unexpected presence of teeth in connection with an otherwise bird-like structure, we have overestimated the true taxonomic significance of the facts, and lost sight, for the moment, of our customs in other groups? May it not be, indeed, that we have been unconsciously affected by the phenomenal nature of most of Prof. Marsh's palæontological discoveries, and that we have not only been unduly impressed by the facts, but also influenced in some degree by the general admiration for the discoverer's achievements, so as to refrain from questioning his conclusions? Yet, as has been shown already, our author has kept his own mind open upon this very point, and it is to be hoped that he may have the pleasure and the honor of discovering other forms of Aves dentatæ, affiliated in other respects to the several groups of existing birds, and held together only by their teeth.

Hereafter such problems as are involved in this memoir will be discussed more advantageously in the light of the considerations respecting the Evolution and Classification of Vertebrates which have been presented recently by Prof. Huxley.

So admirable is the present work as a whole that one shrinks from any criticism of details. Upon the following points, however, some improvement could, perhaps, have been made:

While insisting upon the lack of bony union of the ends of the mandibular rami in the American Odontornithes, our author makes contradictory statements in regard to the tissue by which they were joined during life. On pages 11 and 179 it is said to have been *ligament;* on page 123, and in the explanation of plate 1, *cartilage* is specified, while on page 112 the union is said to have been "as in serpents." Judging from the appearance of the surface shown in plate 1, fig. 4, the union was ligamentous rather than cartilaginous, but there may have been a mingling of the two kinds of tissue.

The date of the discovery of *Hesperornis* is given as November, 1870, on page 2, but as December on page 195.

It would have greatly facilitated references if there had been given in this volume a complete Bibliography of Odontornithology, together with a statement of the dates of discovery of the various forms, and the dates of their assignment to more comprehensive groups than species and genera. The synonymy as given under the species named in the Appendix does not quite meet this want.

In view of the aid which evolution has received from embryology, it would seem that even a special palæontological memoir like the present might have contained some expression of the author's expectation that light may sometime be thrown upon the problems involved by the careful scrutiny of the development of certain recent birds, notably the Struthionidæ.

B. G. W.

REPORT SUBMITTED TO THE ACADEMY OF MEDICINE ON THE SUBSTITUTION OF MARGARINE FOR BUTTER AND LARD IN THE PUBLIC ASYLUMS OF THE DEPARTMENT OF THE SEINE.—M. Riche finds that pure butter yields a quantity of fatty acids insoluble in water ranging from 86.5 to 88 per cent of the weight of the pure fatty matter, whilst in all the other fats and animal oils, and in almost all vegetable oils, there is from 95.20 to 95.80 per cent of insoluble fatty matter.

ON THE SOUTHERN STARS AND OTHER CELESTIAL OBJECTS.

BY J. H. POPE, NEW ZEALAND.

This paper embodies the results of observations made during the last eight years. While most of the work is original, yet, when the object described is important, and an account of my observations could not be satisfactorily given without reference to the work done by previous observers, their facts and opinions have been quoted. An apology is scarcely needed for giving a short *résume* of the facts known about the great star *Alpha Centauri;* accordingly, a very brief history of this remarkable object, from Lacaille's time (1750) to the present has been given.

The instruments used were an 8½ inch reflector, by Browning, and a 4¼ inch equatorial of superior quality. The measures of angles and distances have been obtained by the methods described in my paper in last year's "Transactions."* The angles of position will, I have little doubt, be found to be good, but the atmosphere has not been steady enough of late to admit of the best use being made of oblique transits. I have, however, little doubt that such measures of distances as are given will be found to be very satisfactory approximations to the truth. For the spectroscopic work recorded in this paper I have used an admirable little star-spectroscope, by Browning. This instrument has enabled me to determine, quite satisfactorily, the class to which the stars examined belong, and, in many instances, to say that the spectrum lines of certain elements are probably present. As, however, the means at my disposal did not permit me to make accurate *measures* of the positions of lines, my work in this department should be looked upon as the results, so to speak, of a "flying survey," useful perhaps, in its way, but to be superseded when more thorough and accurate determinations can be obtained.

It should be stated, however, that, while depending on eye estimation alone, it would be very unsafe for an observer to say, that a conspicuous line, for instance, in the greenish blue of the spectrum of a certain star was certainly the F hydrogen line; yet it is unlikely that a practiced eye, one trained to recognize the position of certain lines in spectra that have been already measured, could be mistaken, in any large proportion of cases, in picking out, say, the principal Fraunhofer lines in a stellar spectrum. On the whole, it seems to me that such determinations as are given in this paper are not without a real value, if carefully made. Many years must elapse before the lines in the spectra of the southern stars can be accurately measured by methods like those employed by Dr. Huggins. In the meantime such results as those here given are all that are available. These serve to give us a certain amount of information that can be thoroughly relied on; they enable us to state, further, that the existence of certain physical conditions, and the presence of certain elementary substances in certain stars, are highly probable; and, possibly, they are calculated to create or stimulate in us a desire to learn more certainly and fully the constitution and physical habitudes of the stars.

The objects are treated of in the order of their Right Ascension, and the places of the stars when given, are taken from the "First Melbourne Catalogue," epoch, 1870.

The first star on the list is *Achernar* or *α Eridani.* This fine first magnitude star is very nearly pure white, without any discernable tint, except possibly a slight shade of blue. This star belongs to Padre Secchi's first class of stars, the type of which is the giant sun *Sirius.* In the case of typical stars of this class, the spectrum is

* Trans. N. Z. Inst., Vol. XI., Art. X.

remarkable for the great breadth and distinctness of the hydrogen lines. Indeed these stars are for convenience often called "the hydrogen stars." All of them are white or bluish-white. In *Achernar* the hydrogen lines are not nearly so strongly marked as they are in some others of the class. Indeed the star by no means nearly approaches the type, and is probably to be considered as holding a position between such stars as *Sirius* and stars of the second class, like *Procyon*, though much nearer to the former than to the latter.

π *Eridani*.—This beautiful little double-star is just visible with the naked eye in fine weather. It is about one degree from *Achernar*, north following. The two components are of the same orange color, and of very nearly equal magnitudes 7 and 7. When Sir John Herschel measured this star (anno 1835.0), he found the angle of position with the meridian to be 122.3°. Powell, in 1863, found the angle to be 73.9°. Last week (say anno 1879.75) the angle was 58.8°. The distances for the same dates are 3.65″, 4.88″, and 5.3″. This interesting double is, therefore, very probably a binary star of comparatively short period.

θ *Eridani*.—R. A. 2hrs. 53min. 19.9 secs. Decl. 40° 49′—35′ 17″ S. In the Melbourne Catalogue, the magnitudes 5.2 and 6.2 are assigned to the components of this fine double-star. There is most certainly serious error here. The star is plainly, taken as a whole, a large fourth, or a small third-magnitude star. Probably magnitude 3.9 for the larger star, and 5.9 for the smaller one, would not be far from the truth. The color of the larger star is yellowish-white, with a faint green tinge; the smaller is a light shade of indigo blue. Sir John Herschel's angle of position and distance, in the year 1835.75, were 81.5° and 8.68″. The angle at the epoch 1879.75 is 85.4°. I have not been able to get a thoroughly satisfactory distance, but it is now somewhat over 10″. Time and accumulated observations will, of course, show either that the change in the angle and the distance of the two stars of this double is owing to the proper motion of one, or both, of the components, or that θ *Eridani* is a binary system. The latter alternative appears to me to be by far the more probable.

232 *Reticuli* of the Melbourne Catalogue is a fine star of a magnificent scarlet color. It is of magnitude 6½. There is a distant companion white star of the eleventh magnitude. The R. A. of 232 *Reticuli*, is 4hrs. 35min. 15.15 sec., and the declination 62° 20′ 0.63″ S. The spectrum of this star is very remarkable. It belongs to Secchi's fourth class. The typical star of this division is small—invisible, in fact, to the naked eye; it is variable both in light and color; it is a very distinct red, ruby, crimson, or scarlet; and its spectrum consists of bands of light, sometimes containing faint bright lines with dark spaces between the bright bands. 232 *Reticuli*, though so small, gives a fine spectrum when the spectroscope is used with the reflector, because the light is not spread out over the whole length of the spectrum, but is concentrated in certain parts of it. Thus the red part of the spectrum is very bright, but the place of the orange is occupied by a very thick black "bar." The yellow, again, is pretty bright, and so is part of the green, but towards the violet end of the spectrum the light is very faint, and the colors are quite cut out for large spaces by intervals of almost complete darkness. I failed to notice here what is said to be characteristic of this class of stars—a gradual diminishing blackness of the bars in the direction of the violet end of the spectrum; nor could I distinguish any bright lines in any part of the spectrum. The study and observation of stars of this class is none the less interesting to us, because in the present state of our knowledge their spectra are unintelligible, for it is generally felt by those who have been in the habit of observing them, that there is a great secret of nature waiting to be discovered in connection with them. Their being for the most part so very variable both in light and color, the strongly-pronounced red color of all of them, and their strange and beautiful spectra, all point to the conclusion, that the man who succeeds in "reading the riddle" of the nature and constitution of the red variable stars, will have made a very important contribution to our knowledge of the process by which suns and systems are evolved out of the primordial nebula, or whatever the substance may be, from which such systems are formed, and to which, perchance, when their mission is fulfilled, they again return. In the meantime these red stars seem to set anything, even like rational conjecture, at defiance.

α *Argus* (*Canopus*.)—This great star, the only rival of *Sirius*, is a hydrogen, or first-class star. In its spectrum, the F and C hydrogen lines, and that near G, are broad and distinct, though less so than in the spectrum of *Sirius*. There are a great many very fine lines in the spectrum of *Canopus*, but these are not generally visible. It is only when the atmosphere is very steady and clear that they can be plainly seen. A fine line, however, or rather a small group of lines, in all probability that called *b*, and due to the presence of magnesium in the photosphere of the star, can generally be made out in moderately fine weather.

π *Argus*.—This is a wide telescopic double-star, forming, with a very distant companion of about the fifth magnitude, another double, easily visible as such with the naked eye. The color of the large third-magnitude star is a strongly-marked orange; the other two are indigo-blue. It is a well-known fact, that a large yellow or orange-colored star has frequently a distant companion of a blue or green color. It is generally supposed that this is a sort of *primâ facie* evidence that the two stars are in some way physically connected. It seems to me that the existence of these complementary colors in apparently neighboring stars in no way indicates *per se* that they are physically connected. I am inclined to think that, given a large bright orange star, with a smaller star naturally very white and nearly in the line of sight, this latter must appear greenish or bluish. The light of the bright orange star fatigues the eye as far as its power of receiving the impressions which we call red, orange, and yellow is concerned. Now, when the eye is directed to the smaller star, the less refrangible portion of the light coming from this fainter object is unable to act with its normal effect, while the green, the blue, and the violet rays, by which the eye has not been fatigued at all, produce their ordinary impression.

It is commonly said that this explanation may be true enough in a few cases; but that, if the bright star is hidden behind a thick bar placed across the field of the telescope, and the smaller star still appears blue or green, it is a proof that the light of the smaller star is really blue or green, and that its color cannot be the effect of mere contrast. This is, I feel sure, fallacious. I have often tried the experiment and at first it was very disappointing, for one would naturally expect that a star, which appeared colored in the presence of a very bright companion, would show its color still more distinctly when that companion was hidden from view. But this never happened, the more completely the light of the larger star was removed, the less was color in the companion observable. I feel persuaded that, if the light of the larger star could be entirely cut off, which, by-the-by, is impossible, the blue color would entirely disappear. It is worth noting, too, that the longer one looks at a blue star, its companion being hidden, the more completely does the blue color disappear; that is, I take it, as the eye recovers its normal condition, after being exposed to a severe strain from the light of the large star, so does its sensitiveness to the feeble red, orange, and yellow rays of the small star return, and it sees the small star to be white or nearly so. On the other hand, I have often noticed that the longer one looks at a double star of this kind, both stars being in the field, the more pronounced does the blue become. There is only one instance, that I am aware of, in which this theory will not hold good. The small companion of *a Scorpii* is undoubtedly really greenish. I saw it on the 23rd of March, 1878, emerge from behind the moon after an occultation while its bright companion was still hidden, its color then was a pale pea-green. There could have been no contrast here, except with the moon's light; admitting this exception, however, it seems to me highly probable that while, in such wide double stars as π *Argus* and γ *Crucis* the orange or yellow star is really what it seems, the star that appears green or blue is, *as a rule*, really white. If this view is the correct one, it follows that those observers who spend a great deal of time in observing the tints of the companions to large stars, are, to a great extent, wasting their time.

γ *Argus*.—This fine second-magnitude multiple-star has a very curious spectrum. It belongs to a very small class of stars, the only other one that I have heard of is in the Northern constellation *Cassiopeia*. In the spectrum of γ *Argus* there are certainly three very *bright* lines, one rather faint, and, I believe, many finer ones. I am almost certain, too, that there are several fine dark lines in the spectrum. The brightest line is, not improbably, the F hydrogen line; and the somewhat fainter one, the C hydrogen line. Of the other two very distinct bright lines, one is certainly not very far from the position of the D sodium line; but I cannot place the other. The presence of bright lines in the spectrum renders it far more difficult than usual to estimate the positions, but the other line seems to be about one-third of the distance from D towards the iron line E. Not improbably then, outside the photosphere of γ *Argus*, there are ever-present enormous masses of hydrogen and sodium, as well as other substances in the gaseous condition, which have been ejected from the more central parts of this sun; and, the temperature of these incandescent gases being much higher than that of the solar photosphere below, their spectrum is super-imposed on the ordinary spectrum of the star proper.

ε *Argus*.—This yellow star belongs to Secchi's second class. In these stars the lines are very fine, and not easily seen unless the weather is very favorable. To this class our sun belongs. In the spectrum of ε *Argus* the F line can be seen pretty easily, but the D sodium line seems to be the most distinct of this spectrum.

β *Argus*.—Magnitude, one and a-half. Color, white. A first-class star. The hydrogen lines are pretty broad and distinct.

The blue Planetary Nebula near the Southern Cross.—This object, No. 3365 in Sir John Herschel's Catalogue, is in R. A. 11hrs. 44m., and decl. 56° 31′ S. The color of this strange object is a bright unmistakable blue. This nebula, like other planetary nebulæ that have been examined in the Northern Hemisphere, gives a spectrum of one bright line. Possibly, in a larger instrument, more lines might be seen. It is, of course, impossible with my apparatus to determine the position of this line, as there are no landmarks, so to speak, to guide one to a decision. It is most probable, however, that it is one of the hydrogen or of the nitrogen lines, and that this planetary nebula is a spherical mass of one or both these gases in an incandescent state.

α *Crucis*.—This superb *pair* of stars, by far the finest in the sky, consists of two stars, bluish white in tint, and very nearly equal in size, each being of the second magnitude. There is a distant six-magnitude companion, of a sea-green color, as well as three smaller comites of magnitudes, 12½, 14, and 13 respectively, These latter are well seen in the 8½-inch reflector, but a small telescope of course does not show them. I have made a very great number of measures of the angle of position of this star, and having weighted the observations wtth reference to the state of the atmosphere, etc., at the time when the measures were taken, I find the angle of position for the year 1878.7 to be 118.5°. This by a very singular coincidence, is exactly the same angle as that obtained by Powell in the year 1863. Herschel gives the angle for 1835.33 as 120.6°. I may say that, if I had rejected two of my observations, which were made in rather bad weather, and which exceeded the average of the rest by 1½° and 3½° respectively, the angle obtained, taken in connection with Powell's and Sir John Herschel's, would have indicated, I believe, a very slow but really regular angular motion, in a retrograde direction, since Herschel's time, and would, with the measures of distance given below, have convinced me, at all events, that α *Crucis* is a binary star of very long period. The temptation in such cases to "cook one's accounts" a little to omit taking into account facts or numbers which do not square with one's own views or wishes, is very strong, but the man who cannot resist it had better give up science altogether and take to something else in which it is not of vital importance that he should tell the truth, the whole truth, and nothing but the truth, with regard to his observations. The distance between the two stars at the epoch, 1836.36, was 5.65″; in 1863, Powell made it 4.98″; and at the end of last month, 1879.75, the distance, a mean of several measures, was 4.79″. α *Crucis* is a hydrogen star, but its spectrum is very difficult to observe, except in the finest weather. Even then the only lines that I can make out are the hydrogen lines, and they are by no means very easy to see.

γ *Crucis*.—It has been customary for astronomers to catalogue this star—the "Head of the Cross"—as a double star; but the proper motion of the large orange-colored star is rapidly carrying it away from its five-and-half-magnitude blue companion. The spectrum of γ *Crucis* is perhaps the finest of all stellar spectra. The groups of lines are so numerous and so well marked that this spectrum may be observed under almost any atmospheric conditions, if the star can be seen at all. γ *Crucis* is a typical star of Secchi's third class, which are all orange color verging towards red. In their spectra there are numerous, easily-seen, close groups of lines; but the hydrogen lines are either very indistinct or altogether absent. α *Orionis* and α *Herculis* are good specimens of the two principal subdivisions of this class. In the spectrum of γ *Crucis* there are at least eight broad groups of lines, and some of these occupy the parts of the spectrum at which sodium, iron, magnesium, and calcium lines are found in the solar spectrum. But, because they are groups, it is much more difficult to say whether they contain the lines belonging to those elements or not, than it is in the case of a first or second-class spectrum. Still, I anticipate that careful measurements will confirm my opinion that iron and magnesium lines, especially the latter, are present in the spectrum of this star; the sodium line is probably there too, There is, also, a fine line just at the part where the green merges into the blue of the spectrum. This is possibly the F hydrogen line.

There is one very significant feature in this spectrum, so at least it seems to me. It is well known that when the Sun is near the horizon, especially in damp weather, his spectrum contains certain groups of lines which are due to the aqueous vapor in our own atmosphere, and that, as he reaches a greater altitude, these lines become faint or disappear. Now, two at least of the groups in the spectrum of γ *Crucis* appear to occupy the same position as two of the principal groups of atmospheric lines. Now this being verified, important conclusions might follow. Secchi, on grounds of this sort, infers the existence of aqueous vapors in the neighborhood of sun-spots. The Spectroscope knows nothing, so to speak, about distance, except indeed where motion of approach or recession is concerned. If these aqueous vapor-lines are produced in spots on the sun, may they not be produced in much the same way in γ *Crucis*, the principal difference being that on the distant star the cause is more general and the effect greater than it is on our own Sun. If I am not mistaken, the existence of these spectrum lines should enable us to read a certain portion of the "life history" of a star.

This history might be something like this: Let us suppose that, countless ages ago, γ *Crucis* was a white star, like *Sirius*. It was then far more intensely heated than it is now. All the elements of which it is composed were there uncombined. Hydrogen, the gas of the smallest density, ordinarily extended furthest from the centre of the globe, and this hydrogen, its outer envelope, was nearly always near the confines of the normally cold regions of space. Thus it would have a somewhat lower temperature than the rest of the sphere, and hence well-marked hydrogen lines would appear in its spectrum at this period. Comparatively small quantities of other elements, however, would frequently be erupted from the interior portions of the sphere, and would reach what may be called the surface. The presence of these would cause the appearance of numerous fine lines in the spectrum. As eternity went on, if I may use the expression, the star radiated a large portion of its heat into space, the elements began to combine chemically to a certain extent, large volumes of hydrogen ceased to exist as such, through combining with oxygen and forming water-vapor, of which the outer star envelope would now consist. In place of the hydrogen lines of the white star therefore, we now find the aqueous vapor spectrum—"the atmospheric lines" as they are called. The result of the combination of the oxygen and the hydrogen would, of course, be a great decrease in the volume of the outer envelope. This would probably bring the lines of sodium, magnesium, iron, and calcium into greater prominence, and we should have the spectrum which γ *Crucis* now presents. Between the two conditions described there would be an intermediate one. Through such a stage our Sun may possibly be passing now. It may be, in short, that our Sun was once a *Sirius*, is now a *Procyon*, and will by-and-by be a γ *Crucis*. This is a mere hypothesis, of course, though it appears to account pretty fairly for some of the phenomena of the stars. In fact, I give it merely as a suggestion, feeling that it is as little entitled to carry weight with it as an hypothesis, founded on observed phenomena and not at variance with known facts, can be.

γ *Centauri*.—R. A. 12hrs. 34min. 21.46secs. Decl. 58° 14′ 43.24″.—This is a very fine close pair of stars, each component being of the fourth magnitude, and purely white. In his "Results of Observations at the Cape of Good Hope," Sir John Herschel gives the position-angle as 354.3°, the epoch being 1835.89, while the distance is stated to be ¾″. To this estimate of distance Herschel attaches no value. For the year 1878.93 the angle of position is 6.6°, or 186.6°, and the distance 2.2″.

β *Crucis*.—This fine white star has a distinct deep blood-red companion, the position angle being 260½° and the distance (1879)–208″. It seems to me that the small star varies in size from about the eleventh to nearly the eighth magnitude. It would be well if the small star could be watched, so that its period and the amount of its variation in brightness might be accurately ascertained.

α *Centauri*.—R. A. 14hrs. 30min. 47.07secs. Decl. 60° 17′ 53.93″. Magnitudes, 1-2. The following table will give the position-angles, and the distances of the components of this star, for selected epochs during the forty-five years which have elapsed since 1834, when it was first accurately measured by the greatest of all astronomers, Sir J. Herschel:

Observer.	Date.	Position.	Distance.
Sir J. Herschel	1834.7	—	17.43″
Sir J. Herschel	1834.8	218° 30′	—
Sir J. Herschel	1835.7	219° 30′	—
Sir J. Herschel	1837.3	220° 42′	—
Sir J. Herschel	1837.4	—	16.12″
Pcwell (from Webb)	1864	5° 7′	7.85″
Computed from mean places in F. M. G. C.	1870.0	17° 19′	10.73″
My recent measures	1878.7	156° 19′	—
My recent measures	1879.75	183° 8′	4.55″

With this table as a basis, it will be found that the major axis of the apparent orbit lies nearly in the direction 26½° to 206½°, and that the greatest elongation north is about 11″, while the greatest elongation south is 27″. Mr. Powell makes the period between 76 and 77 years. If the places of the two stars given by Lacaille (1750) were correct, however, the period would be just about 85 years, for the angle of position computed from his places of the stars is 218° 44′, which a reference to the above table will show, was very nearly Sir John Herschel's micrometrically-determined position 84.79 years afterward. As, however, the *distance* obtained by Sir John Herschel disagrees very materially with that deduced from Lacaille's places of the stars, but little weight is attached to the observation of 1750.

This magnificent double star is the finest object of the kind in the heavens. Besides being a binary star of very short period, every one knows that α *Centauri* is our next neighbor among the stars, and that it was the first to give up the secret of its parallax under direct Transit Circle observations. The color of this star is straw-yellow, or sometimes golden-yellow, according to the state of the atmosphere. When there is haze, of course the smaller star is somewhat more affected by it than the larger. This tends to give it a slight brownish tint when the sky is not clear. α *Centauri* is a star of the second class. Its spectrum is very like that of the sun. Even the principal dark lines are fine, and they apparently occupy the same relative positions as do the well-known lettered lines in the solar spectrum.

The resemblance between the two spectra is so striking that any one seeing the two spectra for the first time could hardly fail to notice the similarity. More dispersive power, however, and the means of accurately determining the position of the lines of α *Centauri* might show that they are not the same as the solar lines. Such a result would surprise me much. The D sodium line, the E iron line, the *b* magnesium line, and the F hydrogen line of the Sun have, almost certainly, their counterparts in the spectrum of α *Centauri*. There can be little doubt that the physical constitution of this great star is, in most respects, the same as that of the Sun. It is probable, however, that α *Centauri* is less developed than the Sun; for, as Mr. Proctor has pointed out, its light is brighter than its mass would lead us to expect it to be, judging from the light of our Sun, as compared with his mass. While the mass of the star is to the mass of the Sun as 2:1, the light of the star is to the light of the Sun as 3:1. Now, if it is true, as physicists have good grounds for believing, that the Sun is, and has been, very slowly but surely losing his heat, just as our earth has most certainly lost an enormous amount of hers, there must have been a time when the Sun and his system were less developed, but far hotter and brighter than they are now—when they formed, probably, as I said when speaking of γ *Crucis*, a white star—that is to say, there was, quite possibly, a time when the light from our Sun bore the same relation to his mass as the light from α *Centauri* bears to its mass. We may also believe that matters are less advanced in the planets (if there are any) of this neighboring system than they are with us.

α *Trianguli*.—The spectrum of this star is not very striking, but it is rather curious, as showing, apparently that the star is in a condition intermediate between that of α *Centauri* and that of γ *Crucis*. The lines of the second class, and also the groups, are very faint, but they are there. It will be seen that this fact has some bearing on the suggestion I made respecting the gradual development of stars while speaking of γ *Crucis*. Here it looks as if we had, so to speak, caught a star in the act of changing from the second to the third class. What I have seen of the spectra of the stars, so far, leads me to think it probable that if every star, down to the sixth magnitude, could be examined even with my instrument, and mapped roughly, it would be found that the spectra obtained could be so classified that a series might be made, each member of which would differ from the next almost insensibly. This, of course, would take a long time to do, as small stars can be examined only in very fine weather. When it was done, however, the results would be very valuable and interesting.

α Gruis.—This is a second-magnitude white star, with the usual spectrum crossed by distinct hydrogen lines.

β Gruis is a second-magnitude star, and nearly as bright as the *lucida* of this constellation. Its color is reddish-orange, and its spectrum is much like that of *γ Crucis*, but the groups of lines are not so distinct, and, generally, there is a sort of approach to the appearance presented by the spectrum of *Mira Ceti*, which I find thus described in my note-book, under the date October 8th, 1878: "Saw to-night the spectrum of *Mira*: it is really wonderful—something like that of *α Herculis*, as given by Chambers. It seems to consist of bright broad bands, with narrow ones in between. These bands are dark, but hardly black. The effect produced is, as it were, that of an irregular set of columus. The brightest part of the spectrum is at the yellow and the green."

α Piscis Australis (*Fomalhaut*).—This star is visible at home sometimes, but its altitude there is so small that it can scarcely be properly observed with the spectroscope. *Fomalhaut* is a first-class star of the most pronounced type; it is very remarkable for the great breadth of the F hydrogen line. In *Fomalhaut* it is far broader than it is even in *Sirius*. As an increase in the breadth of the hydrogen lines has been shown to be due to increased pressure, and as the increase in breadth is also proportional to the pressure brought to bear upon the gas which gives the lines in the spectrum, we may, I would venture to suggest, conclude that the pressure at the surface of this star is extremely great. That is to say, *Fomalhaut* is either extremely dense and compact, so that its radius is very small compared with its mass (which is not very likely), or it is one of the very largest stars in the sky.

In conclusion, I would ask you to overlook any faults of style that may be observable in this paper. It claims to be nothing more than its title announces it to be—"Notes on Southern Stars."

SCIENTIFIC BOOKS.

Mr. W. H. Farrington recently gave an interesting Lectures on scientific books before the American Institute, a full report of which may be found in *Engineering News* of March the 19th. He said that in spite of the large number of scientific works published, there still are constant enquiries for books on certain subjects, which have yet to be written. This he explained was due to various causes, one being that the demand for certain books do not warrant their publication, and secondly, that many works treating on manufactures are withheld, it being the policy of those who could write them, to keep from the public such information. He stated that the English publishers seldom stereotype their better class of books, but print from the type, whereas in America it is the custom to print from such plates, permitting a much smaller edition to be issued. Those interested in the literature of Mechanics, and "*Engineering Science*," should read Mr. Farrington's Lecture from which they may gather many practical hints respecting the purchase of such books.

ASTRONOMY.

THE March number of the *American Journal of Science* contains a paper by T. C. Mendenhall, of Tokio, Japan, 'On the Determination of the Coefficient of Expansion of a Deffraction Grating by Means of the Spectrum." The object of the research was to find the coefficient of expansion of the peculiar alloy of tin and copper, now generally used for ruling gratings. The value of the coefficient of expansion is independent of the wave-length of the line upon which the measurements are made and of the number of lines to the inch. The temperature of the grating was altered by placing the plate in one end of a small wooden box which could be filled with water and brought to any given temperature. The resultant value for the coefficient of expansion from the mean of twenty measurements is

$$E = .0000202$$

DR. MEYER, Assistant Astronomer at the Geneva Observatory, has employed the microphone in transmitting the beats of the standard clock of the Observatory to different parts of the building, and also to the Regulating Clock of the city Time Service. The microphone is fixed upon the outside of the clock-case and placed in circuit with a small battery and a telephone. The beats of the clock can then be readily heard throughout the room.

AT the request of the Treasury of the Royal Astronomical Society, a committee has been appointed to advise the Government upon the steps which it is desirable to take in order to secure observations of the Transit of *Venus* across the sun's disk, 1882, December 6. The committee—which consists of the Astronomer Royal, the President of the Royal Astronomical Society, the President of the Royal Society, Professor J. C. Adams, the Earl of Crawford and Balcarres, Dr. De La Rue, Dr. Huggins, Professor H. J. S. Smith, Professor Stokes and Mr. Stone—has already commenced its labors.

ABOUT a year ago Admiral Moucher asked for a credit of 4,000 francs per year in order to publish a monthly astronomical review. M. Jules Ferry refused the grant, but a similar review is now being published at Brussels under the name *Ciel et Terre*. It appears twice a month and is devoted to meteorology and astronomy.

THE second number of *Urania* contains quite an elaborate article by H. C. F. C. Schjellerup, entitled, "Recherches sur L'Astronomie des Anciens;" also a short communication upon Observations of the Spectrum of Comet 1880 f. (Pechüle) at Dun Echt, and a "Circular from the Smithsonian Institution."

A NEW VARIABLE STAR.—M. N. C. Dunér, of the Lund Observatory, reports upon the 24th of February, 1881, the discovery of a new, small variable. The star is given in the Bonn Durchmusterung (1855.0)

9.4 mag. R. A. = $5^h, 17^m, 32^s.7$.
Dec. = $+ 34^\circ\ 2'.1$.

THE asteroid, No. 217, discovered by Coggia at Marseilles on the 30th of August, 1880, has recently been named "*Eudora*."

WASHINGTON, MARCH, 1881. W. C. W.

We are informed by Professor Davidson that the following is the correct geographical position of the Davidson Astronomical Observatory, San Francisco, Cal.:

Latitude = $37^\circ\ 47' - 22''.3$ North.
Longitude = $122^\circ\ 24 - 39.0$ West of Greenwich.
In time = $8^h\ 09^m\ 38^s.6$

This differs from the figures we recently gave at page 107, in the number of seconds in time.