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Contents:

(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 a 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-

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ings. Great difficulty has been experienced in dealing with the different classes of workmen, and in the adjustment of rates of wages. Men brought up to one trade naturally find it hard to estimate the dues of those practising an entirely different trade; and when they are required to assign higher wages than they can hope to receive, to men whose superiority they are unable to appreciate, the difficulty becomes all but insurmountable. The practical result in the Ouseburn Works has been a strike for higher wages in one of the departments—one of the evils which coöperation was specially expected to prevent. The society also suffered severe losses through mismanagement, the taking of orders at too low a price, and other errors, due to lack of technical and practical knowledge on the part of their chief adviser, who was more of a philanthropist than a man of business.

As in other countries, so in England, success in coöperation seems to be limited to moderate undertakings. When the business is of a kind that cannot be carried out advantageously on a modest footing, the coöperative principle is best applied to the execution of parts of the work; in this way the system can be made available in the largest undertakings, after they have been suitably subdivided, the general administration remaining in the hands of an individual owner or company.

As Mr. Brassey observes: Where no special personal influence is needed for the purpose of securing clients and customers, and where the internal economy of the establishment can be conducted by a regular routine, there will be no disadvantage in the management of a board or council. But when no transaction can be completed without long and difficult negotiations: when an undertaking is of a kind that cannot be conducted in accordance with fixed rules, and the emergencies which must, from the nature of the case, arise are always unforeseen, and must be met on the spot by an administration upon whose skill and conduct all will depend; in such a case the coöperative system pure and simple becomes impossible, and the attention of masters and workmen wishing to work together in friendly alliance should rather be employed to devise schemes whereby the equable distribution of profits among the workmen may be combined with the necessary concentration of authority in their employer.

Perhaps the most noteworthy alliance of this sort is that in connection with the collieries of Messrs. Briggs. To avoid, if possible, the delays and losses incident to strikes, this firm voluntarily took their miners into partnership some years ago, dividing the profits above a certain amount annually among the workmen, in proportion to their several earnings. Last year nearly seventy-five thousand dollars in gold were so distributed as the workmen's share of the profits, several receiving as much as thirty pounds ($150) each. About half of this sum has been returned to the company in premiums on shares applied for by the miners. Inasmuch as the owners receive as high a rate of interest on their investment as they had ever made in their best years before the workmen were given an interest in the profits, while the risks and annoyances formerly arising from strikes and labor quarrels are entirely avoided, it is clear that the alliance is mutually beneficial to all concerned.

The experience of Messrs. Fox, Head, & Co., who adopted a similar plan eight years ago, has been quite as favorable to this mixed system. Their plan secures to every person employed a pecuniary interest in the success of the business, as far as possible in proportion to his services. Every one engaged, whether as laborer, clerk, foreman, manager, or partner, is paid at the rate customary in the district for his particular work. The capital employed is remunerated by a specified rate of interest. Provision is made out of the profits of manufacture for keeping the works in repair, and to cover renewals and depreciation, and a fund is maintained as a provision against losses by bad debts. This done, the surplus profit is annually divided into two parts; one to be paid to the capitalist, the other to be divided among those employed, in proportion to their earnings. The sums already divided among the workmen amount to between thirty thousand and thirty-five thousand dollars. A superior class of workmen are secured, and they stay longer at the works than ordinarily.

HINTS TO ARCHITECTS AND BUILDERS.

The late Lord Lytton, in "The Coming Race," pictured a condition of society in which mere manual labor was performed by machines, so that the only duties devolving upon men and women were those requiring the use of the intellect. Although in practice we are far from the realization of that idea, it is in strict keeping with the spirit of modern progress, and also agrees with the laws of true philosophy. It will be generally admitted that the reasoning powers of man are his most valuable possessions, and that undue muscular effort is not favorable to their development. It will likewise be generally conceded that the invention of machinery which lessens manual labor and cheapens the operations in which it is employed, contributes directly to the prosperity and intellectual advancement of the human race. The savage carries on commercial affairs by transporting articles of trade on the backs of men or in canoes impelled by oars. Wagons drawn by beasts of burden, and vessels moved by the force of the wind, mark a second stage of progress. Then come railroads and steamers, still furtherfacilitating the operations of trade; and it is not impossible that these modes of transport may be displaced by still greater improvements. With each of these changes the world becomes better and richer, so that there is great encouragement for showing how improvements may be made, wherever it seems possible.

No one can have walked through this city with observant eyes and have failed to notice the tendency, in constructing new buildings, to place the foundations a little lower, and raise the roof a little higher, than in former structures. Another fact will also strike him: that it frequently takes nearly as long to make the foundations (meaning the part below the sidewalk) of a modern building, as it does to complete the superstructure; and he has doubtless often considered whether it might not be possible to devise some method by which this operation could be quickened and cheapened. Of late years many improvements have been adopted in the building trade. The pleasant occupation of the son of Erin, who told his friend that in this "illigant country" all he had to do was to "put some bricks in a little box, and go with them up a high ladder," is fast disappearing. The elevator, which has done so much in increasing the hight of modern buildings, has been introduced to carry up the materials of construction, so that it is now not uncommon to see one or two horses or a small engine doing the work that was formerly performed by a score of men. This is very well as far as it goes; but further improvements are demanded. Take, for example, the case of the basement of a building which requires an excavation to a depth of thirty or forty feet. Ordinarily, the hole is dug in shelves or terraces, so that the workmen can throw the excavated material from the lower part to the shelf above, whence it will be thrown by another set of workmen to the next shelf above, and so on, until it reaches the surface, and is shoveled into carts to be carried off. In this manner the bottom is finally reached, and then, as each successive shelf is cut away, a platform of boards is put up; and upon this the dirt is thrown, to be transferred as before, by different sets of laborers, to the carts. If any one who has a little time to spare will witness an operation of this kind, taking pains to notice the contents of a cart, and the various manipulations these contents pass through before they are ready to be carried off, a very simple sum in arithmetic will convince him that this excavation is a tolerably expensive affair. Take, for instance, the case of a foundation forty feet below the surface, in which the materials will have to be transferred, from platform to platform, at least six times, and then once more into the carts, making seven transfers in all, and requiring seven times as many men as would be needed if the dirt could be shoveled directly into the carts. This mode of stating the problem will doubtless suggest the idea to the attentive reader to let the dirt be shoveled directly into the carts, and avoid all these transfers. It would not be difficult to accomplish this. Usually, in such an excavation, as soon as the bottom is reached in the center, a crane is set up to be used in moving foundation stones, etc., into their places. Now, when the excavation is made to such a depth that a transfer of dirt is required before it can be thrown to the surface, let the crane be brought into requisition. A small steam engine connected with the hoisting gear will furnish the power for raising and lowering weights. Let, then, the cart bodies be so arranged that they can be detached from the axles, lowered to the place where the workmen areexcavating, and, when filled, be hoisted and again connected to the wheels. An arrangement of this kind would effect a radical change in the time and cost of deep excavations, and it seems strange that it has not been adopted ere now. Of course, a mere outline is attempted in this article, without much attention to minor details. It might be found better, for instance, instead of detaching the cart bodies, to shovel the dirt into boxes, so that it could be hoisted out and dumped into the carts; or still some other method might be preferable. It is only intended to lay stress upon the principle that it is always better and cheaper to perform work by a single operation and with a single gang of men than by several. It is quite likely that there are many other details of the builder's trade that could be improved. No matter what they are, however, they will be performed correctly if they conform to the principles of using the cheapest power and the fewest number of operations possible. Architects and builders are deeply interested in carrying out these principles, since the cheapening of construction is sure to increase their business. It may be added that the principles given above are equally applicable to all operations in which muscular effort is required; and the most successful business men are those who appreciate this fact.

PNEUMATIC BURIAL.

Graveyards existing in the midst of thickly populated districts have been pronounced by sanitarians the world over a source of disease, and hence a standing menace to the people in their vicinity. In many of the cities of Europe, where burying grounds within the corporate limits are much more common than in the newer towns of our own country, the effect of the promulgation of the above knowledge has been a wholesale removal of the dead to new cemeteries situated far in the suburbs. This proceeding has resulted in a largely increased outlay necessary to defray the expense of a procession and more extensive funeral paraphernalia; while in Roman Catholic countries, where it is customary for mourners to follow the body to the grave bareheaded, it has caused much personal inconvenience, owing to the length of the journey, in inclement weather. Accordingly, various schemes have been suggested to avoid the above mentioned difficulties, among which plans is that of transporting the dead by means of pneumatic tubes. This idea has been ingeniously and ably worked out by Mr. F. Von Felbinger, an accomplished engineer, and Mr. J. Hubetz, an architect of Vienna, and by them submitted to the municipal council of that city. We have been favored by Mr. Von Felbinger with copies of the working drawings, and a description of his plan.

It is proposed to erect a great monumental hall or temple, which is to be divided into three portions, a middle hall and two smaller ones, the former to be devoted to the use of Roman Catholics, and the latter respectively for Protestants and Israelites. These apartments will be subdivided into chapels suitably furnished and decorated.

On a funeral taking place, the body in its coffin will be deposited in a sarcophagus in the center of one of the chapels, and the ceremony proceeded with. At the conclusion, the chief mourner touches a spring, when the sarcophagus sinks noiselessly through the floor. This corresponds to the public burial, as, so far as the mourners are concerned, they have nothing further to do with the body. On its arrival, however, in the cellar, men stationed for the purpose attach a check to the bier, showing to which cemetery it is to be forwarded, and place the body, with three others, in an iron car which fits in a subterranean tube, running on tracks placed therein, after the plan described by us as followed in the construction of the experimental section of the pneumatic railway under Broadway in this city. This tunnel in Vienna will be 15,000 feet long, and the carriages will be propelled through its entire length, by means of a blast of compressed air, in about ten minutes.

The tubes are so arranged that the car can be started off to any cemetery by a separate road. On reaching its destination, a small building erected as a terminus, the bodies are removed and buried by officials in the places previously designated by the relatives of the deceased.

The estimated cost of establishing this plan in Vienna is $500,000. This provides for a tunnel about five feet in diameter, a 150 horse power engine, and all the necessary machinery, and buildings of remarkable architectural beauty. The latter it is proposed to locate in a prominent portion of the city, and to surround with a large and handsome garden, so that the gloomy aspect and associations generally peculiar to funereal edifices will be avoided.

COMPRESSED AIR MACHINERY.

A paper on compressed air machinery, recently read by Mr. William Daniel before the British Institution of Mechanical Engineers, is a valuable contribution to our knowledge of a class of mechanism, regarding which trustworthy information is not abundant. A very complete series of experiments was conducted by the aid of an air compresser having two steam cylinders, each 16x30 inches, working compressing cylinders of like dimensions, and the whole mounted on a receiver 24 feet long by 5 feet diameter, which formed the bed plate. After the compressed air was led to a portable engine and there cooled, it was admitted to two cylinders, 10 by 12 inches, which drove an engine working a friction brake. By means of indicator diagrams, taken from this last mentioned engine, as well as from both the steam and air cylinders of the compresser, a record was obtained of the losses of power which took place at various stages. From the data a table was completed, the results of which show that, when working with air at 40 lbs. pressure, the usual effect obtained on the brake was only 25¼ per cent of the power indicated on the steam cylinders of the air compresser, while with 34 lbs. pressure the efficiency reached 27 per cent; with 28 lbs., 28 per cent was gained; with 24 lbs., 35 per cent, and with 19 lbs., 45½ per cent. The loss of efficiency due to increased pressures may be ascribed to the conditions of the experiment and the increased loss of heat from the air, attendant upon the higher degrees of compression.

Mr. Daniel advocates the use of compressed air machinery for mines, and points out the economy which must result from the fact that, when the motor is idle, there is no loss except the interest of money expended on the machinery, which is much less than that incurred where animal power is employed. He also suggests that the ventilation of the mines would be improved by the discharge from the engines, while the air, being always available in the pipes, could be used to dilute an outflow of gas.

The discussion of Mr. Daniel's paper elicited a number of practical suggestions. Mr. C. W. Siemens pointed out that the development of heat during the compression of air might be avoided by the injection of water into the air-compressing cylinder, this water taking up the heat as fast as it appeared; while the formation of ice in the engine cylinders might be prevented by similar means, the water in this case giving up heat to the air during the expansion of the latter. Mr. Firth stated that he had got rid of any difficulty with ice by enlarging the exhaust openings. Mr. Brotherhood described his three cylinder engine, as used for working the Whitehead fish torpedo. This had three cylinders, each 1⅞ inches by 1½ inches stroke, driven by a pressure of 450 lbs. per square inch, admitted through a reducing valve from a reservoir of air, stored at 900 lbs. per square inch. This engine had run at 2.225 revolutions per minute, developing 2½ horse power, or 0·28 horse power for each pound of its weight. Mr. Cowper suggested that radiating ribs, cast on the cylinders of air compressers or of engines using compressed air, might serve the purpose of facilitating the emission or absorption of heat.

A CHEAP GALVANIC BATTERY.—Mr. W. M. Symons proposes a cheap but convenient galvanic battery; each of the zinc plates was two inches square, and covered with fustian or other fabric, outside which thick copper wire was wound to form the other plate; the exciting liquid was weak chloride of zinc. Pairs of plates thus made could be arranged in series to form a battery to give out weak currents for a great length of time.

PERU, with three millions of people (a large part Indian) has twenty-six newspapers. These are published at Lima, Callao, Cuzco, Iquique, Tacna, Puno, Arequipa, Trujillo, Piura, Chiclayo, Cajamarca, Tarapacá, Ica, and Ayacucho.

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