

But there is "practical experience," always the big unmeaning word of the ignorant man. Practical experience without science is but the "cookery book" over again—a thing of recipe and custom—a cyclops without eye or light.

*"Monstrum, horrendum, informe, ingens, cui lumen ademptum."*

And how much has practical experience had to do with the great discoveries, inventions (these are very different things) and improvements of the world?

What was the extent of Bessemer's practical experience in steel-making, when his clear insight of a chemical fact, gave at Cheltenham the first note of the process that will change the ironmaking and the structures and machinery of the world? What practical experience had Siemens of working a furnace of any sort or kind, when his equally keen insight as a man of applied science produced the regenerative furnace, that shall prolong our coal fuel and revolutionise the applications of heat of every sort? What practical knowledge had James Watt when his clear insight of the principles upon which the great losses of fuel in the older engine—learned by him as the pupil or assistant of Black—produced the steam engine? What practical knowledge guided the steps of Davy when he went—question after question put by experiment to nature,—straight to the mark of the safety lamp. No groping in the dark—drifting about without sail or compass, as was the case with George Stephenson the practical man, with a life-long experience of fire-damp and coal-pits, in his attempts to come to the same end, at which it is more than doubtful that he ever unassistedly arrived, if at all.

Ours is the country that has produced Brindley and Telford, Rennie, Smeaton, and Watt—men whose ideas and whose works all the world copies and follows. These were self-taught men, they knew nothing of technical education—some had little or no education at all—yet see what they have done. What great use can there be in technical education when these men have achieved such results—such fame, reflecting glory on the country that gave them birth, and yet without any. What need we fear. That country which for a century has led the van in arts, and holds the vantage coigns of the world in arms, is certain to reproduce those representative men in every generation. Perhaps so, there were brave men before Agamemnon, there is as good fish in the sea as has ever been caught.

But the argument—if such twaddle be worthy of the name—at once proves too much and too little, if it is to be taken as one against the advantages to the average of men of technical education. There have been always giants in the earth, and some few men see by a sort of intuition, like intellectual lightning, what the average of men, to see at all, must approach with previously trained and well opened mental vision. If the splendour of their successes is to be taken as a proof that technical education is useless or unnecessary, then it is, as respects some of them, an equally good proof that any education at all is useless, even that which these men picked up for themselves like weeds at the wayside of life. Great as were these men, and as have been thousands of others like them, in every

age and clime, the true lesson that their lives should teach is this; how much greater would each and all of them have been had they started in their careers, sped with the mercurial wings of knowledge in place of being burdened by the impediments of ignorance. Who can look through "Telford's Pocket-book," in his life by Rickman, and not discern the life-long and daily struggle of that great spirit with the ignorance in which it was his misfortune to have been reared. On the other hand, Watt—who of all other great inventors is the very Newton of machinery—was not an uneducated man, but one who had sat at the feet of the very best teachers of science that Scotland possessed—was *au courant* with all that continental science and art was occupied with, so far as the means of communication of his day permitted; was not an unlettered man, but one acquainted with modern languages and literature, fond of *belles lettres* and fine art, and with the true zest for science in its wide encyclopædic aspects—and not as a mere shop for money-making—that belongs to the man of culture, of the highest order. But enough, appeals to such instances prove nothing, unless it be the utter incapacity of those who employ them to comprehend the great features of the subject of technical education upon which they pretend to treat; they are beside the matter altogether.

And equally so are random-shot catalogues of what wondrous things have been done in our days, and in the great days before us, in and by England, when such are meant to prove, that which is just the question in debate. If we are to derive any light as to what our industrial future is likely to be, from a retrospect of the past—and assuming us to go on as regards education general and technical, in the old jog-trot and well-rutted road—as it would seem Dr. Percy and some others deem sufficient and best—we say let the retrospect be full and sufficient. To be so, it must embrace *all the conditions* that during this nineteenth century have been operative and effective in conferring upon our country the paramount position in industrial arts, and in commerce, and in power, that she has so far maintained. And we must endeavour to ascertain how, and how far, these or any of these conditions have become changed, or are on the eve of being changed, and whether to our disadvantage or to the advantage of continental nations. Such a survey cannot neglect facts of history beside those of mere arts and manufactures; it must embrace international politics and treaties; the changed methods of locomotion traffic, and of warfare; the movements and increase of populations and their food supplies; and must estimate the relations of creeds and beliefs, of castes and classes, and of ancient corporations and of learned bodies, upon the average intellectual and moral force of a people, and still much more besides; then at last we may come with more adequate data to discuss this question itself. If our future industrial supremacy be threatened, how may we best provide against its decline or overthrow; and shall one of the methods consist in giving a better education to our people at large, including in that the establishment of an efficient system of organised technical education for various classes of workers? For the present we do not profess to have ourselves even fairly opened the