cided to replace them by others; which, by making the lights more easy to be distinguished, will, besides, increase the range.

The present characteristics are as follows: —

1. A single fixed light.
2. A double fixed light.
3. An eclipsed light, with flashes every half-minute.
4. An eclipsed light, with flashes every minute.
5. A fixed light varied by flashes every four minutes.
6. A fixed light varied by red flashes every four minutes.
7. A light with alternate red and white flashes.

Fixed lights are obtained with a Fresnel apparatus with cylindrical lenses; the double fixed light, by two lights situated at such a distance that they can easily be distinguished from each other, but still appear to form a pair. Fixed lights will eventually disappear, because they have a less range than flashing lights, and also are liable to be confounded with other fixed lights not belonging to a system of coast-lighting.

Flashing lights are obtained by means of optical apparatus having generally eight faces: each face comprises, first, a lens of the same width as the face, then, above and below, portions of rings having as a common centre the centre of the lens. The apparatus thus gives rise to eight beams of light, separated by dark intervals; and, when it is turned, the navigator sees alternately a flash and an eclipse. The intervals between the flashes depend upon the rapidity of rotation. This light has the inconvenience of requiring sustained attention, and of consulting a timepiece to tell the length of the interval. It should be suppressed.

The fixed lights varied by flashes are obtained by means of an apparatus for a fixed light around which turn two or three vertical lenses which give flashes, either white or red, or alternately white or red, at intervals of some minutes. These slowly revolving lights have the same fault as the preceding, and will also eventually disappear.

The characteristic which will be generally adopted is that of a *scintillating* light. To produce it, a fixed-light apparatus is employed, around which revolves a drum of lenses, placed vertically, composed of straight glass bars of lenticular cross-section; each of these concentrates the horizontal rays, and consequently produces a flash. During a rotation, if all the lenses are alike, the navigator will see a series of equal white flashes, producing a scintillating light. If the vertical lenses are alternately red and white, there will be alternately a red and white flash, and a compound red-and-white scintillating light will result. In the same way, by placing the lenses in groups, there can be two, three, four, or more white flashes, followed by a red one. It should be remarked, that, in this case, as the red color diminishes the luminous intensity, the red lens should have larger dimensions to compensate for this loss: as this causes a loss of light, M. Allard prefers, in most cases, to separate the group of white flashes simply by an obscure interval. This is obtained by a simple modification in the form of the vertical lenses. There are thus the following eight characteristics: —

1. White scintillating light.
2. Light with alternate red and white flashes.
3. Light with two white flashes and one red successively.
4. Light with three white flashes and one red successively.
5. Light with four white flashes and one red successively.
6. Light with two white flashes, with intervals of obscurity.
7. Light with three white flashes, with intervals of obscurity.
8. Light with four white flashes, with intervals of obscurity.

These are the only characteristics which have been definitely adopted. They have the advantage of being readily recognized without consulting a timepiece.

LETTERS TO THE EDITOR.

The new comet in Pegasus.

I DESIRE to give publicity to the following statement regarding the priority of discovery of the new comet in Pegasus. I discovered it at seven o'clock last evening; and, as soon as the direction and rate of motion was ascertained, I repaired to the telegraph-office (a mile away), and telegraphed its discovery to several astronomers, and to Professor Pickering to cable to Europe. In journeying thither I must have passed the messenger-boy with a telegram from Mr. W. R. Brooks of Phelps, N.Y., which I found at the observatory on my return, announcing to me his discovery of the same object.

It was then too late to undo the mischief I had innocently done. In fact, I was not even then sure that there was any guilt attaching to the transaction, as he did not give the time of discovery. He immediately wrote, however, giving the time as forty-five minutes past six, local time, which letter reached me to-day.

I consider it my duty to give to the world the above facts, that no injustice be done to Mr. Brooks. No instance occurs to me of a comet having been discovered by two persons so nearly simultaneously.

The comet is quite bright, with a strong central condensation, though no nucleus could be detected. Its tail was about 40′ in length, faint, straight, and narrow.

The shutter of the dome of the observatory is undergoing some slight repairs, which prevented the use of the 16-inch refractor; and I was, in conse-

quence, unable to obtain its position except by estimation.

At twenty minutes past seven I estimated it to have been in about R. A. 22 h. 57 m., Dec. + 29° 50′, as determined by comparison with Argelander's charts, no allowance for precession being made. It was 2° 37′ almost exactly north of Beta Pegasi, as roughly determined by the size of the field of my comet eye-piece. Its motion is slowly eastward, probably north-east; but its altitude was so low, and the hour being so near moonrise, I could not determine its exact direction.

It presented a beautiful appearance through my 4½-inch achromatic. LEWIS SWIFT.

Warner observatory, Rochester, Feb. 24.

Movement of the arms in walking.

In SCIENCE, Feb. 9, Mr. F. W. True recognizes the 'movement of the arms in walking' as a functional relic of quadrupedal locomotion; urging thereby a modification of the expression of Professor Dana, sanctioned by Dr. Gill, that "man stands alone among mammals in having the fore-limbs not only prehensile, but out of the inferior series, the posterior pair being the *sole* locomotive organs." And the questions are asked, "Have we not at least a ghost of a pre-existing function? Does man walk by means of his feet and legs alone?" Viewing the question from the developmental standpoint, it seems to me that the strongest evidence appears in the first locomotor-acts of the child. Before bipedal progression is learned, *the child goes on all-fours, and is an actual mammalian quadruped.* At the beginning of this the prehensile power of the fingers is very imperfect. Men have been known to educate their toes to do more than the fingers can at that stage of functional development. At that time the palms are of more value as soles than for holding things. In the beginning, also, the arms in some children are better legs than are the hind-limbs, being more easily used. For example, it is more common for children to creep on the knees than on the elbows; but some learn remarkably early to elevate both knees and elbows, to creep on the soles and palms. My own boy walked on his soles and palms from the start, and never upon his knees. The speed with which he finally learned to run in this way was remarkable. After learning to move somewhat on his hind-legs, when he got in such haste as to make bipedal balancement difficult or uncertain, he would take to all-fours, thereby making better speed with less danger of a fall.

U.S. dept. of agric., Washington, Feb. 13, 1883. W. S. BARNARD.

The heart as a locomotive organ.

Every one has observed that the tendency of the heart to beat while walking 'is a most natural one.' 'The action is rhythmical,' the number and force of the pulsations varying with the velocity of the walk. 'It is also involuntary;' but, although proper locomotive movements are usually in a high degree *voluntary*, this consideration need cause us no uneasiness, if we reflect, that, when its action is from any cause suspended, 'an air of stiffness' is soon imparted to the whole body.

In view of these facts, does it not seem that the statement (SCIENCE, p. 11) that "man stands alone among mammals in having the fore-limbs not only prehensile, but out of the inferior series, the posterior pair being the *sole locomotive organs*," should be further modified, and the heart assigned its proper place between the swinging arms as a *true* locomotive organ? O. HARGER.

New Haven, Feb. 28.

The copper-bearing rocks of Lake Superior

There are one or two statements in Mr. Selwyn's remarks on the age of the rocks on the northern shore of Lake Superior, in the number of your journal for Feb. 9, which I cannot suffer to pass unchallenged.

I cannot enter here into a general discussion of the much-vexed question of the age of the Lake Superior copper rocks, — I have discussed it at length elsewhere,[1] — but I must take issue with the statement that there is "no evidence whatever of their holding any other place in the geological series" than that which "includes the Potsdam and Primordial Silurian." My own conclusions in this connection, after an examination of most of the circuit of Lake Superior, are: —

1°. That the copper-bearing rocks underlie unconformably — and with an immense unconformity — a series of sandstones holding Cambrian fossils. These fossils may not correspond to the oldest Cambrian fossils known elsewhere, as argued by N. H. Winchell in the report quoted, but they are distinctly Cambrian; and if the copper-bearing strata are to be called Cambrian, then we must stretch that term over a most immense unconformity, in order to include a rock-series holding no fossil evidence of its Cambrian age, — a thing which appears to me very unreasonable to do. This unconformity is best seen in the St. Croix river region of western Wisconsin, and thence north-eastward. Although attention was drawn some years since by Sweet, Chamberlin, and myself,[2] to the strikingly conclusive occurrences of this region, our evidence has been ignored by others who have never examined the region, and who continue to approach the question from the eastward, or, in other words, from the same direction as a succession of geologists, from Houghton to Selwyn, all of whom have felt baffled. It is interesting to note in this connection that N. H. Winchell, the only geologist who has gone to the St. Croix since our report was issued, confesses to the unconformity,[3] although he had strenuously refused to believe in it before visiting the region. It does not seem to me that any geologist can honestly deny this unconformity until he has done as we have done; viz., followed the copper-bearing strata, with all their characters preserved, mile by mile, from the typical region of Keweenaw Point, to their junction with the fossiliferous Cambrian sandstone of the St. Croix valley.

2°. That the copper-bearing strata also underlie unconformably the 'eastern sandstone' of the south shore of the eastern half of Lake Superior. Winchell has argued a difference of age between this sandstone and that of the St. Croix valley. However this may be, — and I have myself seen no evidence that the one of these sandstones is not merely the direct downward continuation of the other, — the work done by myself and assistants along the contact line of the copper-bearing rocks, and the eastern sandstone from Bête Grise Bay westward to the vicinity of Lake Agogebic, has served to convince me that there is here also an unconformity as great as the other.

3°. That the time-gap between the copper-bearing series and the Huronian was too long to allow of our classing them together, — for it certainly covered a considerable amount of denudation and alteration, — but it is still doubtful if this gap was long enough to cover the folding of the folded Huronian. The greatest confusion prevails as to the use of the term Hu-

[1] The copper-bearing rocks of Lake Superior, — vol. v., monographic publications of the U. S. geol. survey; also Third annual report of the same survey. Both of these publications are still under press.

[2] Geology of Wisconsin, vol. iii. [3] Loc. cit., p. 134.