

ing cards, he made, in all, 2,927 trials, and obtained 789 successes instead of 732, which is the number that chance alone would lead him to expect. The probability that the actual number of successes shall differ from the probable number in either direction by so much as 57 in 2,927 trials (by λ in s trials, say) is approximately, —

$$1 - \frac{2}{\sqrt{\pi}} \int_0^{\lambda} \sqrt{2pq} e^{-t^2} dt,$$

which gives in the present case $\frac{1}{70}$; that is to say, there is in reality one chance in seventy of so great a deviation arising by accident, while Richet would make it fifty in fifty-one.

We repeat that many of Mr. Richet's experiments are interesting, and the results very striking. It is a pity that they are not more effective than they are in placing the question of mental suggestion upon a scientific basis. CHRISTINE LADD FRANKLIN.

THE DIMENSIONS OF SHIPS.

I HAVE often thought, that, in practising the art of ship-building, men have too much neglected the study of the forms of the fish which make the waters their permanent habitation, and are designed for the most part to attain the highest degree of velocity in the pursuit of their prey. No doubt, the case of a ship partly, and that of a fish wholly, immersed, are not strictly parallel; but they offer very many points for comparison of which we may avail ourselves.

A fish makes use of its tail-fin as the chief and nearly sole instrument of propulsion; and, in the adoption of the screw-propeller in preference to the old side-wheels, the steamers of the present day have secured a great advantage over the old forms. In the proportion of length to those of breadth and depth, however, although there has of late been some improvement, there would appear to be a lingering tendency to hold by the old mistaken idea that a ship was rather to be regarded as a wedge to cut the water than as occupying the space of a wave of displacement; and so we have ships nine, ten, or even eleven times as long as broad, and twenty times the length that they have draught. Now, knowing as we do the magnitude of the skin-resistance in ships, and its smallness in the oily coats of fishes, one would expect that the length of the latter would be greater proportionally than that of the former, if ships were built in the proper form to secure a high velocity. But what is the fact? On an average of sixteen fresh-water fish delineated in Daniell, I find that the extreme length, inclusive of the tail-fin, is four and twenty-two hundredths times that of the extreme depth exclusive of the dorsal and ventral fins. The average breadth will be perhaps one-half of the depth, making the proportion to length about 1:8.

Abstract of a paper by Dr. J. P. JOULE, published in the Proceedings of the Manchester literary and philosophical society.

On an average of three species of whale, the narwhal, Greenland shark, dolphin, and the porpoise, I find from Scoresby and other authorities the proportion of either depth or breadth to length to be about 1:4.7, they having nearly circular sections. Therefore it appears, that, while in ships the proportion of length to width of midship immersion is 5:1, that of the shark, the porpoise, or dolphin, is not more than 1.5:1.

Dr. Scoresby, in his 'Arctic regions,' gives twelve miles per hour as the utmost speed of the whale; but Mr. Baxendell gives it a velocity approaching twenty miles. I had an opportunity of witnessing the wonderful swimming-powers of the porpoise during a voyage to the Clyde in the Owl steamer on the 29th of June last. About eight A.M., the sea being calm near the Mull of Galloway, we were beset by a shoal of these animals, which raced with the ship, and kept alongside for three or four minutes with the greatest ease. They swam in twos and threes, at a foot or two distant from one another, several approaching within ten feet of the vessel, which was steaming at the rate of thirteen and four-tenths statute miles per hour. If such a velocity can be maintained by the porpoise, with its comparatively bluff figure-head, we may surely expect a much higher velocity in the case of fish more obviously designed for speed.

My son tells me that in a voyage of the *Malvina* from Leith to London he had observed at night two fishes of about a yard long which kept for a considerable time in advance of the cutwater of the ship, being visible by their phosphorescent light. The ship was at the time steaming at the rate of fifteen and two-tenths statute miles per hour.

The investigation of the resistance of solids moving in fluids has been taken up theoretically by Thomson, Stokes, Rankine, and practically by Froude, who has found that the surface friction in long iron ships is more than fifty-eight per cent of the whole. Froude recognized the study of the forms of animal life in guiding us to practical conclusions.

From the above considerations, I am inclined to believe that a length of not more than five to one of breadth would be better than the extreme proportions of ships now in vogue, and that the greatest breadth should be considerably in advance of the midship.

RECENT TRAVELS IN ARABIA.

FROM the recently printed account of Mr. Charles Huber's mission in Arabia we cull some notes of general interest.

On an excursion to the great mountain Jebel Aga, the party camped at the entrance of the Tuarin valley, near the ruins of the little fortress El Asfar. Three palms grow here; and there is a little spring whose temperature, 75° F., indicates the heat of the soil and rock in this arid region. Around the ruins were traces of cultivation and abandoned wells. At a short distance the traveller was fortunate enough

to make the second known discovery of Himiarite inscriptions, of which there were nine. These were on a block of granite of enormous size, under whose shade travellers have refreshed themselves for many centuries, as these inscriptions, supposed to be more than two thousand years old, sufficiently indicate. They are accompanied by rude outlines of horsemen brandishing the sword and lance, precisely similar to sketches made in Huber's note-book by a living Arab chief at Hail. It is probable that the first Himiarites established themselves in the Tuarin valley on their southward migration. In the numerous revolutions which have devastated Arabia, it is probable that the valley has been many times depopulated.

Farther on, the party passed a singular rock, which, in falling from the crag, had perched itself on a granite mass by three sharp points. Being somewhat concave below, it resounds like a rather heavy bell to the strokes of a cane, — an infallible sign, according to the Arabs, of concealed treasures. Their camp, a few miles beyond, was in the midst of a remarkable ravine of a uniform width of about fifteen hundred feet, bordered by granite walls about nine hundred feet in height, presenting in the sun remarkable hues of red, violet, brown, and rose. The perfectly level sandy soil was of a peculiar rose color, and the impression conveyed was of a gigantic street newly swept and silent. Access to the Gou valley was obtained through a very narrow ravine encumbered with fallen blocks, hardly affording passage for a camel. Above this it enlarges into a circular plateau continued on the other side by a long boulevard of magnificent palms. The spot seemed a terrestrial paradise. Flocks of birds, so rare in this parched land, delighted the eye, and their songs broke the silence of the desert in a delightful manner. Vegetation was luxuriant and beautiful; and a flowing spring refreshed the party, though its temperature was not less than 82° F.

In travelling about the Jebel Aga, ascent was found practicable only in a very few places. The walls rise abruptly without foot-hills, and are of a gray, red, or reddish-brown granite of coarse grain composed of quartz, with large crystals of red and white felspar with grains of pegmatite. The dip of the beds is about 55° toward the horizon. The wind in this part of Arabia blows always from the west.

The road passing through the region of Jebel Selma, at no great distance from the Jebel Aga, traverses an isolated volcanic district, where the passage is often only wide enough for single file. Several craters, one twenty-five hundred feet across, still remain, and, though now safe for travellers, were formerly the fastnesses of Arab robbers, whose attacks made the region deserve, even more than its natural character, its Arabian name of Gehenna. Beyond, just where the grits replace the basaltic rocks, lies the little town of Feyd, containing some forty houses. Anciently this was a site of renown, for whose determination Ritter vainly spent many pages of discussion; but its splendor has departed. Around it, at no great distance, are scattered low hills of volcanic origin, in some of which the craters are still

evident. Water lies under a bed of basalt, very hard, and six or seven feet thick, covered with about thirty feet of sand and gravel. The wells, singularly enough, are connected by subterranean tunnels. This water, accessible only at the cost of so much labor, must be raised to water the palm-trees, and is reported to be gradually diminishing, to which the decay of the ancient city is probably due. The desert around Feyd is called Aba-el-Krüs.

Thence toward El Kehafah the path traverses a region of volcanic rock, which emerges from the surface on either hand in a singular manner. It looks as if the whole region had been once a boiling liquid lava which had been suddenly congealed, leaving solidified bubbles twenty-five to thirty-five feet in diameter, which appear at every step. A little sand is found here and there in crevices, with an occasional shrub growing in it; but apart from this, the desert is absolutely naked rock of indescribable desolation, — a corner of the real Arabia Petraea. The name of this waste is El Saráfah. In this region, according to the Arabs, there are some ten rainy days at the beginning of winter: the rest of the year is literally dry. Beyond Kehafah several small oases were seen of a singular geological structure, which is, however, common in the region. They consist of elliptical dish-like depressions, dipping slightly toward the north, their axes north-west and south-east, and about twenty-four kilometres in length by half as much in width. The margins of these basins are abruptly elevated, rocky walls, about thirty or forty feet in height. The wells pass through twelve or fifteen feet of gravel and rock, beneath which is water in abundance, but too bitter to be potable. Drinking-water is accessible in but two or three places. The road from Kehafah to 'Ayoum passes the boundary of the safe country, and enters the region of robber nomads. A singular rock, much resembling the sphinx in form, partly covered with illegible Himiarite and Arabic inscriptions, lies isolated near the route, and beyond a much smaller one, from which a few inscriptions could be transcribed. The inhabitants of this region are small, shrivelled, and sickly-looking, in strong contrast with the fine physique of the people of El Jebel, which the traveller had left. They are violent fanatics, from whom his safe return was fortunate. The mean temperature of the soil here was 84°; and during one day, with a hot wind, the thermometer rose to 122° F. in the shade.

STEAM ON STREET-RAILWAYS.

THE Hon. R. C. Parsons recently read a paper before the British institution of civil engineers, in which the progress of steam-locomotion on street-railways was very fully considered. It was asserted that very little success had attended the efforts made to introduce steam as a motor on the common highway, while the privileges accorded by special legislation to the street-railway companies have led to comparatively great success in that direction.

The British 'Board of trade' regulations have