

These occurrences assume a graver importance when viewed in connection with the probable efforts of these Provinces to modify or change their present political position. And to these, must be added the existing and growing desire by the United States that Canada should become part and parcel of themselves. It is folly to deny it. For, from their first overt efforts for independence, in 1775, when Franklin came to Montreal, as a delegate from the Congress at Philadelphia until now, that feeling has existed to a more or less extent. During the war of 1812 they were as zealous in urging Canadians to withdraw their allegiance, as they were to defeat British troops in battle. During the struggle on slavery, between North and South, this desire for Canada, was in truth discouraged by the latter, but simply because additional free states would have weakened its influence. Now, that slavery is extinguished, both North and South, will, we believe, unite for its attainment. The wish is not confined to "fire-eaters," and politicians of the Jefferson Brick school. The recent admission of ex-President Grant, subsequently confirmed by such authorities as Mr. Secretary Fish, and Mr. Bancroft Davis, that a man of the high social position, and culture, and political experience of the late Mr. Sumner, actually insisted as a pre-requisite to the settlement of the Alabama question, the abandonment by England of all her American possessions! And not many weeks since, we were told by a distinguished journalist, in New York, that there was really a growing sympathy with Mr. Sumner's wish, and that, if Congress paid the award, for the existing lease of the fisheries, he believed it would be the last payment made for that purpose.

Under these circumstances, it may be asked, what would Canadian independence be worth to Canada? Or, rather let it be asked, could independence thus exist, except for a moment, and then only in name? Existence under sufferance from a rival is not independence. Our fate, under such conditions, might not be unlike that of a mouse, when caught by a cat—now played with, then cuff'd, anon permitted to run a few steps alone, and at the moment when mousey imagines herself to be free again, "gobbled" up.

It would be folly to rely solely upon our national rectitude to perpetuate our independence without sufficient physical power to enforce a disputed right. The rivalry existing in many branches of commerce between the two countries, must, in the nature of things, create misunderstandings, affording plausible excuses for a resort even to the *ultimo ratio regum* when a pretext is wanted for conquest.

"For we make our opportunities,  
And they ever do pretend to have received a wrong  
Who wrong intend."

British protection! British protection! will now be shouted into our ears. We do not under-estimate it, nor undervalue it. We claim, as Englishmen, that we do love our country; while as Canadians, by adoption, the interests of Canada should be paramount to us. We shall be told that if independence would not suit us, we can continue to enjoy *protection* in our present position, and also by becoming a federal part and parcel of the British Empire. But to these answers it may be replied, will our dear old mother-country feel she can in justice to herself undertake our care, in our present relation, for an indefinite period? British America is her vulnerable point, her heel or Achilles, in her disputes with the United States. The latter have become better customers of England, as a confederation of independent states, than they might have been as a colony,—so we are told. Year by year, England appears more and more averse to war. Year by year, we get a warning that the time is approaching when we must stand or fall by ourselves.

But, if the other alternative be adopted,—a federal union with Great Britain,—will it not make our position, *quod* the United States, more dangerous than any other? If the desire for union with us exists in the States, will the establishment of a semi-monarchical power alongside of them have or have not the effect of precipitating an effort for its accomplishment? Is it true that during the Trent difficulty British officers reported that the resources of Canada, though supported by all available British troops, were inadequate to resist for any length of time the forces the United States could accumulate? The odds between the wealth of forty states and seven provinces, of forty millions of population against four, are, it must be confessed, somewhat great, though the latter should be backed by fifty thousand brave British soldiers.

We are justly proud of the extent of this Canada of ours. Stretching from the Atlantic to the Pacific, and from the frozen North to the St. Lawrence, it contains every material element for the foundation of a large and powerful nation. She is indeed something more than the "*deux ou trois cents lieues de neige*" to which she was contemptuously compared by Louis XVI. after the cession to England. But nevertheless, the dangers and questions we have submitted, will, we fear, need to be calmly faced and answered, without passion or sentiment, within the next decade.

JOHN POPHAM.

## PRACTICAL SCIENCE.

### II.—On the Harmony between Theory and Practice.

Everyone, indeed, now admits it to be most absurd to talk against theory, for under no circumstances can a knowledge of the exact sciences be either useless or dangerous. A more harmonious feeling has grown up, too, between the scientists and the practitioners, creating a bond of union between them, which is becoming stronger and stronger every day. As a consequence, we have been called upon to witness, a more extended application of scientific principles to practical purposes, and this has resulted in a rapid and wonderful development in all branches of knowledge, but more especially in those departments relating to the useful arts; still we cannot but confess that the union between science and art is very far from complete, and in fact is most incomplete. Let us look at the question from the practical man's standpoint. He is naturally proud of his position, and of the great experience which a whole life's study of his particular work or works has given him, and will tell you that he has obtained all this without the aid of any theory. He will go on to say, that some of the brightest stars who have ever adorned the ranks of the engineering profession, were men wholly trained in the practical world. George Stephenson

was one of these, and he has often acknowledged that throughout the whole of his life, he ever felt the lack of scientific knowledge, and continually found the utmost difficulty in contending with questions which the possession of such knowledge would have immediately solved for him. So conscious, indeed, was he of the want that he gave his son a sound, scientific education. And surely no one can doubt that great as the undertakings of George Stephenson, of Watt, and of many others certainly were, they would have been still greater had they possessed at the outset a liberal education. But yet the practical man has much reason to be shy of the Theorist. The question ever present to his mind is, "What am I to do?" Trained from his youth up, in the immediate vicinity of his work, he has become, as it were, part and parcel of it, and almost feels "every throb which affects it." He knows by intuition, and shall I say by sympathy, how, when and where anything goes wrong, and how, when and where to apply the remedy. Can one be astonished at the wonder and contempt which he must naturally feel, when he observes men fresh from their theoretical studies, attempting futile and absurd experiments in most unpractical ways; experiments at times so absurd, as to warrant us in classing them with those who have a weakness for discovering perpetual motion? He has, too, many and glorious illustrations of the advantages arising from close and continued familiarity with his work. Bessemer with a minimum knowledge of chemistry, successfully developed his great improvement in the metallurgical industry, and made practicable a question for which the scientists, with every fact written in their books, could never specify the practical conditions.

Bridges, again, fail most frequently, not from having been badly designed, but from a lack of knowledge of the constitution and of the proper treatment of the material itself. The man who has been dealing with the material year after year, can tell at once the weak parts of his structure, and knows how to strengthen them, and can prepare for emergencies which the pure theorist could never by any possibility foresee. This, too, is the case in the world of machinery, and in almost every branch of practical knowledge, and the theorist can only hope to be properly appreciated, when to his theory he has added a due amount of practical knowledge; and, until he has done so, he must expect to see the merely practical man preferred before him.

The practical man, then, has some reason for his objection to the practice of theoretical men, and if he would stop at this point, all would be well. But to this objection he adds bigotry in his ideas, narrowness in his observation, and often exhibits a positive fear of the diffusion of knowledge, and such men the world should visit with its severest condemnation.

Our early engineers, with the exception of a few remarkable men, were almost entirely without theory, and were strongly impressed with the idea, that a knowledge of the exact sciences was both useless and dangerous. They went about their work, guided wholly by their common sense. They knew the difference between good and bad workmanship, and possessed the power of directing the operations of bodies of men, but of the proper distribution of material they had not the least idea. They were totally unacquainted with the first principles of their profession, and their reasonings were, consequently, difficult, precarious and unsatisfactory, and led them into mal-construction, and many of those errors which a knowledge of science would have taught them to avoid. Their chief object was to ensure the stability of their structures, and to effect this they put into them plenty of material, strengthened the weaker parts by an increase of mass, and did so regardless of expense or economy. An immense expenditure has thus been made in the production of totally unscientific work, and we are often called upon to witness failures and abortions in the art of construction which a superior skill and a more extended knowledge would have prevented. From structures of this kind, the engineers deduced formulæ, founded, however, on no mathematical truths, and often derived from most imperfect data. Mathematicians soon saw the absurdity of the reasoning on which their formulæ depended, pointed it out, and deduced other formulæ, which, although they had some scientific basis, were nevertheless of very little use. Some, again, who were doubtless men of power and ingenuity, but who were wanting in that skill of applying scientific principles to the practical requirements of nature, have wasted their time, money, and energy, by directing their attention to the solution of impossible problems, and to the discovery of imaginary inventions. Others, terrified, as it were, by the failures of the former, went into the opposite extreme, and cautiously avoiding all innovations, contented themselves with copying those old types, which had been found by experience to be safe. If such a proceeding as this had become general, all progress would have been stopped, and all science would have been paralyzed. Many circumstances, however, indicate that we have seen the last of such a state of things, and great energy is being displayed on all sides to create a closer relation between the pure and applied sciences. Modern culture shows, that for the future, we must depend for our progress to a very great extent upon the man of science. He, too, now recognises the complete nature of the difficulties which the engineer has to deal with, and desires to study them anew, with all the increased assistance he may derive from the experience of the practical man. This mutual intercourse will remove all pre-judices, and will foster a sounder treatment in all branches of knowledge. The promote a more perfect practice, and will engender ideas less speculative, but promoting this intercourse, and for the more thorough diffusion of that kind of skill which enables a man to apply scientific principles to practical purposes, chairs of engineering have been, and are being established, in colleges and universities in every civilized country, and the course of instruction proposed to the student that kind of knowledge which will enable him to determine the interior forces developed in the different elements of a machine or a structure, and to help him also to distribute his material properly, and to give to it the proper forms and dimensions, and will tell him how economy and strength may be combined. It will enable him to plan new designs by his own individual effort, to test the efficiency and stability of existing structures, to suggest improvements, and to provide remedies in case of accident. The young engineer must join his practical knowledge in the workshop and in the world. This will render him capable of judging whether work is well or badly done, will tell him of the quality