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(Illustrated articles are marked with an asterisk.)

CANDLE FLAMES AND STREAKS OF CLOUD.

Professor Tyndall ends his most suggestive address as President of the British Association with a half regret that he must quit a theme too great for him to handle, but which would be handled by the loftiest minds ages after he and his hearers, like streaks of morning cloud, had melted into the infinite azure of the past.

With what had previously been said still ringing in their ears, this simple figure must have carried to those that heard it a deeper meaning than it would seem to bear when standing alone. At another time, or coming from another speaker, the words might be taken to imply no more than the prospect of human forgetfulness, the oblivion in which the names and deeds of so many human generations have been lost; but in Professor Tyndall's system the failing memory of man forms no essential part of the "infinite azure" to which all human kind is hastening. Indeed the immortality of fame is endless in contrast with the speedy dissolution that awaits us when the environment masters the organism which alone determines the activities that make us what we are.

The cloud melts and disappears, not to continue a ghostly existence in another world of immaterial sky and cloud, as savages have imagined, but to cease utterly and for ever as that particular cloud, while its dissevered elements remain to form other combinations, to assume other forms, to perform other functions, in the ever changing sky and earth.

So man, equally the product of molecular activity, "derived in his totality from the interaction of organism and environment through countless ages past," may or may not make himself a connecting link in the chain of organization and thereby impress his personality upon the future; but whether he does or does not, his individuality ends with the physical frame which gave it being: a product of material conditions, he ceases to exist when death puts an end to those conditions, and fades into the "infinite azure," not lost, but no longer an integral part of the Universe.

It is a striking commentory on the limitations of human thought that precisely the same conclusions were arrived at by the path of experimental philosophy in India thousands of years ago by pure contemplation. The theology of India was underlaid with pantheism. In the Vedas—those books of incalculable antiquity—God is the material as well as the cause of creation, "the clay as well as the potter." Later, the "clay" took on the attributes of the "potter" and became the motor as well as the matter of the Universe. Centuries before Democritus conceived the existence of atoms, or Lucretius detected in the potency of matter the sufficient cause of all things, without the help of the gods, the school of Canade had developed an atomic system as comprehensive as that which Professor Tyndall, with the rest of the modern scientific world, holds today. By the unaided concurrence of atoms, those dusky scholars explained every phenomenon, mental as well as physical, animals, men and gods.

But this was not the highest reach of Indian thought. From the contemplation of matter endowed with "the promise and potency of every form and quality of life," to that of pure force without any association of substance, the step is long but inevitable. Faraday took it when he conceived of a body not as an aggregation of substantial atoms but as an assemblage of "points of force." In like manner Gotama, the founder of Buddhism, took it, basing his system wholly on the idea of force. In other respects, his views of man and Nature are in philosophical accord with those which underlie the last results of modern Science. His fundamental principle is the supremacy of force. He asserts an impelling power in the Universe, a self-existent and plastic principle, but not a self-existent, eternal, personal God. He rejects inquiry into first causes as being unphilosophical, holding that finite minds are capable of dealing with phenomena alone. Like the modern scientist he denies the interposition of any such agency as Providence, maintaining the omnipotence of law. Equally opposed is he to the possibility of chance, saying that what we call chance is but the effect of an unknown, unavoidable cause.

When called on to account for the spirit of man, whence it comes and whither it goes, the reply, in oriental imagery, calls up the flame of a lamp, and asks in what obscure condition it lay before it was kindled, and what becomes of it when it is blown out?

Translated into terms of modern Science, Gotama's answer is as one with Professor Tyndall's. The flames of our nightly lamps, the streaks of morning cloud which warn us to put them away, are alike fleeting products of physical conditions, temporary manifestations of molecular force. Their end is extinction; but their effects are factors of future events.

"When a fire is extinguished, can it be said that it is here or that it is there?" replies the philosopher Nagasena to King Milinda, when asked whether the All-wise Buddha still exists. "Even so our Buddha has attained extinction. It cannot be said that he is here or that he is there: but we can point him out by the discourses he delivered. In them he lives."

Science has no further word to offer.

THE RELATION OF MECHANICAL ENGINEERING TO INDUSTRIAL OPERATIONS.

The popular estimate of the engineering profession is somewhat hazy; and this is due to the very general definition which is given to the term. Just as one who has facilities for erecting a dwelling house advertises himself as an architect and builder, so every one who has charge of a boiler or an engine calls himself an engineer. From this it follows that many persons do not see any difference between those whom they employ to run their engines, and those who are styled consulting engineers, except, indeed, that the former may be the more reliable of the two, since they are practical men, while the latter are mere visionary theorists. The public is not always right, however, and it may be well to revert to the definition of Mr. Tredgold, who says that "engineering is the art of directing the great sources of power in Nature for the use and convenience of man." What sources of power in Nature are used by man in industrial pursuits? Familiar examples may be found in falling water and the heat generated by combustion, the one being employed to move water wheels, and the other to heat water or air for use in engines. The winds and tides furnish motive power, and electricity is also employed to produce useful work. Now in the application of these powers of Nature, intelligence in design and construction are required, to suit the machinery to the power, and skilled attendance is needed for the operation of the machinery. It is also necessary to obtain the fuel for generating the heat of combustion, and this calls for the employment of skill in designing the plant and superintending the operations of the workmen. It will appear from the foregoing that, in carrying out any engineering project, the duties of the engineer are varied. A design must first be prepared for the work, which design must afterward be carried out in actual construction, and finally, the completed machinery must be managed properly, so that it will fulfil the purpose for which it was designed. Some other facts will be evident in this connection. A man who has acquired sufficient skill and experience to design machinery and superintend its erection has done this generally by gaining knowledge in every branch of the profession by education, supplemented by work in the shop and drawing room, and by practical manipulation of the machines that he is called upon to design. He cannot, however, in general devote himself so much to any special kind of construction as to become a practical manufacturer, because, in modern engineering, manufactures are thought to be most economically managed by attention to specialties, while the consulting engineer is required to deal with all branches. It is difficult, also, for the manufacturer of one class of goods to be entirely unprejudiced, since the mind of man is so constituted that he ordinarily has a pretty good opinion of his own devices. The successful consulting engineer, however, should be surrounded by such influences that he can, in contracting for constructions, always select the best, uninfluenced by personal considerations. If the foregoing propositions are correct, it would seem proper to divide the class commonly called engineers into engine drivers, manufacturing engineers, and consulting, designing, and superintending engineers. This classification, already well established in the profession, is gradually gaining a foothold among the general public. The process is necessarily slow, since it is only of late years that public attention has been directed to the higher branches of engineering as a distinct profession. It will not be difficult, however, to show that the community have considerable interest in a true conception of the matter, and a few simple illustrations may be given.

With the introduction of iron bridges a class of builders arose, who, finding it easy to convince ignorant highway commissioners that a bridge built of iron, however proportioned, must be strong, take contracts at such low figures that representatives of the best bridge-building companies in the country are usually conspicuous by their absence from a highway bridge letting. A railroad company or any large corporation, desiring to contract for structures of this kind, usually pursues a very different course. The directors, good business men but lacking the requisite technical knowledge for work of this nature, employ a competent engineer, who advertises for proposals, taking care to draw his specifications in such a manner as to preclude bids from the highway contractors, who are known in the profession as "tin pan" bridge builders. This action is fully justified by the excellent character of the important railroad and public bridges in the United States.

Another illustration may be given, more general in its application, in reference to the purchase of machinery. Any one who has need of engines or other machinery naturally desires to get the best quality—that which will perform the most economically, require the least attendance and repairs, and be the most durable. Under the competition of the trade, such men are marked by vendors of machinery; and if the representations of the latter are to be believed, each one of them has the best article in the market. This they can honestly claim, as already remarked, from a well defined trait in human nature; but it would require no argument to show that an unbiassed consulting engineer, well acquainted with the merits of each machine, could make a much better selection than the unprofessional purchaser, who is unable to judge of the value of the representation made to him by interested dealers. The engineer, also, after contracting for the machinery, is frequently called upon to test it when completed, and see whether it fulfils the conditions of the contract. Numerous suits between purchasers of and dealers in machinery attest the correctness of this position. Sufficient has been said to show the importance of engineers' work in the various industrial pursuits.

In this brief notice, nothing like a comprehensive view of engineer's work has been attempted. The salient points only have been touched upon; but the hints given may be of interest and value to those who require professional assistance, as well as to those who look forward to entering their names on the list of engineers, and desire to know something of the duties which they will be called upon to perform, and the preparation needed to qualify them for the proper performance of these duties.

CO-OPERATION IN GREAT BRITAIN.

The number of cöoperative trading societies in England and Wales, according to a recent parliamentary return, is 746, with a membership exceeding three hundred thousand, and a share capital of nearly fifteen million of dollars. The annual business of the societies amounts in payment to upwards of fifty million dollars in gold, and in receipts to nearly fifty-seven and a half millions, the net profit from all sources being in round numbers four million dollars in gold.

In a long discussion of the principles and prospects of cöoperation, published in the *Contemporary Review*, Mr. Thomas Brassey, M. P., mentions these enormous sums as convincing proof that the principle is convenient and practicable in its application to the distribution of commodities; and, what is more important, the working of the system is the source of considerable profit.

On the other hand, the fact that the annual withdrawals from the societies are half as many as the additions would seem to prove that the management of cöoperative stores is not without serious difficulties, which will have to be removed before the plan can be pronounced perfectly successful.

Still more difficult are the problems to be solved in the matter of cöoperative production, the societies of this sort being few, and the failures more numerous than the successes. Among the successful are the Paisley Manufacturing Society, the Hebden Bridge Fustian Society, the Eccles Quilt Manufacturing Society, and the Lurgan Damask Manufacturing Society, all small establishments whose success is probably due in great measure to the wisdom of the promoters in not attempting their operations on too ambitious a scale. Still, the flourishing condition of the Manchester Printing Society shows that a large undertaking can be successfully conducted on the democratic system, certainly where the range of production is limited, and individual exertion on the part of the workmen is of more account than of great executive skill at the head. The Cöoperative Printing Society, recently established in London, however, has not turned out so well.

The most important experiment in cöoperative production thus far attempted in England is that of the Ouseburn Engine Works. Its experience has not been favorable to the system when applied to varied and complicated undertak-