ng, and 80,000 additional slips have recently been put in. At the end of two years the switches are cut and made into bunches like sheaves of wheat. The leaves and the bark contain the medicinal salicin. This substance crystallizes in plates, is white in color, not very soluble in water, and somewhat bitter to the taste. Like other bitters, it promotes the appetite, and aids digestion, and is regarded as an excellent tonic in some forms of dyspepsia. It is also largely used in the treatment of acute rheumatism, and to some extent in malarial fevers as a substitute for quinine. It is said that the willow switches, when dry, are worth two hundred dollars a ton. The leaves and bark are sold at the rate of twenty-five cents a pound.

— A young woman is said by a writer in the *Medical and surgical reporter* to have acquired the habit of eating roasted coffee, eating sometimes as much as half a pound a day, and continuing it for four months. She was very pale, sallow, and nervous; she had a weak pulse, impaired digestion, and got out of breath easily going up stairs.

— Professor Bystroff has recently examined 7,478 children in the schools of St. Petersburg, and finds that 11.6 per cent suffer from headache. He regards it as due to irritability of the brain, brought on by the excessive forcing of the education.

— The entire population of Germany, as enumerated in the quinquennial census of December last, is given at 46,840,587, an increase of 1,606,526 over that of 1880.

— The entire length of railroads of the world, up to the end of 1884, as recently published by the Prussian minister of public works, was 291,000 miles, an increase of twenty-seven per cent, or over sixty thousand miles, during the preceding five years. Of the entire length, very nearly one-half is that of the American railroads, mainly in the United States.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A contribution to the psychology of the polar bear (Ursus maritimus Lin.).

THE fact that bears occasionally create rotary currents in water by means of their paws, for the purpose of bringing floating objects within their reach, has several times been verified by different observers (Romanes' 'Animal intelligence,' New York, 1883, pp. 351, 352; Darwin's 'Descent of man,' New York, 1875, p. 76). Still, this act of bears has not been so often recorded as to render the present instance uninteresting.

In May, 1886, happening to be in Central park, New York city, I visited the bear-pit. This pit is divided through the centre by a partition of iron bars, black bears being confined on one side and two polar bears on the other. The water supply is furnished by an oblong basin about eight feet long by four or five wide, so placed that the above mentioned partition runs through its short axis. One of the polar bears was resting on the side of the basin, opposite to the front of the pit, with the side of his head snug against the partition, the body being stretched out alongside the margin of the basin, and his fore-paws hanging over its edge. In his fore-paws he had a portion of an ordinary walking-cane, about a foot and a half long, and from this he evidently derived, by playing with it in the water, a great deal of enjoyment. Let this bear be known as No. 1. The other bear, not being able to reach across the basin, nor to reach over the head to the fore paws of No. 1, and having no plaything of his own, was apparently highly discomfited. This discomfiture he manifested by his quick and uncertain turns around the pit, ever returning to the edge of the basin or the back of No. 1, there to again make an unsuccessful attempt to obtain the cane. Let this bear be known as No. 2.

An interested group of spectators had now collected, and one of them, out of sympathy for No. 2, threw him a small painted stick about eight inches long. This No. 2 immediately began playing with, taking it in his mouth and tossing it around in various directions. Finally the little bit of wood fell into the basin of water within reach of No. 1, who hastily appropriated it, much to the seeming chagrin of No. 2, — this bear once more becoming very restless and uneasy. The stick and the cane, however, were too much for No. 1 to manage, for in his maneuvres, seeming unnoticed of him, he lost his hold upon the stick, and it fell into the water. At once No. 2, who, at the time, was sitting on his haunches at the front side of the basin, appeared to comprehend this, and began pawing the water with the right and left paw alternately, thus creating a current in the water which brought the little piece of wood to him from the other side of the basin in about two minutes. Hastily taking it out of the water, No. 2 laid it on the edge of the basin, for in the mean time No. 1 had changed his hold on the cane in such a way that he confined it between his paw and the side of the basin at the water's level. His paw being at the very remote end of the cane, thrust partly through the bars into the black bear's side of the pit, the cane seemed to be free upon the water. No. 2 now went through the same motions as had secured him the small piece of wood. After keeping his exertions up for about one half-minute, he seemed to perceive that the cane did not move towards him: so careening his head around, he brought into full view the paw of No. 1, and appeared to comprehend that the cane passed between the paw of No. 1 and the basin wall, for instantly he stopped pawing the water, and went to playing with his own piece of wood.

Throughout this whole scene, it seemed to me that there occurred a notable change in the facial expression of each bear as he gained or lost a point. There was no evidence of anger; and while No. 2 was creating the water current, his face wore the impress of the most profound earnestness, which gave way, when the stick was obtained, to an expression of great elation, this in turn being replaced by an in-

tense look of cunning as he set about to obtain the cane.

First agreeing that the terms 'reflex action,' 'instinct,' and 'reason' shall be defined according to the definitions of Dr. Romanes ('Animal intelligence,' p. 17), the action, or series of actions, executed by No. 2 must have been, wholly or in part, either reflex, instinctive, or rational. If reflex, there must have been: —

(*a*) Particular and often recurring stimuli, to have given rise to the acts of No. 2; and also,

(*b*) The acts must have been adaptive, although not intentional.

Manifestly, these two prime conditions did not obtain, and therefore the acts of No. 2 were not reflex, either in whole or in part. If instinctive, then the acts of No. 2 must have been performed "without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species."

1° Had No. 2 ceased his current-making when he obtained the piece of wood, his act might possibly have been in part instinctive; but having obtained one object by this means, he seems to set the same cause in action to gain another object, which he conceives to be similarly conditioned, and when, apparently by new observations (data), finding that this second object is confined by a force greater than that which he can command by his water-current, he desists immediately from his exertions, it is evident that three several mental processes have occurred, to wit: —

(*a*) The employment of like causes to produce like effects.

(*b*) The exercise of a certain amount of memory (individual education by experience).

(*c*) The correct estimation of the difference in force, exerted upon the cane, between the water-current of his making and the confining power of his mate's paw, e. g., judgment.

2° By the conditions of our definition, it would be necessary, in order that these acts of No. 2 might be instinctive, that the same should be observed of the majority of polar bears when similarly conditioned. An appeal to facts shows that these acts are rarely executed by bears. Hence it follows that the said acts of No. 2 were not, either in part or in whole, instinctive. Finally, by the conditions of the proposition, these acts, being neither reflex nor instinctive, must be rational, or else did not take place, e. g., either reason must exist in certain bears of the polar species, or the mind of man must refuse to think of the acts of said bears. The only attempt at the vitiation of the foregoing argument is conceived to exist in the fact that it rests upon but one observation.

JAMES P. MARSH.

The eccentricity theory of the glacial period.

Croll's eccentricity theory of the glacial period is certainly an attractive theory. The ingenuity and learning of its author have merited and received universal respect. The proposal thus to link together by one additional tie the sciences of astronomy and geology, is in harmony with that profound sense of the unity of nature, which is a dominant sentiment in modern science. In utter despair of the possibility of constructing any reliable time estimates by measuring the amount of erosion or deposition, every geologist would gladly welcome the opportunity of importing into his science something of the chronological definiteness which has been the boast of the astronomer. And it must, I think, be conceded that no very satisfactory explanation of a glacial period by means of purely terrestrial conditions has been proposed.

Nevertheless, there has always been a considerable degree of skepticism in regard to the fundamental conception of the eccentricity theory. The question whether the conditions of aphelion winter and perihelion summer, in an epoch of great eccentricity, would tend to accumulate snow and ice, and produce a glacial period in the hemisphere so conditioned, has never been so answered as to command universal assent. Indeed, J. J. Murphy has argued, with much plausibility, that the glaciated hemisphere would be the one with perihelion winter and aphelion summer.[1] Others have believed that there would be no appreciable effect in the direction of glaciation in either hemisphere. I desire to call attention to a class of well-known facts whose bearing upon the question has not, I think, been adequately regarded. A very brief preliminary discussion will suffice to show the bearing of the facts referred to.

There would evidently be two marked contrasts in the character of the seasons between the two hemispheres at an epoch of high eccentricity. The hemisphere with aphelion winter would have a long winter and a short summer, while the other hemisphere would have a short winter and a long summer. Again, the hemisphere with aphelion winter would have extremes of heat and cold, its summer being very hot and its winter very cold, while the climate of the other hemisphere would approximate a mean throughout the year. It is by no means certain that the effects of these two contrasts upon the matter of glaciation would be in the same direction. As regards the difference in the length of the seasons, I suppose there can be no doubt that increased length of winter would tend to glaciation. Other things being equal, the longer the winter, the larger would be the proportion of precipitation in the form of snow, and the smaller the proportion in the form of rain. And increased snow-fall would certainly tend to accumulation of snow and ice.

But what would be the effect of the difference in the intensity of the seasons? Would glaciation be favored by cold winters and hot summers, or by mild winters and mild summers — by a climate of extremes, or by a climate of means? It seems to me that a comparison of the northern and southern hemispheres at present, in the matter of glaciation, will suggest an answer to this question. The present value of the eccentricity of the earth's orbit is so small that its climatic effects are completely masked by geographical conditions. The northern hemisphere now has the perihelion winter, and the southern hemisphere the aphelion winter. So far, therefore, as astronomical conditions control climate, the northern hemisphere should have a climate of means, and the southern hemisphere of extremes. But this relation is completely reversed by geographical conditions. The great amount of land in the northern hemisphere gives that hemisphere a climate of extremes, while the vast expanse of water in the southern hemisphere produces a climate of means. This

[1] *Quarterly journ. of geolog. soc.*, xxv. 350, 1869; *Amer. journ. science*, [2] xlix. 115, 1870.