may then snowball. Literacy and arithmetic must come first, perhaps. To teach arithmetic as if it were a part of language is very ingenious, as it utilizes modern ideas about mathematics that most educators ignore.

Speaking today of schools, we still speak of classrooms, and classrooms are naturally deemed uniform with frontal teaching, though in small places they still are not. Frontal teaching in a uniform classroom was a mediaeval invention, linked to university professors dictating lectures to children. (As Marshal Macluhan has observed, professors still overlook Guttenberg's invention of the printing process.) Frontal teaching was brought to elementary schools with the division to age groups and the standard curriculum by Napoleon, who introduced compulsory education for military purposes. Today university frontal lectures to classes of up to one thousand auditors are not uncommon. But no one takes them as the proper way to learn, and the lectures are supplemented by tutorials that are an unsupervised affliction. As long as this is so, there is no point in criticizing extant methods as no one defends them; incentive for new methods are not offered. Yet mammoth classes supplanted by tutorials led by novices have redeeming features: they clash with the drive for excellence. So there is hope for the ambitious who may hope to beat the system. This is possible, since aptitude is not the same as talent, and the drive for excellence forces young people to follow their talents rather than their inclinations, with the result that they find their success not satisfying. The situation is so bad that any imaginative school, on any level, may beat the system at its own game.

### *Conclusion*

The computer world has revolutionized thinking in many ways, but egalitarianism is perhaps its best asset. The concept of computer

literacy is terrific, and the concept of science literacy is even better. Surfing the information highways for educational and intellectual purposes has hardly begun. It will, and then it will snowball, and it may force schools to reform fast. The more intelligent science departments in diverse universities have placed as their educational targets the ability of their graduates to read the relevant scientific literature. So new methods to this end may have a fighting chance. Start your home-page now! Mario Pei reports that he failed to translate a text at the request of his banker, though he was bilingual and a professor of linguistics. He did not know that all that was needed is a smattering of business economics. The need for scientific literacy is clear, though it has to be worded carefully in specifics. We do not expect everyone to be able to read specialized scientific periodicals, but we do find it disturbing that many medical specialists cannot read scientific periodicals even in their field of expertise. This is not the same as the inability of a mathematician or a physicist to read papers even in adjacent fields to those of their expertise: they can acquire the tools needed for it if they have to; the others cannot. What troubles us is a certain helplessness that should be overcome. Rather than apply pressure in order to be able to impart information that may very well be useless, we should help the helpless to fight their helplessness if and when they want to. This will render education both more humane and more efficient.

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