fore stated, has acted on it. The constitution authorizes congress 'to promote the progress of science and useful arts by securing, for limited times, to authors and inventors, the exclusive right to their respective writings and discoveries.' There is no limitation of the power to natives or residents of this country. Such a limitation would have been hostile to the object of the power granted. That object was to *promote* the progress of science and useful arts. They belong to no particular country, but to mankind generally. And it cannot be doubted that the stimulus which it was intended to give to mind and genius — in other words, the promotion of the progress of science and the arts — will be increased by the motives which the bill offers to the inhabitants of Great Britain and France."

I believe that the view expressed by Mr. Morgan in the last paragraph of his communication is correct, and that a "Bill to amend the Revised statutes relating to copyrights" — amending section forty-nine hundred and fifty-two by striking out the words 'citizen of the United States, or resident therein,' and substituting the word 'person;' amending section forty-nine hundred and fifty four by striking out the words 'and a citizen of the United States, or resident therein;' amending section forty-nine hundred and sixty-seven by striking out the parenthetical clause '(if such author or proprietor is a citizen of the United States, or resident therein);' and repealing section forty-nine hundred and seventy-one — would secure to foreign authors protection over their works equal to that now granted to citizens or residents. It is really in this way that the bill introduced into the senate by Mr. Hawley grants protection to the works of foreign authors; the first section being in reality a limiting provision, stipulating that the protection is only granted to authors of such countries as confer equal rights of protection to citizens of the United States, in other words a reciprocity clause. By mistake, the Hawley bill neglects to provide for the amendment of section forty-nine hundred and fifty-two, though careful provision is made for the amendments necessary in the other sections.

Thorvald Solberg.

Washington, D.C., March 30.

The distinction between anatomy and comparative anatomy.

It was not so many years ago that even those holding the highest positions in the profession of medicine regarded human anatomy as the only anatomy entitled to the name, and that comparative anatomy meant something else altogether. Its teachings were not appreciated by the vast majority of those who studied the anatomy of man, and the great surgeons of those days were rather inclined to look askant at one who indulged in researches into the structure of the 'lower animals.' But in these days such matters wear a very different aspect, for anatomy means morphology, — the knowledge of the structure of organic forms, — both living and extinct, and it is rarely indeed that we hear of any one attempting to draw hard and fast lines between the anatomy of man, and either any of his own class or other representatives of the Vertebrata.

Thanks to the progress biology has made during the last quarter of a century, all literature that has any thing to do with such subjects, actually teems with the teachings of morphology. Such being the case, one is rather disposed to regard with some measure of surprise the classification that so excellent a work as the *Index medicus* adopts for its record of such subjects. In its last issue, for instance (February, 1886, p. 54), and I believe it has always adhered to the same plan, it makes one section for anatomy, histology, and embryology, and a subsection for comparative anatomy and embryology. Now, in the section-in-chief, we find entered the recent admirable paper by Dr. E. C. Spitzka, on 'The comparative anatomy of the pyramid tract,' the contribution evidently being considered as an 'anatomical one;' while we find awarded to the subsection Retterer's article entitled "Sur le développement des tonsilles chez les mammifères," to say nothing of all the anatomical articles from the last number of the *Journal of anatomy*, of London.

Now, as fully the larger share of Spitzka's memoir is devoted to the study of the pyramid tract in other animals than man, it would seem, even according to the plan adopted by the *Index medicus*, that that essay has not fallen into its proper section. The same stricture applies, for a similar reason, to Retterer's paper. Surely it would seem better to have one section devoted to morphology, to include all contributions that refer to the structure of organic forms, and, if necessary, two subsections, — one devoted to histology, and the other to embryology.

R. W. Shufeldt.

Fort Wingate, N. Mex., March 30.

Penetrating-power of arrows.

You doubtless have read of the wonderful feats of archery said to have been performed by savage archers. Cabeça de Vaca, for instance, tells us that the good armor of the Spaniards was no protection against these missiles. Some of the men swore that they had seen two red oaks, each the thickness of the lower part of the leg, pierced through from side to side by arrows. I myself saw an arrow that had entered the butt of an elm to the depth of a span. The same author states that the corpses of the Spaniards were found to have been traversed from side to side by arrows. An instance is given, where an arrow shot by an Indian pierced through the saddle and housings, and penetrated one-third its length into the body of a Spaniard's horse. These quotations from Jones's 'Southern Indians' might be increased to any number, covering a period from the Homeric age to our day, all showing the popular belief concerning the power of the arrow.

I desire very much to induce our archery clubs to institute a series of careful experiments upon the following points: —

1. How far can an arrow be shot in a calm? How far with or against a moderate calm?

2. What is the greatest distance at which an arrow can be shot with any degree of accuracy? Experiments should be made both as to the vertical and horizontal.

3. What is the momentum of an arrow leaving a bow? (Tested by shooting against a disk attached to a graduated scale.)

4. What is the penetrating power of an arrow into animals? This may be tried with horses, cattle, or dogs, which have just died, or with those in an *abattoir* just about to be slaughtered.

5. The register of the bow as to length, etc., and

a description of the arrow used, should be carefully preserved.

As soon as possible, I shall publish an account of the bows and arrows in the national museum, and shall be more than pleased to collate and preserve the results of careful experiments as a basis of comparison with the archery of savages. It is generally conceded that the archery clubs, with their much better artillery, achieve higher averages in shooting than could be attained by the aboriginal bowmen.

O. T. Mason,
Curator of Dept. of ethnology.
Smithsonian institution,
March 31.

Underground rivers.

In an article in *Nature* (Jan. 14, p. 246) entitled 'Curious phenomena in Cephalonia,' a former pupil of Ledger writes, "The sea runs into the land in a strong stream, turning a water-wheel on the way, and disappears in the earth about a hundred yards from the entrance. . . . I imagine that this water must be converted into steam, which comes out either at Naples or at Stromboli." Prof. Henry S. Williams of this university called my attention to this quotation, and to its indirect connection with what follows. The writer, while passing through Yucatan, Mexico, in 1870, saw a large stream running with torrential speed within a natural tunnel not far from the seashore, and probably over one hundred feet below the surface of the ocean. These underground rivers, which are said to be numerous in the neighborhood of the city of Merida, are called *zanates* (Thah-n'ah-tess) by the inhabitants of Yucatan. I had time to visit only one of these remarkable subterranean rivers. Its shaft-like entrance was adorned by a picturesque old Spanish well-curb of stone, furnished with standards of fancifully forged iron-work. Nothing on the surface indicated the existence of the vast cavern under the monotonous and flat lowlands of the peninsula of Yucatan; and, though not a breath of air stirred, the deafening roar of the torrent under our feet could not be perceived until we were fully inside of the cave. A rapid descent brought us to the level of the pumps used for irrigating a very extensive *ixtle* plantation; and from here we could see, by the light of our torches, the yellow foam of the waters upon the undefined background of the chasm below. Descending still farther, the full stream could be seen through a wide fissure in the limestone of the cave. It had the rounded appearance of a stream flowing horizontally under great pressure, ten or twelve feet in diameter, and looking like a gigantic black icicle lying on its side. This large volume of water plunged with great swiftness into an unexplored and dark chamber with terrific roar, and producing noises which resembled the hollow echoes of heavy explosions heard now and then above the perpetual rumbling of the rushing water. A visit to this cave cannot fail to produce a very deep impression, and not unlike the feeling which renders so imposing the unpleasant experience of an earthquake.

The manager of the plantation informed me that the mouth or entrance of this *zanate* was only twenty-eight feet above the Gulf of Mexico; and since my barometer indicated a descent of a hundred and forty feet, if the information was correct, this stream was delivering, within forty miles from the seashore, a volume of fresh water about a hundred and twelve feet below the level of the sea. The temperature of the water was 52° F., and is said to remain constant throughout the year. Only a small portion of the stream was visible; and the direction of the current was N. 60° W. I could obtain very little additional information in reference to the other *zanates*, of which the natives speak with almost religious reverence as "great miracles which have always been as they are now."

Since the velocity of the water, as well as the form of its cross-section, can leave no doubt that the delivery takes place under a considerable head, it would be quite important to ascertain the location of its source, and learn why this cave does not fill up to within twenty-eight feet from the surface, if the stream communicates with the sea. This latter circumstance seems to prove that the elevation given by the manager of the plantation may be incorrect; but, besides the fact that the belief in the great depth of these *zanates* below the ocean is current among the cultivated people of Merida, the manager of the plantation insisted on the correctness of his figures, which were obtained by the instrumental surveys connected with the irrigation of his large estate, the waste water from which runs into the sea. It would seem desirable, therefore, to ascertain through the columns of *Science* if any one else has visited these *zanates*, and has satisfactory data bearing upon this question.

A study of the soundings made by the U. S. coast and geodetic survey upon the Bay of North America; the erosions showed by the stereographic model of the Caribbean Sea, made by Capt. J. R. Bartlett, U. S. N.; the gravimetric work conducted by Professor Peirce of the coast survey; and the hydraulic problems connected with the delta of the Mississippi River,—seem to involve problems related to the Gulf Stream which make desirable a better knowledge of these truly remarkable subterranean rivers.

E. A. Fuertes.
Ithaca, N.Y., March 30.

Note on the nocturnal cooling of bodies.

An interesting application to this subject may be made, by way of supplement, of the principles and expressions contained in my letter on the temperature of the moon (*Science*, vi. No. 150). According to these, the rate with which a body radiates heat is to that with which it receives and absorbs heat from a complete enclosure as $\mu\theta$ is to $\mu\theta'$, in which $\mu = 1.0077$, and θ and θ' are the temperatures of the body and of the enclosure respectively on the centigrade scale. In this case we necessarily have for the static temperature of the body, that of the enclosure remaining constant, $\theta = \theta'$; but, in the case of an incomplete enclosure, the body, at the same temperature, radiates more heat than it receives and absorbs from the enclosure, and consequently its static temperature is less than that of the enclosure, since it cools down until the rate with which it radiates heat is equal to the rate with which it absorbs heat received from the enclosure.

In the case of a thermometer exposed near the surface of an earth without an atmosphere, the earth's surface would form the half of a complete enclosure, since it would subtend a solid angle equal to that of a hemisphere. In this case the thermometer would receive no heat from the enclosure by re-