

**WHY THE NEEDLE POINTS IN A NORTHERLY DIRECTION.**

Prof. Patterson, Superintendent of the United States Coast Survey, writes as follows in answer to an inquiry by a gentleman as to the reason why the needle points in a northerly direction :

DEAR SIR :—Your note is duly received, and in answer I beg to state that the reason why the needle points in the northerly direction is that the earth in itself is a magnet, attracting the magnetic needle as the ordinary magnets do ; and the earth is a magnet as the result of certain cosmical facts ; much affected by the action of the sun. These laws have periodicities, all of which have not as yet been determined.

The inherent and ultimate reason of the existence of any fact in nature, as gravity, light, heat, etc., is not known further than it is in harmony with all facts in nature. Even an earthquake is in perfect harmony with, and the direct resultant of the action of forces acting under general laws.

A condensed explanation in regard to the needle pointing to the northward and southward is as follows : The magnetic poles of the earth do not coincide with the geographical poles. The axis of rotation makes an angle of about  $23^{\circ}$ , with a line joining the former.

The northern magnetic pole is at present near the Arctic circle, on the meridian of Omaha. Hence the needle does not everywhere point to the astronomical north, and is constantly variable within certain limits. At San Francisco it points about  $17^{\circ}$  to the east of north, and at Calais, Maine, as much to the west.

At the northern magnetic pole a balanced needle points with its north end downwards in a plumb line. At San Francisco it dips about  $63^{\circ}$ , and at the southern magnetic pole the south end points directly down.

The action of the earth upon a magnetic needle at its surface is of about the same force as that of a hard steel magnet, 40 inches long, strongly magnetised, at a distance of one foot.

The foregoing is the accepted explanation of the fact that the needle points to the northward and southward. Of course no ultimate reason can be given for this natural any more than for any other observed fact in nature.

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**BENEFITS OF A TECHNICAL EDUCATION.**

At the inaugural lecture in connection with the City and Guilds Institute, of London, Professor Ayrton spoke lately of the improvement science can effect in the trades and in the condition of workmen, and, in the course of his remarks said : "It must sometimes have puzzled you to understand why a successful professional man, one who has no manual skill, no strength of limb, earns, by his work, so much money, and what is higher, so much fame. It must sometimes have struck you as, at the very least, rather hard that while you are toiling from morning to night, day after day, to gain only enough to live on, another, by the mere efforts of his thought, amasses a fortune. But you, no doubt, regard it as quite fair that a skilled mechanic should receive higher wages than a navvy. For you say that although he has eyes and arms like yourself, and is, perhaps, the stronger of the two, still you can use your powers with a skill of which he knows nothing. Now, just as he has muscular strength, which, when cultivated, means wealth to himself and his country, so, you have brain power, which only requires education to fit it to do useful work. But, you will say, am I not forgetting you have all been to school, and have received an education at least as good as is given in the board-schools. Consider, however, what is taught in these schools where masses have to be educated in there time to teach reflection, to foster the reasoning power ? Is there that training given you which should make you unwilling to follow any special routine method in your trade unless you are convinced it cannot be improved on ? And can you expect it to be otherwise when the boys and girls leave at twelve or thirteen years old, when the main object of the teacher who is paid by results, is to cram the young, until they are heavy enough to drop through the examining machine, when occasionally the teaching is necessarily confined to the three R's, solely because the government inspector finds that other subjects are—well, a little beyond his limited attainments. Again, what is the feeling boys and girls have at the national schools ? If they succeed in their lessons, they look forward to becoming pupil-teachers ; but if prizes do not fall to their share, they feel that teaching is not for them, and fall back on a trade ; but how very few, if any, ever look to their studies as a means of making them educated workmen, instead of mere copying machines. The consequence is that, when a lad is first apprenticed, he is merely an errand

boy, or fag ; being fit, in fact, for little else. Subsequently, he is posted in one of the departments of the manufactory, his instructor being the man under whom he works ; but this man man having his own work to attend to, has not time to teach ; and even were it not so, he could only show the manual operations. When the piece of work on which the apprentice has been engaged is finished, it has to pass the foreman of the department ; generally, a man who, through honesty, sobriety, and manipulative skill, has risen from the ranks of the workmen, and whose education has been of a character similar to those around him. The foreman's duties, of course, leave him no time, even if he were competent, to give instruction, and thus the lad goes on, probably working, quite mechanically, at only one small branch of his trade. In time, he becomes a journeyman ; he may become a foreman, to govern others. Thus the "rule of thumb," viz., each man working as his shopmates do, proceeds, and thus ignorance of principle has been carried on from one generation to another. And things go on remaining very much as they are, merely because we have never seen them otherwise.

THE NEW TAY BRIDGE.—The North British Railway Company have lodged the plans for the rebuilding of the Tay bridge, as required under the Parliamentary notices. The whole bridge, from shore to shore, has been reduced in height, so that over the middle of the fairway, where the high girders fell, the height of the girders above high-water mark, ordinary Spring tides, will be reduced from 88 feet to 57 feet. The spans in the southernmost portions of the bridge still remaining are not to be altered in width, but the 13 wide spans of 245 feet, which were in the centre of the bridge before it fell, are to be narrowed to about one-half the width by the introduction of additional piers. The first five 245-foot spans, counting from the south end of the present gap, are to be divided into 10 spans of 109 feet each, and will be at the height of 57 feet above high water, ordinary Spring tides. Between the fifth and sixth fallen piers there will be two spans 100 feet wide and 57 feet in height ; between the sixth and eighth fallen piers four openings 109 feet wide and 57 feet in height ; between the eighth and ninth fallen piers two spans 100 feet wide, and gradually falling in height from 57 feet to 54 feet 9 inches ; then from the ninth fallen piers to the first standing pier on the north side there will be eight openings 109 feet in width, and gradually falling in height from 54 feet 9 inches to 43 feet. The spans of the portion of the bridge still standing at the north end are not to be altered in width, but the girders are to be lowered to suit the falling gradient of the line toward the north shore, the height of the large bow-string girder being reduced to about 26 feet, and the similar girder over the esplanade to about 18 feet. It is not proposed to make a double-line bridge, but the new piers to be erected in the middle of the river will be of such a width as will be sufficient to carry a double line of rails should that be deemed necessary. As the result of the recent inquiry into the causes of the fall of the bridge, power will be asked to enable the company to stop the traffic from crossing the bridge when the weather may be too severe as to cause reasonable apprehension of danger.—*Pall Mall Gazette*.

TYNDALL'S DEFINITION OF THE BRAIN.—The human brain, according to Prof. Tyndall's recent definition, is the organised register of infinitely numerous experiences received during the evolution of life, or rather during the evolution of that series of organisms through which the human organism has been reached. The effect of the most uniform and frequent of these experiences has been successfully bequeathed, principal and interest, and have slowly mounted to that high intelligence which lies latent in the brain of the infant. Thus it happens, says Tyndall, that the European inherits from 20 to 30 cubic inches more of brain than the Papuan ; thus it happens that faculties, as of music, which scarcely exist in some inferior races, become congenial in those that are superior ; thus, too, it happens that out of savages unable to count up to the number of their fingers, and speaking a language containing only nouns and verbs, arise at length Newtons and Shakespeares.

DRILLING GLASS.—Stick a piece of stiff clay or putty on the part where you wish to make the hole. Make a hole in the putty the size you want the hole, reaching to the glass, of course. Into this hole pour a little molten lead, when, unless it is very thick glass, the piece will immediately drop out.

THE SOUTH AFRICAN DIAMOND FIELDS.—Advices received from Port Elizabeth state that the value of the diamonds exported from the South African diamond fields last year was £3,685,610, as compared with £3,084,711 in 1878.