

ple) was placed in air, while the free extremity of the petiole was placed considerably beneath the surface of water in a test tube. The apparatus being submitted to solar rays, nearly pure atmospheric air passed rapidly under the tube. This took place as if the leaf were a natural thermo-diffuser; and the phenomenon is purely physical in character. The respiration of animals may also be a similar phenomenon; but this has not been sufficiently demonstrated to warrant an affirmative assertion.

The facts of M. Merget's discovery are interesting both from a physical point of view, and in that they tend to explain effects of which the causes are as yet undetermined. They go to show, besides, the mutual interdependence of sciences, the domains of which formerly appeared absolutely distinct.

PRACTICAL INFORMATION FOR PRACTICAL MEN.

The leading article of the *Journal of the Franklin Institute* for August begins with the positive assertion that the general idea that practical information, useful to a practical man, can be made interesting or instructive to the ordinary reader is an altogether erroneous one. And after a six-page amplification of this discouraging thesis, based on the half century's experience of the *Journal*, the writer closes with the sweeping remark that there is an incompatibility, now and for all time, between practical and popular information.

Bearing in mind the warning of an American humorist: "Don't never prophesy unless you know": we would not venture to contradict the *Journal* with regard to the possibilities of "all time," but for the time that now is, we do not hesitate to say that there is no such incompatibility. And further, an expression of thirty years in trying to meet the popular demand for practical information has given us an abiding conviction that, as in the past, so in the future, in a yearly increasing degree, practical information useful to practical men will more and more be desired by intelligent readers; and the success of periodicals devoted to Science and the arts will hinge more and more—as scientific thinking increasingly prevails—upon their presenting promptly, clearly, and sensibly the very information which the *Journal* asserts to be so essentially unpopular, that is to say, practical information really and truly considered. The impossibility of making attractive to the general reader the stuff which the *Journal* describes as alone worthy of that title, we should not think of doubting. The *Journal* has sufficiently demonstrated that it cannot be done. We doubt whether it could be done even for the ludicrously limited class of men to whom the *Journal* would apply the term practical; in its own words, a few specialists, each of whom "must have acquired, in the course of his practice in some particular direction of knowledge, enough to have compelled him to have learned its 'science,' regularly and methodically, to have investigated by his reasoning faculties and founded himself upon principles and not on half-comprehended facts."

The definition is not very grammatical nor very clear; but we gather from it, and from subsequent remarks, that the practical man must not only be a specialist in scientific investigation, but one so furnished with all that has been accomplished in his particular department that no information can be practical to him unless it is wholly original and presented along with the most thorough and elaborate reasoning and formulæ that may be required for its support and demonstration. "It is the progress and advance of the arts and sciences, not the arts and sciences themselves, that the practical man needs information about;" and the method approved for the presentation of such additions to "practical" knowledge is the driest and most elaborate possible, albeit the investigation is "tedious," the discussion "recondite," and the concluding results "unintelligible, almost incomprehensible, to any others than practical men in an extremely limited kind of practice."

It is not surprising that the *Journal* finds an incompatibility between such information and popularity: but it is surprising to find an editor of intelligence coolly assuming that such information exhausts the limits of the practical, and that no man deserves to be called practical who does not delight in it. The position is sufficiently absurd to be grotesque.

WORKMEN AND THEIR INSTRUCTORS.

A hammer and a chisel are two very simple tools, and surely it seems there can be no great mystery in the use of two such implements; but a foreign language, or the groundwork of a whole science, can be learned in far less time than it takes to learn to chip a piece of metal an inch long so smoothly upon its surface that the chipping marks cannot be felt. The reason for this difference is simple, and lies in the fact the language or science has teachers who are masters of their subjects, and who make those studies the work of a lifetime; whereas the mechanic has as a rule to work out the whole problem for himself. It is as ridiculous for a man whose ten or fifteen years' experience has included the principles of construction, mathematics, mechanical drawing, etc., to assume to teach that intricate knowledge of manipulation necessary to make an expert workman as it would be for a workman who had spent his leisure time in reading books of science for instruction to attempt to instruct the scientific world; and this would have been made apparent long ago but for the lack of education so common to expert workmen, and but that, so soon as an expert workman attains the knowledge of his trade, and the skill in the use of language which enables him to enter the arena of debate or tuition, he ceases to be a workman and becomes too often a stranger to the workmen's interests. Such a faint concep-

tion of the real value of an unusually expert workman is possessed by employers that, if he possess such a qualification only, his sphere of usefulness is limited to his practice, and he would search the wide world in vain for a means of giving to others the benefits of his skill by imparting to them the minutæ of movements, processes, forms, time, speed, etc., which, combined, form that skill which is best known as manual dexterity. There never has been nor can there ever be a piece of expert workmanship done that was not governed by distinct principles and laws; and the misfortune is that they are to a very great extent unwritten laws. Volumes are written for the edification of the workmen that had better far never have had existence. Can the workman do aught but smile at the statement, given under assumed authority, to the effect that tools for cutting wood can be much harder than for cutting iron, or, to state it better, "tools for cutting wood are harder than those usually employed for cutting iron"? And what are we to think of the advice that "the better way to make a scraper" (for flat surfaces) "is to form it like a Venetian stiletto or a beech nut"?

Not long ago, a statement went the rounds of the mechanical press to the effect that a certain French mechanic had discovered a method of reducing the diameters of the tires of locomotive wheels by a process of partial immersion in water: whereas such was the practice twenty-five years ago, and it has been in common use ever since: principles governing the process, together with its application to wheel tires, having been published, together with an illustration, months before in the *SCIENTIFIC AMERICAN*. Instances of this kind are so numerous that it would take a volume to recite them, nor would the recital bring us any nearer to a solution of the question of how best to impart manual dexterity by means of instruction. Our knowledge of practical mechanics, as commonly applied in our machine shops, is crude in the extreme, and will continue to be so until we have placed within reach of the workman all the intricate knowledge that goes to the very bottom of expert workmanship, which information can only be obtained by practical experiment, made by men chosen by reason of their mechanical skill, under the directions of teachers capable of explaining and formulating the principles and rules governing the practice of the skillful artisan.

BORN SCIENTISTS.

The importance of the innate tastes of an individual being considered in determining the choice of a trade or profession is well shown in Mr. Francis Galton's recent work on the antecedents of English men of science, a volume prepared as a sequel to the treatise on "Hereditary Genius" already reviewed in these columns. Mr. Galton adopted the excellent plan of a well chosen series of questions, which every scientist was requested to answer and return to the sender. One hundred and eighty scientific men were thus questioned, and the replies which most appeal to the thoughtful are those relative to prevalent tastes. We should expect to find a taste for mechanics among the physicists, and such is the case: the same among the mechanics and engineers. The underlying cause of scientific research may be traced in the repeated mention of the possession of a "desire to know facts," curiously coupled in some cases with a strong repugnance to works of fiction. More interesting, however, is the schedule of influences and motives which urged the various individuals to follow scientific pursuits. Out of 191 people, innate taste for their calling influenced 59; fortunate accidents (generally showing innate taste), 11; indirect opportunities and indirect motives, 19; professional influences to exertion, 24; encouragement of scientific inclinations at home, 34; influence and encouragement of friends, 20; of teachers, 13; travel in distant regions, 8; residual influences, unclassified, 3. The large plurality in favor of innate taste is striking. Now take the various callings: Out of 26 cases of physicists and mathematicians, 12 had an innate taste, 1 no natural taste at all and 7 are doubtful. Of 11 chemists, the taste of 5 was innate, 1 not, and 5 doubtful; of 8 geologists, 7 innate, 1 doubtful; of 24 zoölogists, 17 innate, 3 not, 4 doubtful; of 10 botanists, 8 innate, 1 not, 1 doubtful; of 7 medical men, 2 innate, 4 not, 1 doubtful; of 6 statisticians, 3 innate, 1 not, 2 doubtful; of 5 mechanics, 2 innate, 3 doubtful.

It is clear from this that a strong and inborn taste for science is both a prevailing and an enduring peculiarity of the persons considered. A fair estimate for Mr. Galton's deductions is that out of every ten men of science, six were naturally gifted with a strong taste for scientific pursuits. Not one person in ten, taken indiscriminately, possessing such an instinct, it follows that its presence must add five fold to the chance of scientific success.

The possession of a special taste for any pursuit is therefore a gift of Nature not to be slighted, and it is in fact something to be seriously studied and its development advanced.

EDUCATED FARMERS.

If we were asked to point out any especial fact as denoting beyond all others our rapid progression in knowledge and in civilization, we should select the strong tendency everywhere manifest to abolish empiricism in all pursuits of life. It is not very long ago that the physician administered his remedies blindly, and knew less of the functions of the heart than does his modern descendant of the spleen and gall bladder. Meteorology, most fickle of all sciences, based as it is on the most changeable of all things, the weather, has within a very few years made marvelous strides; and we are certainly advancing to a point when it will be

as easy to foretell the rain and storm of tomorrow as to remember the fine weather of yesterday. Even cookery is no longer to be the science in which inaccurately compounded ingredients, under constantly varying conditions, are supposed by some pleasant fiction to yield invariable results for has not a college been endowed, to educate our future *chefs de cuisine*? Thumb rules in every trade are now scouted by intelligent working men. The world has shaped itself into a gigantic point of interrogation; "why" is the question of the hour, and faith in things earthly is confined only to those who, like the deluded partisans of Keely and others of his ilk, mistake ignorance of that which is possible for belief in that which is not.

Of all the sciences, none within recent years has so quickly emancipated itself from the fogs of empirical conjecture as that of agriculture. Up to the end of the last century even, people believed that air, water, oil, and salts were the sources of plant nutrition. Wallerius, Bergmon, Palissy, Davy, De Saussure, and Sprengel contributed discovery after discovery, investigation after investigation, but their work was scattered and little known outside their laboratories. It was reserved for the genius of Liebig to unite all these fragments of truth; but it was not until 1840 that he produced his great work "Chemistry in its Application to Agriculture and Physiology," and thus gathered in concrete form the materials which are the basis of a now great and rapidly growing science. It is hard to realize that agricultural chemistry has found its application for but 26 years, so clearly are its benefits before us in tangible form. But on the other hand, this only serves to indicate to us how vast must be the results yet to come, when agriculture, through the instrumentality of its knowledge, shall have become in its turn as exact as its sister sciences, and as susceptible of being taught and learnt in the same manner as they. And to attain this much desired end, our schools and colleges, under the guidance of far-seeing men, are doing splendid work.

The youngest of our universities, Cornell, established an agricultural department three years ago, under the charge of Professor Roberts, the farm consisting of 150 acres, in not over good condition. Upon this tract of land the whole science of raising crops, as well as the business of managing a farm, is taught with a thoroughness which we doubt has ever been exceeded. Eighteen square rods of clover, for instance, are set apart for eighteen different modes of treatment with fertilizers. In the experiments with corn, three rows of each kind, or of each mode of manuring, or of the different modes of management in other respects, extend across the field. There are also experimental strips of oats and wheat; and thus every method of cultivation of all the farm products incident to our climate is practised directly before the student, who is required personally to perform the labor necessary in connection therewith. The results of the experiments are carefully recorded and stored away until sufficient shall have been gathered, over a number of seasons, to justify the determining of accurate averages.

Besides this, the students are taught a complete system of accounts. Every hour of labor hired, every product of farm sold, is minutely registered. The food which live stock consumes is recorded on one side and balanced yearly by the market value estimated by a skilled butcher. So that, in this way, the gains or losses, not only of the farm as a whole, but of every branch, are known with the utmost accuracy. Every student is required to become proficient in this account keeping. Each keeps his books separately, and determines estimated values; and as he may sell his own labor to the farm, outside the time required of him, which is but two hours and a half for two days of the week, he is directly interested in the task. Besides the farm, there is a garden of six acres, conducted under the same admirable system; and in addition, lectures on practical agriculture are given four times weekly by Professor Roberts. The *Country Gentleman*, to which we are indebted for these facts, states that the number of agricultural students is still too small, so that there seems to be abundant opportunity for all who may desire to acquire a thorough and most valuable education. Certain it is that such instruction is most urgently needed in this country. It has become too much the fashion for young men to crowd into the great cities, and there to eke out lives behind desks and counters which should be spent in developing the vast resources of the thousands of square miles wherein the richest soil on earth awaits the plowshare. In the Centennial Exposition are exhibited actual glass-enclosed sections of prairie soil with the black unctuous loam extending downwards far below the reach of the deepest furrow. Go look at that superb exhibit in Agricultural Hall, and think of the possibilities which educated farmers cultivating such land might accomplish. Think of it, stalwart young men, who meditate coming into the city after the present harvest is garnered, to find work where there is none to be had. Expend your labor and means at Cornell, Amherst, Dartmouth, and other like colleges, and obtain such an education as we have described then; "go West," pre-empt your land, and start on the high road to independence and ultimate fortune.

Crystallized Glycerin.

Dr. Armstrong, recently exhibited, at a meeting of the Chemical Society, London, a specimen of pure crystallized glycerin. The solidification took place while the glycerin was being agitated on a railroad journey in cold weather last winter. Dr. Odling mentioned the curious fact that hydrocyanic or prussic acid is an excellent test for the purity of glycerin, the slightest admixture of any foreign substance causing the glycerin to turn yellow in a short time if a little hydrocyanic acid be stirred into the liquid.