having a capacity of 8,000 gallons of gasoline or alcohol for the motor. Besides the 200 horse power motor for driving the propeller, there will be a small 25 horse power motor to operate the capstan and for raising and lowering the nets. The large motor has four cylinders of 50 horse power each, and the smaller one two cylinders. The mechanism is arranged so that the small motor can be coupled to the larger, and thus add its power if need be. Both motors work at 300 revolutions per minute and have governors which may be controlled either from the engine room or the deck so as to vary the speed at will. The combustible to be used is either ordinary gasoline or pure alcohol without the usual mixture with gasoline. The carbureter is designed to work equally well with either. As the nets, when they are lowered, might become caught in the propeller, the latter is provided with a sliding covering which may be run down along a guide support and thus be partly inclosed.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The finest region in all the starry heavens now occupies the eastern sky. In one-tenth of the total area of the visible heavens it includes eight out of the sixteen brightest stars visible in our latitude. As we turn our gaze eastward at our customary hour of 9 o'clock on December 15, we find near the horizon the two dog-stars, Sirius and Procyon. The latter is nearly due east, and is somewhat higher up than the former, which, even at its present low altitude, gives evidence of its surpassing brightness. Both these stars are among our near neighbors in space, and both are attended by faint companions, visible only with the largest telescope.

Above Sirius is Orion, with the bright red star Betelgeuse on the left, and the still more brilliant Rigel lower down on the right. Gemini, which lies above Procyon, has also a pair of bright stars. The upper one is named Castor, and the lower Pollux. Still higher up are Auriga (above Gemini) and Taurus (above Orion) bearing the bright stars Capella and Aldebaran.

The long line of faint stars which begins at Rigel and can be traced westward, then southward, and then back toward the southeast, forms the constellation Eridanus. Its one bright star, Achernar, which nearly equals Rigel, can be seen at this season low on the southern horizon from places south of latitude 32 deg. The large constellation of Cetus, the Whale, occupies a great part of the southern sky. The monster's head is marked by an irregular pentagon of small stars, which is now on the meridian, about half way up to the zenith. The brightest star in the constellation, Beta Ceti, lies nearly 40 deg. to the westward, and is the only conspicuous one in the southwestern sky.

Aries is nearly on the meridian above Cetus, and Perseus is directly overhead. Observable minima of Algol will occur on the 12th at 11 P. M., on the 15th at 8 P. M., and on the 18th at 5 P. M. Andromeda and Pegasus are the most conspicuous constellations to the west of the zenith, Cygnus is still visible in the northwest and Lyra is low on the horizon. Ursa Minor and Draco are below the pole, Ursa Major coming up to the east of it, and Cassiopeia and Cepheus high on the west.

We have had some occasion in the foregoing to refer to the distances of certain stars. Nothing in all the realm of astronomy impresses the imagination more than these enormous distances. Indeed, they are so vast that it is hardly credible that they can be measured at all.

The principle used by astronomers to determine them is exactly that of the range-finder employed by modern gunners. Bearings are taken on the distant target from two points as far apart as is practicable. Knowing the distance between these points, the distance of the target can be calculated from the difference of its bearing at the two points.

When we come to apply this method to the stars, we find that the whole diameter of the earth is far too short a base-line. Fortunately, we have a longer one available, the diameter of the earth's orbit. By taking observation of a star at properly chosen dates six months apart, we have a base 186,000,000 miles long, and can proceed with some chance of success.

The next question is: How can we measure the bearing of the star with sufficient accuracy? The best way is to choose some small stars near the one to be investigated, and use them as points of reference. Such small stars are usually so far away that their change of bearing may be neglected, while the nearer star appears to be slightly displaced with reference to them. Occasionally the faint star chosen is no farther off than the other, or even nearer. This is the case with Rigel, which has a ninth magnitude star close to it. The measures showed that the faint star, far from being behind the other, was actually the nearer of the two. But by choosing several small stars and measuring from them all, this source of error can be pretty well done away with.

The whole observed change of bearing of the star is evidently equal to the angular diameter of the earth's orbit, as seen from the star. Half of this, or the radius of the earth's orbit, as seen from the star, is called its parallax. The nearer a star is the greater its parallax will be.

By the methods outlined above, the distances of a considerable number of stars have been measured. The nearest one is Alpha Centauri (invisible in our latitude) whose parallax is three-quarters of a second of arc, corresponding to a distance 275,000 times as great as the sun's.

The most convenient unit for measuring these great distances is the *light-year*—the distance light travels in a year. This is about 63,000 times the sun's distance, so that if we made a map on such a scale that the earth was one inch from the sun, a light-year would be represented on the map by one *mile*.

Alpha Centauri is a little over four light-years distant. Sirius, whose parallax is half as great (0.37 sec.) is twice as far away.

If a star is over 100 light-years distant, its parallax is too small to be measured, and we must remain ignorant of its true distance. This is the case for some of the very brightest stars, and for the vast majority of the remainder. For example, all the conspicuous stars in Orion have no sensible parallax. All we can say is that they must be many times as far away as Sirius or Procyon—how many times we do not know. But it follows that they must be really much brighter than Sirius, which if transported to so great a distance would at best be inconspicuous to the naked eye.

THE PLANETS.

Mercury is morning star until the 12th, but evening star before his passage through superior conjunction on that date. He is too near the sun to be seen.

Venus is evening star, and is also very near the sun, though she may perhaps be visible at the end of the month, when she sets half an hour after sunset.

Mars is morning star in Virgo, and is now rapidly gaining brightness. On the 22d he is in quadrature with the sun, and crosses the meridian at 6 A. M. He is at his greatest phase, and appears through the telescope like the moon three days from the full.

Jupiter is evening star in Capricornus, setting about 8:30 P. M.

Saturn is evening star in Sagittarius, setting at about 7 P. M.

Uranus is in conjunction with the sun on the 14th, and is invisible.

Neptune is in opposition on the 24th. His position on the 1st is in right ascension 6 h. 12 m. 40 s., and declination 22 deg. 16 min. 25 sec. north, while on the 31st it is right ascension 6 h. 9 m. 7 s., and declination 22 deg. 17 min. 27 sec. north. He can be seen with a small telescope, though it takes a large one to show his disk. His green color will aid in finding him, though he can only be certainly identified by his motion.

THE MOON.

First quarter occurs at 1 A. M. on the 8th, full moon at 11 P. M. on the 14th, last quarter at 2 P. M. on the 21st, and new moon at 4 P. M. on the 29th. The moon is nearest us on the 15th, and farthest away on the 2d, and again on the 29th. She is in conjunction with Saturn on the 3d, Jupiter on the 5th, Neptune on the 15th, Mars on the 21st, Uranus on the 28th, and Venus and Mercury on the 30th. On the 13th she occults the fourth magnitude star Delta Tauri, and two smaller ones near it. The occultation lasts from 6:55 to 7:59 P. M., as seen from Washington, and should be interesting to watch with a glass.

At 1 P. M. on the 22d the sun reaches its greatest southern declination, and enters the sign of Capricorn, and, according to the almanacs, "Winter commences."

THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The Scientific Session, as the autumn meeting is called, of the National Academy of Sciences, was held in the Physical Laboratory of the Johns Hopkins University in Baltimore, on November 11 and 12, 1902. Fifteen papers were presented before the Academy, several of which were of considerable importance, and a brief abstract of these is herewith given.

Under the title of "On Elevated Oceanic Islands in the Pacific," Dr. Alexander Agassiz continued a description of the results of his interesting researches into the character of two of the islands of the Fiji group made by him some years since while cruising on the U. S. Fish Commission steamer "Albatross."

Dr. Lewis Boss, Director of the Dudley Observatory, in Albany, N. Y., read a technical paper on "A New System of Positions for Standard Stars, with Notes Relative to its Bearing upon Sidereal Astronomy," and a short biological contribution on "The Embryology of Salpa Cordiformis" was presented by Prof. William K. Brooks, of the Johns Hopkins University.

"The Spectra of Stars of Secchi's Fourth Type," by Prof. George E. Hale, of the Yerkes Observatory and the University of Chicago, was the first paper read before the Academy. It is too technical, however, for abstraction here.

A series of papers by non-members introduced by Prof. Ira Remsen, President of the Johns Hopkins University, were read, and of these "The Preparation of Cells for the Measurement of Osmotic Pressure," by Prof. Harmon N. Morse, called attention to the fact that our knowledge of osmotic pressure has been very defective, because of the lack of an experimental basis for it. It has been seventeen years since Van't Hoff told us that osmotic pressure obeys the same laws as those for the pressure of gases. Since this principle was enunciated not more than half a dozen quantitative experiments in this field have been undertaken. Prof. Morse then explained the results which he had obtained from his studies, and showed cells which he had made himself, and which gave a higher osmotic pressure than has as yet been obtained by anyone in the world.

Prof. Robert W. Wood, who succeeded to the chair of physics in the Johns Hopkins University on the death of Henry A. Rowland, announced, under the title of "A Substance with Remarkable Optical Properties, and Screens Transparent only to Ultra-Violet Light," a discovery which is said to be of great value in science, and which was a notable personal triumph for Prof. Wood. He first described Tyndall's experiments with a screen that cut out all the visible rays of the spectrum, as well as the ultra-violet rays, and let through only heat rays. For the past thirty or forty years eminent physicists all over the world have been trying to find a similar screen that would cut out all the heat and all the visible rays and let through only the ultra-violet rays. Dr. Wood had for some time known that the substance called nitroso-dimethyl-aniline would keep out all the visible and heat rays, except some red and violet, and that it would also let through the ultra-violet. It has been only within the past few days that Dr. Wood has discovered the much-sought screen. He combined the known substance with cobalt glass and obtained a screen that lets through only ultra-violet. One striking peculiarity of the nitroso-dimethyl-aniline, which Dr. Wood dwelt upon and especially emphasized, is the fact that it gives a spectrum about thirty times as broad as that produced by ordinary quartz.

An exceedingly interesting communication on "The Occurrence of Reef Corals near Beaufort, North Carolina," by Dr. Caswell Grave, a non-member who was introduced by Prof. William K. Brooks, was then read. In introducing Dr. Grave, Prof. Brooks said: "Rocks are entirely absent from the coast of North Carolina. The natives use the word 'rock' to designate a bed of oysters. Notwithstanding this, however, I have observed along that coast for many years signs of animal life which seemed to indicate a rocky bottom not far away. Dr. Grave discovered last summer, twenty miles off the coast, what seems to be a coral reef." Dr. Grave then said: "The fishermen about Beaufort have long known of a spot over which, if they strike it just right, they can always fill their boats. In the ship "Fishhawk" we located this place about twenty miles off the Beaufort inlet, half way out toward the Gulf Stream. We dragged it thoroughly, and the many forms our dredges brought up resemble closely those from the coral reefs common farther south. Among other things, we found the corals themselves. Fishing with fifteen lines for the two hours it took us to drift across the reef, we caught seven hundred fish so large that they filled ten bushel baskets. No one could get a bite after we had drifted over the edge of the reef." In discussing this paper President Agassiz expressed the opinion that the bed found by Mr. Grave must be a spit or spur of the great Florida reef, which he and Prof. Shaler traced as far north as South Carolina and there lost.

A "Biographical Memoir of Henry A. Rowland" was presented before the Academy by Thomas C. Mendenhall. It will be recollected that Prof. Rowland was from the opening of the Johns Hopkins University until his death in 1901 in charge of the Physical Laboratory, and it was therefore especially fitting that this memoir should be read in the laboratory where he had so often lectured.

President Agassiz announced the deaths of the following members who had died since the last meeting: Henry Morton, President of the Stevens Institute of Technology, Hoboken, N. J.; John W. Powell, Director of the Bureau of American Ethnology, Washington, D. C., and Ogden Nicholas Rood, Professor of Physics in Columbia University, New York city.

The members were made the recipients of many social courtesies, President Gilman, of the Carnegie Institution, entertaining a number of them at dinner and at a public reception, and Profs. William H. Welch and William Osler giving the members of the Academy a dinner at the Maryland Club.

It is reported that H. W. Menke, of the Field Columbian Museum, Chicago, has discovered in Oklahoma the fossil remains of enormous amphibians. Some of the bones found are as large as those of a modern ox.