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(Illustrated articles are marked with an asterisk.)

THE CENTENNIAL SUBSCRIPTION.

The centennial managers are taking the right course to impress upon the people the importance of the great celebration of 1876. The address which we publish in another column is a business-like, straightforward document, which sums up the past progress, present condition and future needs of the enterprize in very few words. It is not signed by an impersonal committee, but by the President of the Board of Finance; and with happy terseness, it condenses the gist of the most telling arguments in favor of the plan into the fewest possible sentences. If anything will tend to reconcile the unfortunate differences and local jealousies which have presented themselves and have served to interfere with the unanimous support which the entire country should give to the Centennial, it is such appeals to the people as this. Memorials to legislatures or lengthy arguments more theoretical than practical, scattered through the press, are of little avail in securing the necessary returns of cash which are needed, not at some future and indefinite period, but now, in order to ensure the success of the scheme. The people, are told, plainly and succinctly, that if the United States is to commemorate its hundredth birthday by a grand celebration which will worthily testify its unexampled progress, it must not be left to politicians to dole out such appropriations as will make up the requisite number of millions, but that individuals must personally open their pocket books and buy the shares. Ten millions of dollars is the total amount needed; of this, four millions have been subscribed, and a good percentage of the balance Congress, it may be expected, will provide for. The remainder, divided throughout the country, is a sum trivial in comparison with merely the benefits to be gained by exhibitors leaving out patriotic considerations altogether.

There are scores of manufacturers who intend, beyond doubt, to be represented in the Centennial, who will partake largely of the advantages it offers and who are abundantly able to take up the remaining shares of stock without feeling the outlay. It is time that the jealous feeling against Philadelphia should die out; in this city it has disappeared, and there is an earnest desire for the unequivocal success of the work. Philadelphia has fully made good her claims to be the site of the exposition, by the subscription of $4,000,000, tenfold her quota and nearly half of the entire sum needed, supplementing, by magnificent energy, the justly important advantages offered by her situation and revolutionary associations.

It is too late also to continue an unseemly dissension over the question of a national or international exposition. By its official acts, which cannot be honorably recalled, the government has invited other nations to participate in our festival, and many have already signified their intention of so doing. It would hardly be just to invite guests to our feast, and, after they have begun their preparations and set aside money for their coming, to request them to stay away. The Centennial was inaugurated as an international affair, and as such, we think, it should be carried out.

It is moreover to be the largest and grandest exposition that the world has yet beheld. In point of space alone, its buildings are to cover 3,000,000 yards, against 2,530,400 and 481,500 square yards filled by the Vienna and Paris fairs. The time remaining is but two years, and the greatest activity will be necessary to complete preparations during that period. It is for this reason that the appeals now before the people are doubly urgent. We trust that the response will be both speedy and adequate.

THE FAMINE IN BENGAL.

Accustomed only to unbroken plenty, it is happily impossible for American minds to form any adequate conception of a state of things like that now prevailing in Lower Bengal. The haziness of our knowledge of Indian geography helps still more to lessen the effect of the pictures of human wretchedness outlined in the cable reports. We are incapable both of estimating the extent of the troubles there, and of supplying from our own experience the unreported details. Benares, Patna, Baugulpore, Rajshaye, Burdwan—what are they but heathenish names, standing for we know not what? Even when we translate them into familiar terms, and find that they represent a territory greater by a third than all New England, packed with a population equal to that of the United States and British America combined, the appalling fact that its swarming millions are pressed by want, if not face to face with starvation, loses most of its significance through our ignorance of what famine really means.

As mapped by Sir Bartle Frere, the stricken district is shaped somewhat like a clumsy boot with a thick foot and an expanded top—the toe resting on the Hooghly, the heel on the Brahmapootra three hundred miles away to the north, the leg covering the broad valley of the Ganges to the westward, a distance of five hundred miles, with a breadth from one hundred and fifty to three hundred miles.

Throughout this vast area, protracted drouth last fall caused the almost total loss of the rice crop, the principal food resource of the people, who have been brought in consequence to the brink of starvation. Indeed had assistance from without been less prompt or less generous, the victims of famine would have been numbered by millions. Even with the most untiring and liberal efforts of the government of India, supplemented by the gifts of the charitable the world over, deaths from starvation have already been numerous, and more must follow. And what makes the prospect still more deplorable is the fact that years of irregular and deficient rainfall rarely come singly. As of old, they occur in cycles; and though the present disastrous season has been preceded by several years of short crops and scarcity, it is impossible to say whether it marks the culmination of the series or is the first of a new and worse one. The problem which the government has before it for solution is therefore twofold: 1. To supply the present wants of its hungry millions; and 2, to make such improvements in their political and agricultural condition as shall make the immediate or remote recurrence of famine an impossibility.

The first part of the task is more difficult to perform in Bengal than in any other part of India. It is at once the richest and most unfortunate province of the Empire, the victim of greater wrongs and more pig-headed political blundering than any other. In no other part of India is there so great a lack of administrative machinery competent to grapple with the evils of scarcity and famine, the native system having been destroyed and nothing efficient put in its place. Means of transportation and communication are also lacking everywhere; so that, if left to itself, each petty district would be practically dependent on its own crops, and millions might starve while there was plenty all around, for the simple reason that food could not be brought to them. To provide for the distribution, at the right time and in the right places, of the thousands of tuns of food, which the government has thrown into the suffering districts, has been and must be the most difficult portion of its gigantic charity.

The distribution of food is made still more difficult by the system of caste, stronger in rural Bengal than in any other part of India. The ordinary Hindoo is not only restricted to a very limited range of vegetable diet, but even that must not pass through the hands of one of lower caste. He will starve rather than touch forbidden food, though of the most tempting and nutritious character. That so much has been done to restrict the area and the severity of the famine, in spite of these and a thousand other obstacles, will be a lasting credit to the present government of Bengal.

It has also grappled with the second part of the problem with considerable earnestness. Many extensive works of internal improvement—railroads, canals for irrigation and commerce, and local roads which had been suffered to languish through false economy—are being pushed to completion by the thousands of agricultural laborers thrown out of work by the failure of the crops, and driven to the public works by need of food. Had these safeguards against famine been completed in time, it is safe to say that the greater part of the existing distress would have been prevented. In the Deccan, and other parts of India formerly subject to fearful seasons of famine, the people are now as free from that danger as those of any part of Europe, ample irrigation making the general destruction of crops an impossibility, while good roads make it possible to import promptly food enough to supply any accidental deficiency. If the trouble in Bengal shall have the effect of compelling the government to do as much for that unfortunate province, its affliction will not be an unmitigated misfortune.

G. W. P., M. D., writes to point out that Mr. R. B. Forbes' suggestion as to calming the sea by means of oil originated with Benjamin Franklin, who saw the effects produced by the accidental upsetting of a barrel of oil, while crossing the Atlantic. It is described in Franklin's autobiographical work.

EREMACAUSIS VERSUS BURIAL AND CREMATION.

BY PROFESSOR ALBERT R. LEEDS.

Is there no other alternative in the disposal of the dead than our present practice of inhumation and the proposed cremation? The shortcomings of the former, and the long catalogue of hurtful consequences, are conceded; but are the superior advantages of cremation established? Passing by the social, æsthetic, and religious considerations involved, can the advantages which are claimed for cremation, by those who profess to advocate it on scientific grounds, be regarded as proven? Is the immediate conversion of the highly organized and nitrogenized tissues of the body into certain gases and water, the most economical method of returning to the earth the forces and substances needed for its fertilization? No: on the contrary, cremation would proceed in direct violation of well ascertained principles in the use and economy of natural forces; for all the power exerted by the burning fuel, to break up the animal tissues into carbonic acid and water, would have to be put forth again in order to recombine them into those compounds of carbon, hydrogen, and oxygen, which make up the cells and fibers of animals and plants. Nature, which has the vastly greater burden of disposing of all animals other than man, rarely resorts to the wasteful expedient of burning them by rapid combustion. She effects this end by slow combustion, or, as Liebig termed it, eremacausis.

It would be well, then, before resorting to artificial devices and patenting improved forms of furnaces for most rapidly getting rid of the dead body, as it is feelingly called, that we should turn to Nature and take from her a few preliminary lessons. We shall find that she seldom applies the torch, while all the while accomplishing her end. There is not a rotting log, a fallen leaf, or a dead insect, worm, or animal, which is not burning slowly, combining insensibly with the oxygen which is present in the air or dissolved in water, and becoming converted into fertilizers. Regarded in this aspect the whole world is a cemetery, and the tropical forests along the Niger and Amazon are densely populated ones. Yet we do not find that pestilences make life impossible to the survivors. The ground is black with organic remains, and furnishes beneath its surface such stores of food that it supports a subterranean population, almost as vast as that which teems above it. It is a magazine of vegetative power, sending up all shapes of luxuriant life, just such a soil as the husbandman endeavors to create by artificial means. Is it not possible for man to do safely what Nature does on so much vaster a scale with impunity? Should he be compelled to destroy in hideous conflagration what Nature consumes so gently on her funeral pyres?

Our error is, and has been, that, in this as in other cases, we have done wrong by interfering with or only partially obeying the laws of Nature. While professing a belief in the immortality of the soul and the perishability of the body, we have acted as though the body should be immortalized; and, by placing it in stone vaults of Cyclopean masonry or in non-oxidizable metallic envelopes, have endeavored to thwart the operation of natural forces and prevent the return of the effete to the realm of the useful. In the burial of the dead, the coffin is sunk beyond the reach of infiltrating waters and frequently surrounded with impermeable clay, than which there is nothing better to exclude the operation of decomposing agencies. We rightly view with reverence the spot where a dear friend is laid, just as we do the ground where some great achievement was wrought, although we know that every vestige of his body has perished. Why then attempt to prolong by a few years the pitiful remains? This idea has had but the effect of populating the ground, and rendering it necessary finally to desert it, and seek some new cemetery. Instead of so doing, make the spot for ever hallowed, and let our cemeteries remain, while permitting Nature, untrammeled or assisted by means which she herself teaches, to dispose of the bodies.

This is not an empty suggestion. Chemistry points out to us what must take place, and suggests a variety of substances and means for accomplishing the desired result. The stoutest granite exposed to the action of air and rain eventually crumbles into sand; and for most rocks, a few years suffices. Great beds of limestone may be dissolved by the action of surface waters percolating through the ground. Cannot similar agencies dispose of the few pounds, mostly of carbonate of lime, making up the animal skeleton? It would not be necessary to employ chemicals having a violent caustic action, like lime or acids, which, in consequence, suggest operations repulsive to our sentiments of tender respect for the dead. It would suffice to surround the body with some substance which would carry oxygen to the tissues, and allow the products of the slow combustion thus effected to be distributed through the soil. Such a substance, for example, is the hydrated oxide of iron. This is the same material that gives the yellow color to the soil, and which Nature has diffused everywhere to sweeten the ground and assist in the oxidation of organic remains buried in it. There is certainly nothing objectionable in the appearance of oxide of iron, a body which forms the coloring matter of yellow and brown ocher; yet, as Professor Wurtz suggested, it probably would be sufficient to lay the body in this, in order that every vestige should be destroyed in a few years.

We propose, then, that cemeteries should not be transient, or banished to distant spots, or allowed to be located in unsuitable places, or managed (as at present) as successful speculations, frequently in defiance of well known sanitary laws. Instead, let them be made permanent, bearing a definite proportion in size to the surrounding population: not restricted to the outskirts of cities, and swept away by the advancing tide of humanity, but located upon sites well adapted for them, whether in the midst of cities or in suburbs. Let the ground grow more sacred as the spot where were placed not one but many generations of those connected with us by the ties of filial love, and more beautiful by accumulated treasures of art erected as memorials of the unnumbered dead who have temporarily reposed there. We believe that some method similar to that which has been advocated above, and which is, to the best of our knowledge, brought forward for the first time in this place, is not open to the objections which are justly urged against our present methods of inhumation: that it is in accordance with the latest teachings of Science in this direction, and that it will serve to increase and not diminish the tender love and reverence for the dead, which has steadily grown with all that is most excellent and beautiful in poetry and religion.

THE EFFECTIVE POWER OF TURBINE WATER WHEELS.

The failure of turbine water wheels to supply the amount of power expected is not less common than that of steam engines, and the causes are more numerous. Before purchasing turbines, it is necessary to ascertain the head of water available, and that there is an abundant supply; after which large allowance should be made for the friction of shafting, as well as for the power necessary to drive the special machinery, and thewhole determined in horse power. The selection of a wheel then becomes necessary. There are legions of makers, each of which is ready to warrant his to be the best wheel made. All of them publish artistic tables of sizes and powers, always guaranteed reliable. The uninitiated purchaser usually procures many of these tables, having voluminous descriptions and letters of commendation attached; and on examining them, he is surprised at the elaborate displays of figures, and often loses himself in contemplating the accuracy of the decimals. When comparing the tables of the various makers, he wonders why there is such uniformity of high powers in wheels so different. In studying the details, he finds that Smith's Excelsior Concave Fluted Turbine of forty-eight inches diameter will give him 84·71 horse power; while Jones' Scroll Flanged Buggy Wheel of the same diameter is fully warranted to yield 85·97, that being a gain in favor of Jones of 1·26 horse power, besides the further advantage of running with or against the sun, as desired. In continuing his comparisons to other wheels, it is needless to say that he becomes bewildered among so many wheels so far excelling each other, and finds himself unable to decide which wheel is the best. He is forced to seek the advice of some competent engineer, and, to his utter astonishment, learns that the figures of the tables so nicely prepared are in almost all cases totally unreliable, there being scarcely a maker's wheel that, in a test flume, under the most favorable circumstances, ever for a single hour indicated the the power claimed, and almost none that in actual use approach the figures, many of them scarcely yielding half what is claimed. Under these circumstances, it becomes important, in selecting a good wheel, to be assured that it will furnish ample power. After ascertaining a reliable maker, in order to determine the exact size of the wheel it is necessary that at least one third should be allowed for variations in water levels, and for the loss consequent to the wear of wheels and gates; and, in addition, figures should be made, based on but a little more than a half gate of water to the wheel. The best wheels afford almost all of their power at a five eighths gate or under, and a difference between a half and full gate is not more than should be the margin necessary to regulate speed. In use it will be found that opening gates seven eighths or fully simply amounts to a large consumption of water, generally without producing five or ten per cent additional power. Some good wheels give less power when at full than at part gates. The rule should be to buy a wheel amply sufficient at about half gate, due allowance being also made for over estimate of power. We think the experience of all who have placed wheels with a less liberal allowance will bear out and confirm this rule. Allowing one fourth for the friction of the shafting of a cotton or woolen mill, without adding one third more for a reserve when in actual use, will scarcely fail to cause a manufacturer to wish that he had bought a larger wheel. Actual tests, accurately conducted, of thirty-one styles of turbines show the comparative range of effective force, under the best possible advantages, to be as follows: At quarter gate, from 13 to 50 per cent; half gate, from 11 to 71 per cent; three quarter gate, from 31 to 82 per cent, and at full gate, from 52 to 84 per cent, the best wheels giving out about all of their power at from five eighths to three quarters openings; while the lower classes give but little power unless flooded with water, and even then fall far short of the amount claimed for them. Another reason why large wheels should be used is that, almost universally, high and low points of the head and tail waters so reduce the force of wheels as to cause partial stoppages of machinery, unless there is surplus power when the water is at the ordinary stage. We are acquainted with a mill using ten independent turbines of various styles. Experience has here shown practically that the relative power of the wheels, to that necessary to drive the machinery under constantly occurring unavoidable disadvantages, has not been unduly stated, and that not meager allowances should be made as reductions from makers' over-estimates of the powers of their wheels, as well as farther liberal allowances for the friction of the shafting, loss of power in times of high and low water, and the margin necessary for the action of the governors. It has also been found true here that substituting large wheels, operating at from one fourth to one half gate, for small wheels, requiring seven eighth gates, results in the use of much less water for a given effect. Were wheels accurately tested in places of use, and actual power ascertained, such large fractions of allowances would not be necessary; and a less rate of proportion between that wanted and that claimed by makers is accordingly found satisfactory with wheels where such claims are based upon tests. It will always be found to be by far the most economical, with both steam and water, to provide abundance of motive power.

ARMY ANTS.

It is a suggestive circumstance that, among the many varieties of animal forms, those which approach man most nearly in social and mental development are not his nearest allies, but creatures of an entirely different order, and those which stand at the head of their class, the articulates, as man does at the head of the vertebrates.

The closeness of formic mimicry of human civilizations is all the more surprising when we take into account the vast difference between the physical conditions of the two types of life. With nothing apparently in common, not even similarity of structure, men and ants have fallen into lines of development so nearly parallel in many instances as to suggest the existence of something far more imperative in the tendencies of life, and at the same time a much greater limitation in the possibilities of development, than are commonly suspected. Especially to those who regard mind as an unmixed product of material conditions, and would measure mental power by weight of brain, nothing can be more perplexing than to see the almost microscopic cerebral ganglia of the ant evolving products so like those of the immensely more bulky brain of man that their practical identity is unquestionable.

But our purpose is not to study the mystery of formic intelligence in general, but the peculiar manifestations of it by certain species whose modes of life have been recently investigated.

As a general thing, ants are found in settled communities, which change their habitations rarely, and then for causes not under their control. A remarkable exception to this rule is found in the *ecitons*, or army ants of Central America. These, while existing in thoroughly organized communities, numbering myriads if not millions, never make permanent settlements, but are constantly roaming about the forests in vast multitudes, scourging the insect world as the migrating armies of Attila scourged the less warlike nations of Europe.

The traveler's attention is usually called to one of these predatory swarms by the twittering of birds which follow their course to feast on the flying insects which they scare up. Approaching, he will discover a dense body of ants, in a column three or four yards wide and of enormous length, moving rapidly and examining every nook and corner where their game may hide. The captured insects are speedily torn to pieces and carried to the rear, or to their temporary camp, by relays of workers. On the flanks and in advance of the main army, smaller columns of skirmishers are thrown out to flush the insects they are in pursuit of, many of which, in their terror, bound right into the midst of the main column, to be torn to pieces instantly. The greatest catches occur in masses of brushwood. Here the cockroaches, grasshoppers, spiders and other insects take refuge among the branches, while the ants are occupying the ground below. But their security is brief. In a little while explorers are sent up, following every branch and driving the refugees to the ends of the twigs, to fly into the air and be snapped up by the birds, or drop among the throng of ants below. In this dilemma the spiders alone have any means of escape; they can suspend themselves in mid-air and remain in safety until their enemies have retired from the bushes and passed on to other conquests.

The individuals of this species of ants (*eciton predator*) are of various sizes, the largest being about a quarter of an inch long, the smallest less than an eighth of an inch. A much larger variety (*eciton hamata*) pursue their prey in a similar manner, but vary their tactics somewhat as occasion demands. When on a general hunt, they spread their columns over a considerable breadth and sweep everything before them, crickets, grasshoppers, scorpions, centipedes, woodlice, cockroaches, and spiders falling almost certain prey. Exploring parties are also sent up trees to look for nests of bees, wasps, and probably birds. The moment a prize is found the fact is reported to the army below, and a column is sent up to take possession. Mr. Belt, to whom we are indebted for these observations, and whose "Naturalist in Nicaragua" gives more numerous and valuable additions to the science of natural history than any book of travel since Wallace published the "Malay Archipelago," describes these ants as pulling out the larvæ and pupæ from the cells of a large wasp's nest, while the owners were hovering about, powerless, from the multitude of their invaders, to render any protection to their young.

When hunting in solid columns, these ecitons were found to be generally, if not always, in search of the young of another species of ants (*hypoclinea*) which make their nests in fallen timber. When a log is found, the column spreads out over it, searching all the holes and cracks, the smallest individuals pursuing the unfortunate hypoclineas to the furthest ramifications of their nests. The invaded ants rush out bearing their young in their jaws, and are despoiled of them so quickly that it is quite impossible to see how it is done. The ecitons do not harm the mature hypoclineas, caring only for the larvæ and pupæ, which are hastily borne to the rear of their column. What they do with their plunder finally does not appear. It would seem that they cannot rear the young hypoclineas for slaves, as certain northern ants do with their prey, since no mention is made of any such addition to the membership of their communities.

When marching, these eciton armies appear to be directed by numbers of individuals, of a larger size and a lighter color than the regular workers, scattered at intervals of two or three yards. They stop often, and occasionally run back a little and touch some of the other ants with their antennæ, as though giving orders. At the headquarters there are individuals of still greater size and more ferocious aspect, which soon make any one molesting the nest acquainted with the efficiency of their enormous jaws. The temporary resting places of these ants are usually in hollow trees or underneath large fallen trunks that offer suitable hollows. One which Mr. Belt found in a hollow log, open at the side, must have contained a cubic yard of ants clustered in a dense mass, like a swarm of bees. And these were but a part of the whole community, as many columns were outside, some bringing in the pupæ of other ants, others the legs and dissected bodies of insects captured on their foray. These incomers proceeded directly into the interior of the living mass through tubular passages, which were kept open just as though it were formed of inorganic materials. Like the hunting races of mankind, these predatory swarms are compelled to make frequent removals to new hunting grounds. The migratory columns are easily known by all the common workers moving in one direction, the larvæ and pupæ of the community being carefully carried in their jaws.

Many observations and experiments were made by Mr. Belt, testing the individual intelligence of these wonderful creatures. Though inferior in some respects to ants which hunt singly, he does not hesitate to place them at the head of their order for intellectual and social development.

SCIENTIFIC AND PRACTICAL INFORMATION.

STEAM LIFE BOATS.

Mr. H. G. A. Mitzlaff, in a paper read before the Institute of Naval Architects, proposes the use of steam in life boats, and suggests the hydraulic propeller or rotary pump as best adapted for propulsion. He proposes the following dimensions for such boats: Length 45 feet, breadth 11 feet, draft 3 feet. The boat is provided with airtight chambers to prevent sinking.

THE HEAT OF THE SUN.

Father Secchi, the distinguished Italian astronomer, has recently published the result of his investigations in the solar temperature, made during last summer, and states that his efforts were directed toward the determination of the relation of the solar radiation with that of the electric light. The instrument used was a thermo-heliometer of the investigator's own invention, and the conclusion reached was that the radiation of the sun would be 36¼ times that of the carbon points. If, therefore, the temperature at the surface of the latter is fixed at 5,432° Fah., a number not exaggerated, and supposing the radiation proportional to the temperature, we obtain for the potential temperature of the sun 240·836° Fah.

ELECTRICAL FIGURES UPON CONDUCTORS.

M. Schneebeli has investigated the conditions on which depend the dimensions of Kundt's electrical figures, which result from the adherence of a fine isolating powder on a metallic conductor, from which a discharge is emitted. In the experiments, the discharge of a Leyden jar took place between a horizontal metallic plate sprinkled with lycopodium and an electrode in the form of a ball or cone above the plate. It was found that, the circumstances being equal, the diameter of the figure augmented with the distance from the electrode to the plate, but never in a constant ratio. The size of the figure augments also with the quantity of electricity which produces it. When the electrode is composed of a certain number of points, a regular circular figure is formed beneath each one. If in the path of the discharge a small plate of glass be introduced, a space clear of powder appears on the metal plate of exactly the form of the glass plate interposed. With electrodes of conical form, present ing an angle of 60° or 30°, it is stated that the electrical figure is larger as the angle at the summit of the cone is smaller. Finally, the diameter of the electrical figure is larger when the discharge takes place in a rarefied gas than at normal atmospheric pressure.

JAPANESE BRONZE.

A curious bronze is produced in Japan, which, when made in thin plates, resembles slate, and is covered with designs in silver. M. Morin has lately analyzed and examined the properties of the alloy, and finds that it contains, in addition to copper, from 4 to 5 per cent of tin, and on an average 10 per cent of lead. The combination is easily molded into thin plates. These are varnished, and through the covering the designs are scratched with a burin. The plate is then plunged in a silver bath, when the silver is deposited on the unprotected portions. Lastly, it is placed in a muffle furnace, when the copper blackens and the silver remains bright.

CURIOUS PHENOMENON OF ENDOSMOSIS.

If the membrane which lines the interior of an egg shell be used to close the tube of an endosmometer, the latter being filled with sugar and water, and its containing vase with pure water, an odd circumstance will be noted. If the external surface of the membrane is toward the pure water, endosmosis is very rapid, and the water rises at the rate of some 4 inches per hour. But if, on the contrary, the interior surface is turned to the water, the phenomenon is almost annihilated. Matteuci, is appears, has noticed a somewhat similar peculiarity in the skin of a frog. It would seem that the phenomenon is worthy of study, since it shows that a liquid does not traverse the interior of a cellule with the same facility outwards as in the contrary direction.