F.R.S., gives an exhaustive statement of the experiments that have been made on various targets at Shoeburyness, representing the armour of different ships. A table is given showing the displacement, thickness of armour, and proportion of the former to the latter in ships of different types; this ratio varies from 6·38 in the *Warrior*, 4·00 in the *Alexandra*, to 2·95 in the *Dreadnought*, and 2·50 in the *Glatton;* thus the last may be considered the most heavily-armoured vessel in proportion to size in the navy. The penetration of shot of different diameters and weights with various velocities is given, and the experiments show that it is proportional to the energy of the shot on impact whether due more to velocity or weight, and inversely proportional to diameter of shot; also that the resistance of solid plates is proportional to the square of their thickness. The resistance of composite targets is treated at some length, and a comparison drawn between the various forms adopted in existing ships and the Millwall shield designed by Mr. Hughes, in which the latter is shown to be preferable; but the questions of steel and steel-faced armour which are now attracting the attention of artillerists are not gone into, and are only referred to with the evident feeling that the end of the battle between guns and armour has not yet come.

The paper "On the Resistance given to Screw-Ships by the Action of the Screw-Propeller, and how to Remedy it," by Robert Griffiths, points out an important difficulty in screw-propulsion which has only recently been recognised. A screw-propeller obtains the resistance to drive the ship forward by accelerating the velocity of the currents of water flowing past the stern of the vessel; as in different parts of the screw's disk these currents are encountered at different velocities, the resistance to a blade is not uniform throughout a revolution. In experiments made at Devonport by towing a screw-pinnace, it was found that the water flowed through the lower half of the screw disk nearly at the speed at which the boat was towed, but in the upper half it was so dragged by the boat as to flow past the screw at only half that speed. In dynamometer diagrams, taken with H.M.S. *Rattler*, it was shown that the thrust of the screw varied from 2·9 to 4·1 tons in each revolution. The increase in the resistance of the ship, due to the working of the screw above that due to the ship herself when towed at the same speed, and which Mr. Froude has shown to be 40 or 50 per cent., is considerably greater when the upper currents are more accelerated than it would be if the acceleration were uniformly given to the whole column of water passed through by the screw disk. The author proposes a screw-propeller so constructed that the blades always meet with equal resistance. The blades are so made that more than half their surface is aft of the centre line, so that the pressure on their surface tends to lessen the pitch; they are also made movable in the boss, but so connected that by decreasing the pitch of one, that of the other is increased; when, therefore, one blade meets with more resistance than the other, the increased pressure causes it to turn and throw some of the work on the other.

In his paper on naval guns, Mr. C. W. Merrifield vigorously attacks the Woolwich type of gun, pointing out the disadvantages and absolute futility of the increasing twist in rifling at present adopted. It is now four or five years since this was first done by Prof. Osborne Reynolds, and, aided by the *Thunderer* explosion, it is to be hoped that the time is drawing near when the subject will receive the consideration of the War Department. The author also lays great stress on the advantages of breech-loaders over muzzle-loaders, regarding the latter now, with its complication of gear and fittings, as inferior to the former, even in the simplicity always claimed for it.

Amongst other papers read at the meeting are the following:—"On Sir William Thomson's Navigational Sounding Machine," by P. M. Swan, in which the accuracy of this now well-known apparatus is amply testified by a large number of observations; and a paper by Mr. J. Scott Russell, F.R.S., "On the true Nature of the Wave of Translation, and the Part it plays in Removing the Water out of the Way of a Ship with least Resistance."

OUR ASTRONOMICAL COLUMN

NOTE ON 72 OPHIUCHI (O. Σ. 342).—The publication of the entire series of observations of this suspected double star, made at Pulkowa to 1876, does not lessen the difficulty of arriving at a definite conclusion as to its duplicity or otherwise. On November 1, 1841, it was noted double magnitudes 4 and 7 on Struve's scale, and, no doubt attached to the observation; on May 14, 1842, it appeared single, but at the epoch 1842·72 it was again double, the measures giving for position, 156°·6, and distance, 1″·3. Subsequent observations gave the following results:—

1844·85 ...	Single, or with only a suspicion of elongation at 63°; images excellent.
1845·62 ...	With very good images; no companion seen.
1846·49 ...	Single, or perhaps slightly wedged at 87°.
1847·50 ...	Pos. 162°·4, dist. 1″·61, but there was a doubt if the object observed was not an optical illusion.
1847·70 ...	Pos. 168°·1, dist. 1″·6. M. Struve says: "I feel sure of the duplicity, but the images are not very good."
1848·79, 1850·50, 1851·51 ...	Single.
1851·67 ...	Pos. 166°·3, dist. 1″·49. After the observation a note was added—"This is only an optical deception."
1852·63 ...	Single; under excellent atmospheric conditions.

This last observation appearing decisive, M. Struve considered that 72 Ophiuchi should be omitted from the list of double-stars, and in the following years only examined it once (1859·66), when it was again single under very favourable conditions. But in 1876 he found reason to modify his view: at 1876·67 the satellite was seen very distinctly, with position 156°·0, distance 1″·60; a fortnight later there were only very slight impressions of a satellite, and M. Struve remarked that the principal star of 70 Ophiuchi presented an analogous phenomenon, though less distinctly. Hence arose the suspicion that the said impressions were caused by accidental conditions of the air and the instrument. Nevertheless, on considering the preceding observations and the fact of their being made without the least recollection of anterior ones, M. Struve thinks their approximate agreement cannot be attributed to chance, and that we are necessarily led to infer that the star is really double, but the companion undergoes considerable and rapid variation of brightness. It is worthy of note that only three weeks before the Pulkowa observation of 1859, when the star was pronounced single, Secchi had recorded of it: "Certainly double, and well separated," his measures giving the position 3°·75, distance 0″·61.

THE VARIABLE STAR χ CYGNI.—According to the later observations of Dr. Julius Schmidt at Athens, it is probable that the next maximum may occur on or about April 25, and the next minimum about December 14. At the last observed maximum on March 14, 1878, the star was hardly a fifth magnitude, which is about the mean brightness in that phase, the extreme limits of variation being two magnitudes or 4m.—6m. according to Prof. Schönfeld; at minimum it descends to 13m. No formula has yet been deduced which will represent satisfactorily the totality of the observations, commencing with those of Kirch the discoverer in 1686; considerable

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irregularities following no law so far discovered occasionally presenting themselves. This is particularly evident if we compare Argelander's last formula in vol. vii. of the Bonn observations with the observed times of maxima during the last fifteen years. The place of the true χ Cygni of Bayer, which is the variable, is, for 1880·0, in R.A. 19h. 45m. 57·3s., N.P.D. 57° 23′ 18″; it therefore follows the star to which Flamsteed attached this letter, 4m. 4s., and is south of it 50′·6; Flamsteed's star ought to be called by his number, 17 Cygni. At the times when he was looking for Bayer's χ, as Argelander has remarked, the variable would be near a minimum; hence his observing the nearest star of similar brightness.

THE MINOR PLANETS IN 1879.—Advanced sheets of the *Berliner astronomisches Jahrbuch* for 1881, containing places of the small planets during the present year have been circulated amongst observers, the ephemerides for the planets coming into opposition early in the year, some time since. There are positions of the first 187 members of this group, with the exception of Nos. 99 and 155, for which sufficient data are not available. Only two out of the number approach the earth at opposition, within her mean distance from the sun: *Isis*, on June 20, is distant 0·995, with a south declination of 25°, and *Hertha*, on September 12, 0·988, just upon the equator. No. 154 travels as far south as 50½° about July 14.

BRORSEN'S COMET.—The observations of this comet made at Arcetri and Kremsmunster from March 10 to 19 with Dr. Schulze's other elements, fix the time of perihelion passage to about March 30·5716 G.M.T., which is nearly twelve hours later than that assigned by calculation. The following ephemeris is founded upon this corrected epoch for arrival at perihelion:—

For 12h. Greenwich M.T.

1879.	Right Ascension. h. m. s.	Declination, North. ° ′	Log. distance from Earth.	Log. distance from Sun.
April 14	3 39 10	38 44·7	9·9202	9·8199
„ 15	3 43 59	40 3·9		
„ 16	3 49 0	41 23·0	9·9092	9·8317
„ 17	3 54 12	42 42·2		
„ 18	3 59 37	44 1·2	9·8986	9·8442
„ 19	4 5 18	45 20·0		
„ 20	4 11 16	46 38·4	9·8887	9·8571
„ 21	4 17 32	47 56·3		
„ 22	4 24 9	49 13·6	9·8794	9·8703
„ 23	4 31 8	50 30·0		
„ 24	4 38 33	51 45·4	9·8709	9·8836
„ 25	4 46 25	52 59·5		
„ 26	4 54 46	54 12·1	9·8633	9·8969
„ 27	5 3 39	55 22·9		
„ 28	5 13 7	56 31·6	9·8565	9·9103
„ 29	5 23 12	57 38·0		
„ 30	5 33 57	58 41·7	9·8507	9·9235

EDISON'S LAMP

A COMMUNICATION in yesterday's *Daily News*, from a New York correspondent of that paper, gives a glowing, and to all appearance justifiably so, account of Mr. Edison's success in attaining a form of electric lighting that seems to be in all respects much superior to anything hitherto produced. The first impression made on the correspondent was the mild effect of the light on the eyes, its steadiness, and the absence of that ghastly hue which seems to be an invariable accompaniment of the carbon. This new form of light has only been attained after many disappointments on the part of Mr. Edison, who, however, has all along been confident of success.

During the past two months the progress towards its present perfection has been very rapid. Chiefly contributing to this result has been the discovery of a new alloy, the fusing-point of which is much higher than either platinum or iridium, in fact, than any known metal. This discovery is spoken of by some of Mr. Edison's chief *employés* as the greatest achievement of his life. This alloy also reduces the cost of the valuable metals used in each lamp to such a point as to do away entirely with Prof. Tyndall's criticism. It is said to possess properties heretofore unknown, or at least undefined by scientific men. Not only has it cheapened the cost, but the union of the metals has increased the illuminating power to such a degree that six lights are now obtained per horse power where only four were possible with the pure platinum coil. Six lights per horse-power is the number authoritatively stated, but Mr. Edison's chief assistant does not hesitate to predict that eleven lights will eventually be obtained for each horse-power. This is not expected from the Gramme machine, however, which is now used; but is hoped for after the completion of the new generator, which a dozen of the most skilled workmen at Menlo Park are now engaged in constructing.

The lamp itself takes many forms. In some instances it is attached to the wall, like a gas bracket, and in many others it hangs from the ceiling and takes the external form of a glass globe, capped by brass or nickel attachments. There is none of the hissing, sputtering, and flickering observable in the carbon lamps. The lamp which attracts most attention is, in appearance, a St. Germain student lamp, without the reservoir for the oil. It stands in the middle of a small table, and two fine covered copper wires alone connect it with the main conducting cables from the Gramme machine. In this the *Daily News* correspondent tells us, are embodied all the latest improvements. He also tells us that there cannot possibly be any mistake, as Mr. Edison has taken crucial precautions in all directions. There is nothing in the lamp itself that gives any idea of its construction. The cunning device for rendering the flame steady is in reality the idea of the quadruplex telegraph applied to heat instead of electricity. Now that the new alloy has been discovered, its twofold purpose of preventing fusion and steadying the light is no longer served. The expansion of the tiny key, or switch, breaks the current for the fraction of a second, and permits the actual, though imperceptible, cooling of the incandescent coil. This connection is made and broken many times during each second, so that to human eyes the light is constant as the sun. The movement of a finger and thumb converts the glowing meteor before us into a night lamp for a sick-room. Again, it is seen at one-candle power, then at two, and so on. It is as manageable as a tallow dip, and much more satisfactory. It will not go out of itself, and needs no care. The little coil of wire is hermetically sealed in the glass chamber. It is not in a vacuum, but the chamber is filled with air. There is a sensitive spot on the metal cap in which the glass tube sits, and the expansion of the air manipulates the switch. The heat of the metal itself, therefore, is no longer relied on. The inventor explains that after all manner of severe tests this has been found the easiest and the least easily deranged manner of controlling the light. The difficulty of making thin plates of metal of equal density and weight rendered the previous method impracticable for small lights, although it will probably be the best form in which to secure the desired result where the lamps are to show lights of great intensity.

As there seems no reason to distrust the evidence of the *Daily News* correspondent, it may be accepted that Mr. Edison has succeeded in going a long way to solve some of the difficulties connected with the practical adoption of electric lighting. It is stated that in a few months the Edison Company will be prepared to supply the light to such private consumers as may desire it at at least one-third or one-fourth the cost of gas.

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