stresses on the connecting-rods were always those of compression. With such an arrangement naturally a given cylinder only does half the work that can be obtained from a double-acting cylinder of the same capacity, and this leads to additional weight and space being required for the single-acting engine. For this reason it was the common practice, and still is to a large extent, to run the necessarily quickly rotating dynamo belt-gearing from a large engine making moderate revolutions, and occupying much space; but for a considerable time past the high-speed, single-acting engine, coupled direct, has been a formidable rival. The high-speed double-acting engine has also been growing in favour of late, and, as has been stated, undoubtedly has advantages. The dynamo-electric machine has certainly done one good thing—it has raised the standard of stationary engine design and manufacture enormously, just as the torpedo boat did for marine engineering. The chief features dealt with by Mr. Morcom in his paper were lubrication and vibration, the two great difficulties to be met in quick-turning engines. To effectually lubricate bearings a force-pump is employed, which continuously injects oil at pressure into the space between the shaft or journal and the bearing. The reciprocation of pressure of the shaft on the bearing assists the circulation of the lubricant for the following reason: when strain is above the piston, and the connecting rod is in compression, the journal will be pressing on the bottom brass—we put out of consideration any tendency of the shaft to bend—and, as a journal can never be an absolutely tight fit in its bearing, there will be a space between the top bearing and the shaft. Into this space oil is at once forced by the pressure-pump, and when the stress is reversed the film of oil remains during the whole of the up-stroke, because there is not time to squeeze it out from between the rubbing surfaces before the pressure is again released. The same thing, of course, applies to the bottom brass, and in this way there is always a liquid film of oil between the journal or shaft and the brass or bearing, and the two, therefore, never come in contact. Observed data support the latter view, as the wear on journals has been found to be inappreciable after considerable running; but perhaps the best testimony is that Prof. Kennedy, in an exhaustive test of one of these engines, found the mechanical efficiency of the machine to be 96·3 per cent. It will be seen that in this matter of distributing the oil on the bearing surfaces the double-acting engine has an advantage over the single-acting engine, where the pressure is always in one direction, and is never released while the engine is running, although it may be relaxed. In regard to vibration so much has been done lately, especially by the builders of torpedo craft, that not much is left to add. It may be said that Mr. Morcom is fully alive to the need for providing against the disturbance "due to couples produced by the changing momentum in the several lines of moving parts," and that occasioned by the obliquity of movement of the connecting-rod. He refers to Mr. Yarrow's admirable experiments, and considers the effect of crank angle and multiple cylinders. We have not, however, space to go into these problems, and must refer our readers to the original paper.

A long and interesting discussion followed the reading of the paper.

There were several excursions to neighbouring towns, where works were visited, speeches made, and luncheons eaten after the manner of meetings of this kind. One of the trips which attracted a great deal of interest was that to Coventry, where the much-discussed "motor-mills" where "horseless carriages" are made in such profusion, according to certain glowing accounts, were to be inspected. This establishment is said to be "the largest and best organised for the purpose in the country." To judge by what was seen in regard to work in progress, there need not be much fear that the country will be flooded by horseless carriages for some time to come yet.

A TROUBLESOME AQUATIC PLANT.

FOR several years past an aquatic plant known as the water hyacinth has been developing to such an enormous extent in the St. Johns River, Florida, as to cause serious apprehension in that region regarding its possible obstruction to navigation. About two years ago the War Department was asked to investigate the matter, and did so. In answer to urgent requests for exact information on the subject, the Department of Agriculture, on January 25, directed one of its agents, Mr. Herbert J. Webber, an assistant in the Division of Vegetable Physiology and Pathology, to visit the region and prepare a report covering the following points: (1) Historical notes regarding the plant, including its habitat, manner of growth, propagation, and anatomical and physiological characters; (2) an account of its introduction and spread in Florida; (3) the present distribution of the plant in the State, and its effect on navigation and commerce; and (4) possibilities of exterminating it. Mr. Webber's report has now been issued from the Government Printing Office, Washington, and is very exhaustive. The plant is mostly limited in its growth to sluggish fresh-water streams, lakes, &c., and the character of the water appears to have much to do with its growth. It can endure only a small percentage of salt, and is killed when it floats down into the sea-water. It is normally propagated by seeds and by stolons. Its introduction into the St. Johns River took place about 1890, when a number of plants were thrown into it. They grew there luxuriantly, producing beautiful masses of flowers which rendered the river attractive. At this time no one suspected that the plant would become a nuisance, and it was introduced at various points to beautify the river. In a short time it interfered very materially with navigation, making it, in fact, both difficult and dangerous. Its effect has been most disastrous to those engaged in the lumber trade and in the fishing industry. It is feared that eradication is impracticable, but suggestions are made as to possible methods for keeping the evil in check. Of these the one most in favour with the author is the use of a light-draught stern-wheel steamer, having a double bow or outrigger, which, being forced into a mass of plants, would cause them to gather towards the middle of the boat, where an inclined carrier would pick them up and deposit them in front of rollers driven by machinery, which would force the water from them, thus greatly reducing their bulk. The crushed material could be delivered to barges alongside, to be deposited where no injury could again result, or a cremator could be arranged on a barge alongside of the boat, and so save additional handling.

THEORY AND PRACTICE.[1]

I PROPOSE to speak to-day of the relative importance of theory and of practice in the arts; and especially, of course, in the art of medicine. It is said that Englishmen are falling behind other nations, and especially behind the German nation, in their perception of the value of theory in the practical arts. Now this is somewhat strange and inconceivable to us. Englishmen proudly feel in this year of the Greater Jubilee that their achievements in the conduct of life are not only great but incomparable. Not only has England become great as an empire, as the Roman Empire; it is great also in the achievements of the intellect: the land of Roger Bacon, of Francis Bacon, of Newton and Adams, of Berkeley, Locke and Hume, of Boyle, Priestley, Cavendish and Dalton, of Young and Faraday, of Harvey, Owen, and Darwin, need not be ashamed even before the brilliant nation of Descartes and Laplace, of Lavoisier and Cuvier, of Paré, Bichat, and Bernard. Nor will I forget to speak of our place in letters, wherein we acknowledge none as our masters; for it is of the gifts of imagination no less than of the gift of analysis that scientific theory is born. Can it be true, then, that with these endowments we are to fall behind in the practice of the arts because, as a nation, we have no due sense of the bearing of theory upon practice?

It cannot be doubted, I fear, that, in some departments of knowledge we are falling behind relatively if not absolutely; that we have failed to keep before ourselves a due sense of the value of theory, and have forgotten that, although in generalisation we should never lose our hold upon detail, nor lose our tact in converse with the manifold aspects of life, nor our memory of the devices whereby we must meet the incursions of contingencies often themselves incalculable, we shall nevertheless fall behind in the fight with reluctant nature if we do not incessantly revise our formulas in the light of progressive research on more and more general lines. We have perhaps forgotten that the work of Watt and Stephenson would have made little progress but for the great modern advances in thermodynamics in which, among others, are

[1] Abstract of an address delivered at the combined meeting of the Cambridge and Huntingdon, the East Anglian, and the South Midland Branches of the British Medical Association at Cambridge, by Prof. T. Clifford Allbutt, F.R.S. Abridged from the *British Medical Journal*.

eminent the names of our own Joule and Thomson; we have perhaps forgotten that, brilliant as is the work of the modern electrician, his achievements depend upon the theoretical researches of disinterested students such as Faraday and Hertz; we have perhaps forgotten, as a contributor to NATURE said last year, that "Kekulé first gave definite form to Frankland's conception of valency, and his application of this idea to the study of the carbon compounds was nothing less than epoch making. Out of this conception grew the famous theory of cyclic compounds which has been prolific to an extent almost unparalleled in the history of pure science, and which on the practical side has made Germany what it is in the domain of organic chemical technology." In our own art, proud as we may be of Jenner and Lister, yet we have to remember that the recent advances in the theory of infection are due rather to the schools of Pasteur and Koch than to our own; while the scarcely less remarkable advance in the discovery and manufacture of new drugs is almost entirely of foreign growth.

How comes it, then, that if we are a people of contemplative as well as of practical gifts, we have so far forgotten ourselves as to fall behind—in many respects far behind—in discovery and, consequently, in practical success? Some of the reasons are not far to seek. The most important of all is, no doubt, that Englishmen, by their practical genius—that is, by their gifts of adventure, of restless energy, of perception of contingency and accident in daily life, and of a correlative readiness of resource—have achieved so much in the mastery over man and nature, that in their day of prosperity they have lost reverence for those qualities of the mind upon which the development of science and art must in the main depend. The system of practical rules and maxims which they have built up are now becoming obsolete, and need revision in the face of larger requirements; as the rules of the first steam engineers had to be revised in the face of the discovery of the mechanical equivalent of heat, a discovery not made by engineers, but given to them. That practical rules shall from time to time be brought up for revision, and be remodelled on the lines of advancing theoretical research, is essential to the continuance of our progress and of all successful practice.

Another reason of our defect is that our people are above all things efficient in the manual arts. Now the manual arts are less open to theoretical inadequacy than the chemical arts or the art of medicine; the complexity of the conditions is less, the incursions of incidental contingencies are fewer, and the necessary calculations are both simpler and in their effects more immediate and obvious. Hence we are tempted to assume that the ready calculations of the practical man are roughly sufficient for all other arts, as they are for the manual; and that they pay as promptly and obviously. But this is not the case; as we pass from the manual arts to the chemical, let us say, or to the physiological, we have to deal with causes of much greater complexity, contingencies are multiplied and are less and less easily foreseen; thus it is that even valid generalisations have to wait for the fulfilment, or practical fulfilment, of a number of secondary verifications before they can be utilised; meanwhile they are as useless to the practical man as, for example, the more general laws of meteorology are to the navigator. Now thus to wait means time and men's lives; both must be spent without reward until a considerable block of discovery is made, verified and applied. Research, then, in the chemical and biological sciences, at any rate, cannot be self-supporting, but must rest on large endowments. The American people and the people of Lancashire and Yorkshire now see this more or less darkly; and they are endowing research with a generous hand; but national aid—liberally given in the United States as well as in France and Germany—is refused in England, and will be refused until the nation, aroused by the urgency of pressing need, determines no longer to be governed by the clerks of the Treasury.

Another reason for our defect is the want of a bridge between the contemplative and the practical man. The man of abstract speculation, the experimenter absorbed in his single desire to wrest her secrets from nature begins at the opposite pole from him whose whole activity is absorbed in industrial adventure.

It is not that theory and practice are essentially opposed, but that the man of theory loves to move in the larger sphere of those more general laws which express the order of phenomena in their wider orbits, and therein to neglect those incidental and subordinate causes which, after all, are the main concerns of the journeyman. It is as though a mathematician would work at his problems, neglecting friction; a political economist at the secular aspects of industrial problems, without taking account of the passions of mankind; a hydrographer at the sweep of the great systems of oceanic currents, without taking account of the whirlpools, races, and under-currents which modify them on every coast and in every gulf; yet the journeyman is mainly concerned with the irregularities of which the abstract-thinker may be ignorant. While, therefore, the theorist may rightly reproach the practical man with the narrowness of his outlook, the practical man may usefully retort that a theory which only accounts for the larger recurrent cycles is imperfect, even as a theoretical statement; and that in respect of cases not only are the wider laws to be formulated, but also the smaller periods of those many contingencies and perturbations which, in a complete theoretical statement, have all to be reckoned with. If we forecast our weather on barometrical pressure alone, we shall be disappointed; a complete theory of meteorological cases must comprehend formulas for the phenomena of moisture, of temperature, of electricity, of oceanic currents, and so forth. A meteorologist, who pursued his studies in the Islands of the Blest, might become a very learned philosopher, but would be a very untrustworthy guide to the weather; and one who should work, say at physics or physiology, in a university where engineering and medicine are unknown, would likewise fall out of touch with the practical ends which are the ultimate purpose of all science. There is a casuistry in the arts, as there is in morals; particular instances are apt to elude general principles: and although it be true that, as with statistics,, by taking a sufficiently large number of instances we may eliminate incidental causes, yet this is precisely what the practical man must avoid.

We shall not, as practical men, whether in medicine or in morals, allow ourselves to be blinded by the light of the brilliant generalisations of the laboratory and the lecture-room, helpful as this light is, to the value of the empirical rules which have been painfully gathered together in the trials and errors of generations of men. As Oliver Wendell Holmes says, "Science is a first-rate piece of furniture for a man's upper chamber if he has common sense on the ground floor; but if a man has not got plenty of good common sense, the more science he has the worse for his patient." A sagacious man is not to be driven too readily out of his rules, absurd as they may seem.

On the other hand, while clinging to our rules until something better is demonstrated to us, we practical men must not forget day by day to submit our empirical laws to revision; we must bear in mind that empiricism is science without roots. We are right in our paradoxical tolerance of anomalies; we are right in our instinct that broad generalisations are too often impracticable in that they may not take account of incidents and contingencies, but this is not all.

In England the man of thought and the man of action have been too much apart; thus both have suffered. So long as our national work has been pioneering work, rough practical rules of thumb, applied with indomitable energy, have been irresistible; but as industrial pursuits become more complex, and the sciences concerned also more complex, rule of thumb is no longer wide enough or refined enough; methods based upon wider theoretical considerations have to be introduced.

We cannot stand still; we must advance, revolve, or degenerate; pathology must be renewed by the new meanings and new bearings of biology and by a comparative method, embracing in experience no less than the diseases of all living things. We must work out, or obtain from our fellows who work them out, the mechanical and chemical laws which underlie all life, and by a method of exclusion ascertain what the residuum is which may be peculiar to living matter. We shall not assume vitality as a principle, and grudgingly admit a little chemistry and physics to fill up a few holes in a threadbare principle. Medicine depends upon theoretical advance, not in physiology only, but in all sciences; and upon the practice of many, as upon practical optics in respect of our microscopes, upon mechanics in respect of our graphic machinery and so forth; as we change we change our circumstances, and circumstances reacting on us change us again; so that we depend upon a highly compound process of advance, and need theoretical reinforcement from all sides.