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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF
THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 57.

For the Week ending February 3, 1877.

SOME SUGGESTIONS FOR FUTURE POLAR EXPEDITIONS

Of the numerous suggestions for reaching the north pole, which the failure of the recent English expedition to attain that goal has elicited, there are two which, apparently more than any of the others, have attracted public attention. The first is that, to cross the palæocrystic sea, which, by reason of its very irregular surface, Captain Nares pronounces impassible by any known means of sledge or like conveyance, balloons may possibly be utilized. The second contemplates the establishment of an arctic station, at as high a latitude as may be practicable, which shall serve as a basis of operations by a party who shall there take up a permanent residence until the object of the enterprise is accomplished. It is expected that, by this last plan, men can be acclimated, so to speak, to the intense cold, the absence of light for long periods, the deprivation of vegetable food, and other hardships of the polar regions; and they may be thus rendered less likely to be baffled by obstacles which have determined the failure of most previous expeditions. A project substantially similar to this is, we understand, already before Congress; and an appropriation of $50,000, and the ordering of government officers and vessels to the duty is proposed.

The objections urged against the balloon project are, first, that the natural phenomena of cold, etc., would probably act upon the gas, or the envelope material of the air ship, and determine conditions unfavorable to its continued buoyancy; and secondly that, as balloons cannot be steered, the voyagers might find themselves carried anywhere but in the right direction; and that, in case of the balloon failing and compelling their descent far away from their base of supplies, their perishing would be a certainty. We allude to this plan simply because it is open to modification in a manner which we shall point out further on. We have first to suggest a possible improvement on the fixed station scheme.

We do not see the necessity of educating a band of men to dwell under adverse conditions as proposed, when the most that will be required, of all but the leaders, is physical work and endurance; and most especially when the people already fitted by nature for arctic life are at hand on the spot. In other words, we think that it would be much more practicable to engage a number of Esquimaux, bring them South, and educate them up to a point equal to that of the working white men, who would be otherwise employed as pioneers, hunters, sledge haulers, etc. We would teach them the object of the enterprise, and place them under the officers—of course white men—who would furnish the brains, and under whose government the work would be conducted.

It may be argued that the Esquimaux cannot be taught properly to serve the interests of such an expedition. Experience shows to the contrary. They are an intelligent people, and there is not an arctic explorer but can testify to the material aid which they have rendered. Hall and others who have dwelt among them state that they are quick to learn; and as an instance, Hall mentions that he found no difficulty in teaching them the intricate game of chess. They are the only people that can live in the land of no wood. Peschel, in his new work on "The Races of Man," says: "They have found out how to build huts of snow as quickly as tropical natives build them of branches and leaves: nay, they have constructed arched vaults of stone, which had not occurred to any of the civilized people of Mexico." The same authority, summing up their achievements, tells how they warm their huts with train oil lamps, how they invented sledges, and utilized the dog as a draught animal: "while in America, the most advanced stage of such art was to be found only among the Incas of Peru, who used llamas as beasts of burden, though not as draught animals." "Like assistants in the darkness," adds Peschel, "appear beings of our species whose cheerfulness is unaffected by cold and obscurity, and who contentedly wander and range over regions in which Nature seems armed with all the horrors of one of the circles in Dante's hell." We need not recall the invaluable services of Esquimaux Joe in sustaining the sailors of the Polaris on their voyage on the ice floe, or the many instances in which the narratives of arctic explorers quote the value of his people as guides, as proofs of the fidelity of the race.

The expense of maintenance of a party of Esquimaux, with white men as leaders, would clearly be less than that of a party of white men alone. It will further be evident that to dispatch Esquimaux in balloons would be a different matter from sending other people, because, no matter where the balloons might come down, unless in the open sea, the travellers, being used to shift for themselves, would be as much at home as anywhere else. And they would thus be able to support themselves, and also the single white man who might go with them in command. But—supposing of course it be possible to make the gas and the envelope of the balloon withstand the climate—it does not seem to us that high-flying, wind-driven balloons are the proper means to be employed. While any balloon system is open to objections, the low-flying balloon, just capable of lifting one man off his feet so that he can propel himself over the surface with a pole, and by the same means cause his balloon to jump over high obstacles, appears to be the most promising means of locomotion for traversing the palæocrystic sea. A party starting would, therefore, go in as many balloons as there were individuals; and the chances of failure of all the air ships would be materially less than if the expedition travelled in a single large balloon; while there would be the additional advantages of strength of fabric, easy handling, and possibility of stopping during adverse winds by merely mooring the air ships without discharging gas.

MIND READING AND CONJURORS.

We have recently witnessed two exhibitions of the alleged abnormal power of second sight, or, what amounts to the same thing, mind reading. One was the performance of Mr. J. R. Brown, who has acquired considerable reputation as a mind reader. His exhibition consisted in experiments intended to prove the existence of a genuine phenomenal faculty whereby he reads the thoughts of other people. The second was the exhibition of Mr. Robert Heller, the well known conjuror, and his assistant, Miss Heller, wherein the lady, blindfolded, ostensibly saw and described articles not visible to her, but known to the conjuror and his audience. The reader will observe the distinction. Brown seeks to prove a supernatural power by curious experiments. Heller, likewise, performs equally curious experiments, but candidly avows them to be part of his programme of illusions—in short, neatly executed tricks.

Mr. Brown's so-called manifestations have an advantage over those of spiritualistic and other wonder-working mediums, in that they are reared on a small basis of actual fact. And it is just this modicum of reality which has commended them to college professors and others seeking the solution of many perplexing biological problems. At the same time, the phenomenal nature of the mind reader's apparent power has secured for him a host of adherents from the ranks of those whose peculiarly framed intellects are always ready to believe anything which rises above the level of their comprehensions to be superhuman. Mr. Brown's ability seems to consist in an exceedingly delicate sense of feeling, doubtless cultivated by long practice; he is also endowed with quick perceptive powers, likewise trained, and possesses a sensitive nervous organization. By the aid of these not at all phenomenal powers, he is enabled to detect the involuntary changes either of the pulse, or the breathing, or in the muscles in the person with whom he is in contact. It is an old and well proved fact that a person who has performed any secretive action, which is on the verge of discovery by another, will infallibly and involuntarily indicate the fact by some such bodily motion as above noted. This mental peculiarity is constantly taken advantage of in the cross examination of witnesses in courts, and by detectives in seeking to fix proof of guilt on criminals. Guilty individuals will usually betray themselves by their physical behavior; thus their actions are carefully scrutinized. Nothing is better understood than that the mind strongly affects the body: witness the actions of blushing, becoming pale, trembling, weeping, and laughing, all of which are involuntary, betraying even to the dullest observer the sentiments of the person affected. Deaf mutes can catch the meaning of persons conversing with them by the merest shades of change in countenance; and nothing shows more clearly how the perceptive powers may in this respect be developed than the fact that the deaf mute has long since ceased the constant spelling of words with his fingers, and has substituted, in an immense number of cases, slight symbolical signs with the hands, movements of the body, and facial expressions, which fully convey the ideas. We might multiply instances, all showing that Mr. Brown's mind-reading faculty consists in a keen perceptive faculty rather than in any supernatural mental qualification. Examples of this ability exist in deaf, dumb, and blind persons, who communicate with each other by touch of fingers. But sufficient has been suggested to account for Mr. Brown's ability to find hidden articles while grasping the hand of the concealer.

As the foregoing negatives the idea of any superhuman power, it will be seen that the mind reader and the conjuror practice their arts by similar means; and on comparing them we do not hesitate to say that Mr. Heller's tricks are immeasurably more mysterious than Mr. Brown's. Eliminating the idea of jugglery altogether, it is evident that, for Mr. Heller's lady assistant to name articles touched by him at random, requires on her part a wonderful exercise of the memory, to return the exact answer called for by the peculiar form of question; and on the other hand an equally marvellous celerity of thought is necessary on the part of the conjuror to frame exactly the proper question to convey the information to his blindfolded assistant without a moment's hesitation. Robert Houdin, in his "Memoirs," explains the immense labor involved in two persons thus learning what amounts to a new language, the intricacy of which is shown from the fact that the conjuror repeatedly asks questions which convey to his assistant the ideas of phonetic syllables, which the latter links together to form the names of persons designated.

THE COST OF THE EAST RIVER BRIDGE.

It is a curious fact that, in the construction of great public works in this State, the original estimates of the architects or engineers are uniformly exceeded. The two largest structures now in progress, the State capitol at Albany and the East river bridge, are both instances of the truth of the above. The capitol is, on paper, an imposing palace, covered with ornamentation of the most elaborate and expensive description. Its original estimated cost (some $4,000,000) has already been far exceeded, and yet the building is not half finished. Indeed, so great, it is now said, will be the additional expense that it is seriously proposed to abandon the work rather than tax the people for the necessary outlay. Regarding the East river bridge, the cost first estimated by Colonel Roebling, in 1868, was $7,000,000, exclusive of the land. After this engineer's death, his son, Mr. W. A. Roebling, succeeded to the supervision; and he, in 1872, three years after the work was begun, revised his father's estimate

and added about $1,000,000 more. He stated, however, at the time that the probable total cost would be about $9,500,000, an increase of size of the work having raised the expense some 8 per cent. That even this estimate was too low was proved in 1875, when the directors sought and obtained an appropriation, raising the sum to $13,000,000. Up to the present time, $6,000,000 has been expended, for which we have to show two anchorages, two completed towers, and the connecting wires across the river. There are yet the wire and superstructures, additional stone and masonry, land and labor, to be paid for, the total outlay for which, according to estimates obtained by the New York *Sun*, will swell the entire cost to $17,569,000.

It will be interesting to compare this with the cost of tunnelling. The clear span of the bridge across the river measures 1,595 feet; so that for the actual means of transit, the cost is about $11,015 per foot. Even measuring from anchorage to anchorage, a distance of 3,475 feet, the cost reaches $5,056 per foot. Let us contrast these figures first with those shown in the results of submarine tunnelling. The first Chicago waterworks tunnel, 5 feet in diameter and two miles in length, cost $457,844, or some $43 per foot; the second bore, 7 feet in diameter and of the same length, about $39 per foot. These are of course too small for traffic purposes, but may be quoted to aid us in reaching an idea of relative cost. The Thames tunnel can hardly be used for comparative purposes, since it was the forerunner of submarine excavation, and was worked upon over a period of some 36 years. Its total cost was $2,000 per foot. Lately a very heavy tunnel belonging to the London Underground Railway has been finished under the London Docks. The work was exceedingly difficult, and the quantity of water to be pumped out enormous. The final cost was £390,000 per mile, or about $369 per foot. Lastly, we have the estimates of the English channel tunnel, 31 miles in length, which amount to $20,000,000, or about $122 per foot.

Now we may glance at land tunnels. The Mont Cenis tunnel cost about $300 per lineal foot, inclusive of equipment of road, etc.; the Kilsby (England) double track railroad tunnel, in the construction of which great difficulties in the form of quicksands were encountered, $262.50; the Hoosac tunnel, $300; Underground Railway, Fourth avenue, New York city, $285; Bletchingly (England) double track tunnel, $120; the very difficult Hauenstein tunnel between Basle and Berne, Switzerland, $133; the contract price of the St. Gothard tunnel now in progress is £1,896,945, or about $189 per foot. Many more examples might be given, but the above will suffice to show that in all probability $350 per lineal foot would be a large estimate for a tunnel under the East river. Supposing for the sake of comparison that the total length of excavation be equal to the total length of the bridge, 3,475 feet (it obviously would be much less), its cost would be, at the above figures, some $1,200,000. Consequently, for the sum now estimated as the probable cost of the bridge, New York might have at least fourteen tunnels crossing the river at as many principal streets.

Meanwhile the success of the bridge as an engineering work is by no means assured; nor is it certain that the estimate of $17,569,000 will not still further be exceeded. The distance from the pier to the City Hall terminus on the New York side is 2,381 feet; on the Brooklyn side the distance from tower to terminus is 1,881 feet. The whole aggregates 660,000 square feet, or some 200 city lots, largely covered with buildings, to which title must be acquired. The estimate given fixes $25,000 each for the lots; but in cities where real estate fluctuates so greatly as in New York and Brooklyn, it must be clear that any such calculation is merely an approximation.

Again—and we cannot gainsay the wisdom of the conclusion—the Board of Directors of the bridge are strongly opposed to take any risk of inferior material on account of an apparent economy in its cost. It has been a question for some time past whether the cables shall be made of Bessemer and open hearth steel, or crucible cast steel only. There appeared from the engineer's report a saving of some $250,000 to be effected by the use of the former. Thus the Roeblings offered crucible steel at 9 cents per lb. gold, or for $612,000, and Bessemer steel at 6¾ cents, or $459,000 in all. The strain withstood by each, per square inch of section, was respectively 179,019 lbs. and 178,163 lbs.

Mr. Abram S. Hewitt, in a letter to the Board referring to Bessemer steel, said: "The peculiarity of that material is that it is apt to have weak spots of which there is no external indication. This is probably due to the enclosure of bubbles of air in the mass, or possibly to the oxidation of minute particles of the material while the air is being driven into it under high pressure. No amount of visual inspection can determine in what part of the ingot, the rod, or strand of wire, such defects will occur, and I have seen Bessemer rods break under apparently very inadequate strain." Finally, the Board, after carefully considering the question, concluded not to use Bessemer steel—and this even after proposals for the same had been invited—and awarded the contract to supply crucible cast steel wire to Mr. J. Lloyd Haigh (he being the lowest bidder), at the price of $8\frac{7}{10}$ cents gold per pound.

We said, nearly five years ago, that the probable cost of the East river bridge would be $20,000,000. At present the indications are that our prediction will be realized; and judging by the rate of increase in previous years during the progress of the work, even the large sum we named may be insufficient to cover the actual cost of constructing the bridge.

THE MIGRATIONS AND DISPERSAL OF ANIMALS.

One of the most important considerations in studying the past history of the earth, as shown by the distribution of animals, is that which leads us to examine, first, what means animals of every class have for dispersal, and second, what barriers Nature interposes to prevent the same. It is a necessary part of the great struggle for existence, which pervades all life, that the creature shall encounter not merely active enemies but passive ones: not merely those which directly threaten its existence, but those which prevent its self-maintenance by cutting off its access to the necessary means of so doing: and against these last the organism is often compelled by force of necessity to oppose itself. Animals, even those which breed most slowly, increase with a rapidity out of all proportion to the available food in any specified district which they may inhabit; and therefore all are obliged to struggle against the obstacles which prevent them wandering in search of fresh hunting grounds or pastures.

Whether a certain natural phenomenon is or is not a barrier to further dispersion depends very greatly upon the class of animals inhabitating the region which it limits. Thus the elephant will climb the loftiest peaks and mountains, traverse rivers, and range the densest forests; the tiger can endure the widest extremes of heat and cold, and can swim moderate distances; but on the other hand, the monkeys, for example, must remain within the limits of forest vegetation, while the antelopes and zebras cannot exist otherwise than on the deserts.

Mr. Alfred Wallace, in his "Geographical Distribution of Animals," the underlying theory of which work we recently reviewed, devotes some very interesting pages to the above topic, considering in some detail the various obstacles to animal emigration. Climate seems to be a potent boundary to the travels of mammals, as there are such animals as the polar bear and walrus, which cannot live, in a state of nature, far beyond the polar ocean. But it is believed that it is not so much the climate itself as the change of vegetation consequent on climate which renders it effective as a barrier. It appears that valleys and rivers are often insurmountable obstacles, as animals which naturally exist on hills would be checked by the difference of vegetation and of insect life, and also by the unhealthy atmosphere often found in valleys. An arm of the sea over twenty miles wide cannot be traversed by land animals, by swimming; but on the other hand, long voyages are often made by mammals that are involuntary passengers on uprooted trees and ice floes. Bats and the cetacea have exceptional means of dispersal. The latter, however, find themselves opposed by temperature, as the polar species cannot cross the equator, nor can those indigenous to the tropics venture into the cold polar waters.

It would seem that no barrier could limit the range of birds, and that consequently they must be the most ubiquitous of living things; but this is far from being the case. The petrels and gulls are the greatest wanderers over the ocean, and the sandpipers and plovers roam over immense extents of coasts; but there are many species which are wholly checked by natural obstacles. The ocean presents an almost absolute barrier to prevent the birds of one continent passing over to another. Large numbers of birds cannot exist outside the forest countries; others cannot soar above the mountain ranges which bound their inhabited region. Again, the prevalence of their enemies is a potent barrier to birds dwelling in or crossing any region; and where nest-hunting quadrupeds, such as monkeys, abound, they are comparatively scarce.

We now reach that very interesting phenomenon known as migration; and here must be drawn a distinction between the true migrations of fishes and birds and the periodical movements of certain mammalia. Thus, in summer, monkeys ascend the Himalayas to heights of 10,000 and 12,000 feet; in dry seasons antelopes move southward toward the Cape of Good Hope. These differ from the great movements of fishes and birds, since such take place in large bodies and often to considerable distances. Migration may be looked upon as an exaggeration of a habit, common to all locomotive animals, of moving about in search of food; and in birds, it is especially exaggerated by their powers of flight and the necessity of providing soft insect food for their unfledged young. In North America, every grade of migration is found, from that peculiar to species which merely shift the limits of their range a few hundred miles (so that in the central parts of the area the species is a permanent resident), to others which move completely over 1,000 miles of latitude. So that, in all the intervening districts, such species are only known as birds of passage. There are many curious facts peculiar to migration, notably that of birds returning, year after year, to build nests in the same spot: a local attachment which prevents their wandering into localities unsuitable for them. Also that the old birds migrate first, the young following at random. This indicates the absence of imperative instinct in the habit, and it also accounts for the diminution in numbers of the young that return. On the succeeding year, however, the young profit by their experience, and fly when the old birds do. Another curious fact, however, in favor of instinct, is that "agitation" of caged birds at the time when their wild companions are migrating. This, however, Mr. Wallace considers to be due to a social excitement, due to the anxious cries of the migrating birds, and to be ascribable to some strong social emotion, gradually developed in the race by the circumstance that all who, for want of such emotion, did not join their fellows inevitably perished. The long flights of some birds, without apparently stopping on the way, is thought to be inexplicable, as well as their finding their nesting place of the previous year from a distance of many hundreds or even a thousand miles. But the observant powers of animals are very great; and birds flying in the air may be guided by the physical features of the country, spread out beneath them, in a way that would be impracticable to purely terrestrial animals.

Reptiles are scarcely more fitted for traversing seas than mammals; but lizards evidently possess some unknown means, probably while they are in the egg state, of passing the ocean, since they are found to inhabit many islands where there are neither mammals nor snakes. Fishes are not without means of dispersal over land. Some are carried through the air by hurricanes; those living in subterranean waters have been thrown up by volcanoes. Geese and ducks often eat fish eggs without impairing the vitality of the same, carrying them meanwhile over long distances. Molluscs often attach themselves to animals or to fragments of wood and stone, and so are transported.

Winged insects possess more varied means of dispersal than any other highly organized animals. Many fly to immense distances; others are carried off by storms; and the floating trees which serve as rafts for mammals are the homes of myriads. Immense numbers of tropical insects are brought to the London docks in foreign woods; and they have often emerged from furniture, after lying dormant for many years. They will survive wonderfully hard usage. Many species can withstand hours of submersion in strong spirit; others can go for months without food.

But on the other hand, wide as is the distribution of insects, the barriers opposed to the same are equally great. Hundreds of species of *lepidoptera* can subsist, in the larval state, only on one species of plant; so that, on perfect insects being carried to a new country, the existence of the race would depend on the presence of the same or of some closely allied plant. Again, some require succulent vegetable food all the year round, and hence are confined to the tropics; some are dependent on water plants, some on mountain vegetation. Many are parasites of other insects; all have enemies in every stage of their existence; and the abundance of any one of these may render their survival impossible in a country otherwise well suited to them.

We have thus briefly reviewed the means which animals have for their dispersal about the globe, and the barriers which Nature has interposed to limit their wanderings. What effect these obstacles have exerted in determining the present distribution of animals, we shall consider in a future article drawn from the same source.

THE CAUSE OF THE DELAY IN ISSUING THE PATENTS.

We are in receipt of numerous letters from inventors, inquiring the cause of the delay on the part of the Patent Office in forwarding their patents, and also calling our attention to the fact that notices of their inventions have not appeared in these columns. In reply to all, we would state that, for the last two months, the Patent Office has encountered considerable difficulty in having the photo-lithographic copies of the drawings prepared. The acting commissioner has issued a circular, which is forwarded to individual patentees, in which each is informed "that, on account of the imperfection of the photo-lithographic copy of the drawing which was to accompany the patent, the Office was compelled to return the drawing to the photo-lithographic company for reprint. As soon as a perfect drawing can be procured, the patent will be forwarded to your address."

As fast as we receive copies of the delayed patents, we shall prepare and publish the usual notices. The difficulty has now existed since October 31; and while a few patents of subsequent dates have reached us, the large majority have yet to come.

A Prepared Codfish Patent Litigation.

The patent of Mr. Elisha Crowell, under which he claims a royalty on all cod and other fish deprived of skin and bones and packed in boxes, etc., for transportation, is to be contested by the wholesale fish dealers of this city. Mr. Crowell has heretofore issued stamps, which the trade purchased and affixed to the boxes of fish, at the rate of ¼ cent per pound. The dealers now claim that this tax inflicts injury on their business, and that Mr. Crowell has no legal right to exact it. As a large number of merchants are associated in these legal proceedings, and as it is reported that other fish dealers throughout the country will co-operate with them, it is probable that Mr. Crowell's claims will be vigorously fought in the courts.

Six Tons of Gold.

Three million dollars in double-eagles recently arrived in this city on a Baltimore and Ohio railway car. The treasure, which weighed six tons, was brought overland from San Francisco, to be deposited in the New York Sub-Treasury. It filled fourteen iron safes, and was guarded by a squad of soldiers, and was in charge of eight Treasury Department clerks.

In our description of the Tomlinson axle box, on page 54, present volume of the SCIENTIFIC AMERICAN, the address of Mr. Tomlinson should have been: "Care of G. L. Kelty, 80 and 82 White street," instead of "C. L. Kelly," which was the name and address given in part of the edition.

Persons desiring further information may address Mr. Tomlinson as above, or Mr. James E. Crane, 76 Park Place, N. Y., or Wm. Knifton, Black Hawk, Gilpin county, Col.