from the Bay of Fundy. We have a third species from Behring's Straits, and that described below makes a fourth.

CHELYSOMA PRODUCTA.

All other known species of this genus are remarkable among Ascidians for their depressed form, the body being very short, sessile, attached by their flattened anterior extremity, to which the broad disk is parallel, and forms nearly the whole of the part of the body which is exposed to view. In *C. producta*, on the contrary, the anterior part of the body is much produced, laterally compressed, and longer than the disk is broad, while its attachment is inferior and usually very narrow. In well-formed specimens the dorsum is compressed and arched with a well-marked carina, beneath and parallel with which the rectum may be seen through the translucent test. The disk is obliquely placed, and its margin projects strongly beyond the sides of the body. Its surface is divided into 14 polygons, 4—5 sided, beside the two which contain the apertures, each of which latter is again subdivided into six triangular valves.

In our largest specimens the body is 1·5 inch in length, and 0·5 broad at the middle; the disk is 1·08 high and 0·81 broad.

It is usually attached to Sertularians.

Dredged by Lieut. White in "8 to 12 fathoms, shelly, off the N. W. point of Lummi Island."

HOLOTHURIADAE.

PENTACTA PIPERATA.

Allied to *P. frondosa*. Body ovate, smooth and glabrous, of a yellowish color, speckled and spotted with black. Sucking feet retracted in our specimens, not numerous, and arranged in five irregular rows. Tentacula short and broad, ramose. Length (contracted) 1½ inches: breadth, 0·8 inch.

We find three or four specimens in the collection, none of them with protruded tentacles.

PENTACTA POPULIFER.

Body thick-fusiform in shape. Surface entirely covered with minute, perforated, polygonal, calcareous plates, each plate having from twenty-five to forty holes, and being armed with a sharp umbo or spine at the centre of its outer surface. Sucking-feet small, of moderate length, very numerous, and arranged in five regular double rows, extending from one extremity of the body to the other. Tentacula ten, eight large and two small; the large ones of elongated form, and shaped like Lombardy poplar trees, (*Populus dilatata*), branching nearly from the base; branches short. The small tentacles are placed together, and are minute, not a tenth part as long as the others. Length of the largest specimen 2 inches; usual length from 1 to 1½ inches.

From the number of specimens collected we judge this species to be common in the Sound. It is found in the circumlittoral zone.

The Influence of the Earth's Atmosphere on the Color of the STARS.

BY JACOB ENNIS.

From the small amount of attention paid to the colors of the stars as a distinct branch of physical research, a vague and indefinite impression has been somewhat prevalent that the atmosphere of our earth has great power in producing the apparent colors and the changes of colors of the fixed stars. The subject is highly important. During the last two or three years it has occupied much of my attention, and I propose in this paper to present my

method of investigation and the results to which I have been led. To ascertain what the influence of the atmosphere might be, I selected for special observation a few of the larger stars, taking some of the red, some of the blue, some of the green, some of the yellow, and some of the white. So many different classes of stars watched carefully during the various changing conditions of the atmosphere, seemed most likely to yield valuable conclusions.

1. The red stars were Aldebaran, Antares, and Betelgeuse. These are all of different shades and intensities of red. In proportion as the atmosphere loses its transparency by the condensation of moisture, these stars lose their distinctive peculiarities. Their redness gradually becomes obscured, and they at last appear of a dull, unsatisfactory white.

2. The blue stars were Capella, Rigel, Bellatrix, Procyon and Spica. Some of these, as first Procyon, and then Rigel, are far more intensely blue than the others. But as the atmosphere becomes thick and more impervious to distinct vision, their different intensities of blue fade away, and the observer is at length puzzled to decide of what color these stars really are. He feels safest in announcing that they seem white, though not of a clear, decided whiteness.

3. The green stars were Sirius, Vega, Altair and Deneb, or the largest star in the Swan. These stars were observed to be green by myself, in the following order: Sirius in the autumn of 1862, Vega in June, 1863, and Altair and Deneb in August, 1863. It is remarkable that a very slight haziness in the sky completely hides their green color, and causes them to appear unmistakably blue. A still thicker haziness has the same effect on them as it has on all the blue stars already described, gradually obscuring their blue color, and ranking them among the many hundreds of stars which the naked eye cannot decide to be colored.

4. The yellow star was Arcturus; this being the only one which appears decidedly yellow to my vision, unaided by instruments. Several others incline the naked eye to regard them as yellow, such as Polaris and the larger stars of Ursa Major and of Cassiopeia, but not sufficiently so to produce a firm belief. Arcturus, in a clear sky, has a fine light orange yellow; but as the sky becomes less and less clear, the yellow fades away, and ultimately the color of this star turns to a dim white, and becomes undistinguishable from that of the larger stars of Ursa Major, with which, from their position, it may be handily compared.

5. The white stars were Regulus, Denebola, Fomalhaut, Polaris, the constellation of the Wagon, and several others of the second and third magnitudes. They may be called white stars with reference to their appearance to the naked eye, to mine at least, but we are not bound on that account to believe them to be really white. As they are not first magnitude stars, they probably seem white to the unaided eye only because their light is not sufficiently great in amount, or intense in color, to appear colored. There may be persons with unaided vision acute enough to perceive their true colors. But whatever may have been the conditions of the atmosphere, I have never observed them to be other than white. No changes of the air have had the power of presenting them in any shade as colored stars.

Thus the influence of the atmosphere of our earth upon the stars of all the different colors, according to these observations, is the same. Whether the stars be red, blue, green or yellow, the effect of changes in the atmosphere is to rob them of their peculiar shades and intensities, and to reduce them all to a dull colorless condition,—a dim whiteness, in which their indistinctness produces a feeling of uncertainty and doubt in the beholder. Nor in any case have I seen any change in the atmosphere turn a star from one color to another, except from green to blue, and this is simply reducing one shade to another; for green, like purple, is but one of the modifications of blue. I have never seen a red star become blue, nor a blue star become yellow, nor

any other similar change by any change in the atmosphere. If such an occurrence were possible, I believe I would have observed it during the past two or three years. The effect of moonlight in obscuring the colors of the stars, and giving them a yellowish shade, can hardly be called an atmospheric action. Neither can the effect of the rays of the sun in the earliest daybreak of the morning or in the latest twilight of the evening, be called an atmospheric operation. Such an effect tends to impart a general whiteness to the stars, obliterating their colors in part or in whole, the same as in the end it obliterates all their light.

The question now arises, How is it that the atmosphere, when hazy and imperfectly transparent, has the power of depriving the stars of their colors, whatever their colors may be, and reducing them all alike to a dull whiteness? The reason may be seen in the simple fact of the obstruction of their light. Their light becomes diminished in amount to such a degree that it no longer has the power to produce the sensation of color on the retina. Nearly all the stars, when viewed through a telescope, are colored; they are of some hues other than white. Of this I adduced evidences in my communication for these Proceedings in June, 1863. They appear colored through the telescope because their light is collected by the instrument in a comparatively large mass; so large that it can make their colors readily perceived. Take away the instrument from all except the larger stars, and the pencil of light becomes so small as to be without the power of imparting the sensation of color. In the same manner the pencil of light from the larger stars may be reduced by haziness in the atmosphere to so small an amount as to be incapable of imparting the sensation of color, except a dull whiteness, whatever their real colors may be.

But how does it happen that a green star is changed by haziness to blue? I once thought that possibly this effect might be due to the same cause which makes the deep ocean, the distant mountainns, and even the atmosphere, appear blue. After further observation and reflection I cannot adopt that explanation; for then all the stars, like the distant mountains, would be colored blue. Then there would be no such contrasts of all colors among the stars as we now behold. The true explanation seems to be that the mists of the atmosphere, in acting on the light of a green star, first obstructs the yellow rays, and after these are all absorbed then the blue rays alone will be visible, and the star must appear blue. Ultimately the mist may become so impervious that the attenuated ray of light can no more excite the sensation of color and the star must appear dimly white.

Before it can be admitted as a scientific truth that the atmosphere of our earth has the power of changing the color of a fixed star from one hue of the rainbow to another totally different, there must be brought forward a number of well authenticated facts as grounds for such a belief. We must have the specifications of certain stars which have been seen to change, and the dates of such changes, and the conditiöns of the atmosphere by which such changes have been produced, and also the numbers and the names of the persons by whom such phenomena have been witnessed. Such evidences of the changes of the colors of the fixed stars by our atmosphere have never been seen nor heard, and for my part, judging by my own observations, I never expect to see them, nor to hear of them. An exception to this remark may be the case of a green star turning to blue, as already explained. Perhaps another exception may yet be found, as indicated in the following passage from Humboldt. The italics are not in the original: "We do not here allude to the change of color which accompanies scintillation, even in the whitest stars, and *still less to the transient and generally red color exhibited by stellar light near the horizon*, a phenomenon owing to the character of the atmospheric medium through which we see it, but to the white or colored stellar light radiated by each cosmical body, in consequence of its peculiar luminous process, and the dif-

ferent constitution of its surface. The Greek astronomers were acquainted with red stars only, while modern science has discovered, by the aid of the telescope, in the radiant fields of the starry heavens, as in the blossoms of flowering plants and in the metallic colors, almost all the gradations of the prismatic spectrum." The turn of the expression "still less" shows that he regarded the matter as inconspicuous and unimportant, and the remark is made only in a casual manner. Nevertheless, incidental as the remark may seem, it is the most precise and circumstantial I have found in any author on the influence of the atmosphere on the colors of the stars. But is it really true that the atmosphere can impart a transient and generally red color to stellar light when near the horizon? In the absence of all confirmation to the above remark of the distinguished philosopher, I selected as test stars Vega and Capella, both first magnitude stars, the former green and the latter blue, and the one or the other is grazing the northern horizon nearly all the year. But I have been unable to detect the changes he mentions. May not his remark have arisen from observations on the planetary bodies, and have been inadvertently extended to the fixed stars? The planets, especially Jupiter, according to my observations, are sometimes, though rarely, sensibly reddened like the sun and moon by the atmosphere. But whether Humboldt's assertion be confirmed or not, it cannot effect our decision about the real changes of the colors of the stars. No one would pretend to announce a change in the color of a star simply because of a "transient" appearance of a change while near the horizon. In the same manner, probably, the idea has got afloat in a vague manner that, because the atmosphere of our earth has the capability of giving occasionally a red color to the sun, moon and the planets, it must therefore have not only the same effect on the fixed stars, but even the power to turn them to all the hues of the spectrum between red and blue. But this rapid generalization is no more warranted by sound reasoning than by observation. The sun, the moon and the planets have sensible disks, which the fixed stars have not. Hence the optical phenomena of these two classes of bodies differ widely. The fixed stars, under the influence of our atmosphere, are made to scintillate; they then twinkle with an unsteady light, and to good eyes they flash out rapidly and fitfully all the varieties of colors. This shows the difference, in an optical point of view, between the fixed stars and the other celestial bodies, and the impropriety of a hasty generalization from one class to the other. Because the atmosphere can redden one class it by no means follows that it can redden the other, much less that it can impart to the other all imaginable hues.

Another cause for the belief that the atmosphere can impart different colors to the stars, may be found in the necessity for some explanation of their changes of color. It is assumed, though without any known reason, that the intrinsic colors of the stars cannot change, at least in the space of two thousand years, and hence there is a necessity for an explanation of their apparent changes in some other way; and as the handiest method these changes are attributed to the atmosphere of our earth. That the various colors of the stars are not produced by our atmosphere, nor by optical instruments, nor by personal peculiarities of vision, becomes perfectly evident from the following simple consideration. If their colors were produced by any one of these causes, then there would not be that beautiful contrast of colors which we now behold; then it could never have been said of the cluster Kappa Crucis, that the various bright contrasted colors of its different members give it all "the effect of a superb piece of fancy jewelry." Instead of this there would be in that cluster, and in every other region, a dull monotonous color in all the stars alike. It has happened that travellers, in coming from Europe to America, have expressed their surprise at the beauty of our sky, when noticing for the first time in their lives the different colors of the stars. This has been supposed to be the work of our atmosphere, the natural operation of the

gaseous envelope of our earth. The true explanation is this. The stars appear colored to the naked eye in Europe as well as in America. Astronomical observers see them colored the same in all countries. But in some countries their colors are slightly dimmed by the more habitual haziness of the atmosphere, so much dimmed that they are not noticed by unprofessional gazers. When these latter persons arrive in a more cloudless region, they notice the colors of the stars simply because a slight veil is withdrawn, and not because new colors have been added.

The evidences of changes of color are now most abundant among the double and multiple stars. This is because the colors of these have been more generally recorded. Hence the importance of having records made, as frequently as possible, of the colors of all the stars, as they appear both to the aided and the unaided vision. Of course no careful observer will decide on the color of a star from its appearance in an unfavorable atmosphere, nor will he neglect the influence of the sun and moon, nor other means for correcting and confirming his observations, as presented in the rules of my last paper.*

July 5th.

DR. COATES in the Chair.

Eight members present.

July 12th.

Vice-President BRIDGES in the Chair.

Eleven members present.

A paper was offered for publication entitled "Description of a Gar-Pike, supposed to be new." By Alexander Winchell.

July 19th.

Vice-President BRIDGES in the Chair.

Ten members present.

A paper was offered for publication entitled "Contributions to the Herpetology of Tropical America." By E. D. Cope.

The death of Thomas Dunlap, member of the Academy, on the 11th instant, was announced.

July 26th.

Vice-President BRIDGES in the Chair.

Six members present.

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* Page 57 of this volume.