grated by moisture. The rubber coating, however, serves to keep out the moisture, and the brass wire in the packing prevents blowouts.

Another steam packing designed for permanent joints comprises a mixture of rubber and graphite. The material is put on the market in its unvulcanized state; but it contains the requisite amount of sulphur, so that when set in place it is automatically vulcanized in the joint by the heat of the steam. The material can thus mold itself to the joint, and will take up any unevenness in the surfaces with which it contacts, but when once it is set it will retain its shape unchanged.

RUBBER BELTS.

The term "mechanical rubbers" is quite a broad one, and covers a great variety of subjects, with which we cannot deal in these limited columns. We have endeavored to describe only such of the principal branches of manufacture as possess particular interest and novelty. But before closing, mention should be made of the rubber belting industry. The belting is made of cotton duck, coated with pure Para rubber. The duck is coated in a frictioning machine in the same way as is the canvas used in hose. The duck strips are assembled in as many plies as may be desired. The strips are rolled together in this form, and are then vulcanized. Rubber belting has the advantage of being very economical, and if properly used will last a long time. Aside from this, it may be used in places where leather belting would not be suitable, because it is not affected by heat or cold, and will not swell in damp weather.

Racing Carnival of the Motor Boat Club of America.

The International World's Motor Boat Championship was won last week by J. F. Anderson's "Irene" over a 30-mile course on the Hudson during the carnival races of the Motor Boat Club of America. The contestants ran thrice over the ten-mile course which was measured from the club station at 108th Street, up the river to Fort Washington Point, down to 64th Street, and back again to the club quarters. In the race on Wednesday E. J. Schroeder's "Dixie," which was twice winner of the international championship and also winner of the Harmsworth cup off the English Channel, was expected to beat its competitor, the "Den," owned by J. H. Hoadley. In this race the "Irene" did not compete, as it had been too badly battered by Tuesday's storm. The result of the race was that the "Dixie" had to drop out owing to carburetor trouble, and the "Den" finished alone in 1 hour, 15 minutes, and 52 seconds. In the second race of the series the "Den" declined to compete, and the "Irene" won from the "Dixie" in 1 hour, 15 minutes, and 7 seconds. In the finals the "Dixie" was unable to race owing to a cracked cylinder, and the "Irene" beat the "Den" by nearly four minutes. The time of the "Irene" was 1 hour, 15 minutes, and 56 seconds, while that of the "Den" was 1 hour, 19 minutes, and 47 seconds. Immediately before the International World's Championship Race was run the "Den" and H. N. Baruch's "Skedaddle" competed for the One Nautical Mile Championship (flying start). In this race, the boats ran a mile three times upstream and thrice downstream, and the average speed was counted. The "Den" won with an average of 25.622 knots, or 29.504 miles per hour. The average of the "Skedaddle" was 23.334 knots, equivalent to 26.1 miles. The contest for the National Motor Boat Championship was won by the "Skedaddle," which retains the title and cup. The Interstate Championship was captured by C. J. Swain's "Sparrow."

Fulton Day at Jamestown.

On September 23 a Robert Fulton celebration was held at the Jamestown Exposition. A spectacular feature of the celebration was a typical representation of what the inventions of Robert Fulton meant to the world. It was the assembling in Hampton Roads just off the exposition grounds of every sort of craft propelled by steam.

While the Italian Lloyd's transatlantic steamer "Princess Yolande," 12,000 tons, the largest emigrant ship ever built in Italy was being launched, on September 21, at Rivotrigoso, near Spezia, she heeled over and rushed into the sea on her side and sank. A number of workmen and guests who were on board were saved. The slipway is supposed to have been too steep, and before the vessel floated her portholes plunged under water.

THE NEW PHOTOGRAPHIC MERIDIAN TELESCOPE OF THE PARIS OBSERVATORY.

BY JACQUES BOYER.

The instrument for the determination of right ascensions which is shown in the accompanying photograph has been installed in the Paris Observatory by Profs. Mascart and Ebert. It was designed by Prof. Lippmann, constructed by Gautier, and is based on the following principle:

If a collimator is directed in the plane of the meridian and a cylindrical mirror, with its axis normal to that plane, is placed in front of the lens, the rays which emanate from the illuminated vertical slit at the other end of the collimator will be spread out by the mirror into a plane sheet, which will intersect the celestial sphere in a meridian circle. If these rays fall on the object glass of a telescope, visual or photographic, which simultaneously receives light from stars, the images of the latter will be formed in the focal plane, together with a line which represents the image of the great circle of the heavens (the circle of reference) traced by the luminous sheet reflected from the cylindrical mirror. For convenience the eyepiece of the visual telescope is placed at the side of the tube and the rays coming from the objective are reflected into it by a mirror.

The telescope is mounted equatorially in order to permit long photographic exposures to be made. The diameter of the object glass is 6.3 inches. The slit of the collimator is provided with an instantaneous shutter which is opened and immediately closed once a minute by clockwork. The theoretical field of view of the instrument comprises 180 degrees and stars of the 9th magnitude can be photographed with an exposure of 12 minutes.

The plates show, in addition to stellar images, a

THE NEW PHOTOGRAPHIC MERIDIAN TELESCOPE OF THE PARIS OBSERVATORY.

number of black lines which are the photographic impressions made by the luminous meridian plane of reference at intervals of one minute. The right ascensions of the stars can be computed from the distances between their disks and the black lines, the clock time being given by the positions of the images of standard stars. The distances are measured with a micrometer and the right ascensions are obtained to 1/10 of a second of arc. About thirty stars are photographed on each plate. Because of the unsteadiness of automatic electric lamps the slit is illuminated by an electric arc which is regulated by hand, and the telescope is shielded from all reflected and extraneous light.

The formulas which are used in reducing eye observations are also employed in this photographic method, in which many data, free from personal error, are obtained in a few minutes. In the photographic determination of stellar co-ordinates it has hitherto been necessary to refer images of faint stars to images of brighter stars on the same plate and then to connect these brighter stars with standard stars by eye observation. Hence it was necessary to know the simultaneous indications of three independent instruments—the photographic telescope, the reticle telescope, and the clock—which in the new method are replaced by a single apparatus.

Profs. Mascart and Ebert are now endeavoring to introduce improvements suggested by their preliminary experiments. In particular, they propose to increase both the length and the diameter of the collimator, to prolong the running time of the driving clock in order to be able to increase the exposure, to devise means of photographing more southerly zones and determining the nadir, and to modify the circuit breaker so that the opening of the slit may be made

at regular intervals of any desired number of seconds.

With these improvements the new apparatus may be expected to give rapid and accurate determinations of the right ascensions of the heavenly bodies.

THE OUTLOOK TOWER OF BEINN BHREAGH, THE FIRST IRON STRUCTURE BUILT OF TETRAHEDRAL CELLS.

BY T. W. BALDWIN.

An experimental structure embodying several new and interesting features of construction has recently been built by Dr. A. G. Bell at his summer home in Cape Breton.

From the general appearance down to the minutest details its construction is a departure from ordinary engineering practice.

Perched up on the top of a hill some 500 feet above the Bras d'Or Lakes, it looks like a huge camera tripod, but in reality is a lookout tower about 70 feet in height, made to demonstrate the tetrahedral principle applied to large structures.

Dr. Bell has used the tetrahedral principle in the construction of his man-lifting kites for some time, finding that it gives a perfectly braced structure of great strength and lightness. It occurred to Dr. Bell that this system might be used to advantage in engineering work on a large scale, and this tower is the first iron structure built on this principle.

The unit cell, which is the basis of the whole tetrahedral system, is the framework or outline of a solid having four sides, as the word tetrahedron implies. The solution of an old trick of making four triangles out of six matches may serve to impress the idea on the minds of some. This is an impossibility if the attempt be made to get them all in one plane, but the moment it occurs to one to make a triangle first and then a tripod of the three other above, it is very simple indeed.

The resultant structure, if the sticks are fastened at the four corners, gives a regular tetrahedral cell, which is the unit of construction analogous to the brick in ordinary building. This miniature truss, made of four triangles in different planes, gives a framework of wonderful stiffness and strength. It also lends itself easily to combinations having the same good qualities to a remarkable extent.

Utilizing this principle, the cells used in the tower were made of ordinary 1/2-inch galvanized iron piping, secured at the four junction points by cast-iron corner pieces, into which they screwed. The piping was cut into lengths of 44 3/4 inches, allowing 5/8 of an inch thread in each casting, when the cell measured exactly 48 inches from tip to tip of the castings. One of these cells was subjected to a compressional strain of 4,000 pounds without showing the least sign of failure.

The tower, which is composed of 260 of these cells, rises to a vertical height of about 70 feet above the ground. It rests on three concrete foundations, which go down to bedrock. A glance at these widely separated points of support (72 feet apart in the form of a triangle) at once suggests several questions as to the method of erecting the large tripod structure above them, and herein lies a distinct and useful feature of the tetrahedral system. Employing ordinary methods, its erection would have been very expensive, necessitating an immense amount of staging and falsework; but upon the cellular system of construction it was very simple, and no staging or falsework of any kind whatsoever was required. Practically all the work was done on the ground, the workmen having all the advantages of *terra firma* until the last section was completed.

The plan of erection was a simple one. The leg containing the stair and one of the other legs were first built along the ground, forming a large V. In this position the foot of each leg was securely fastened by a hinge to its foundation; the hinge forming an axis, about which it was free to turn if raised at the junction of the two legs (which corresponds to the point of the V, and was directly above the third foundation).

A system of jack screws was used to do this, and the third leg was built up section by section. For convenience and safety during this operation, an arrangement like a gallows was made, to support the structure while the next section was being bolted on.

It consisted of four braced uprights of stout timber with a cross beam between them. Most of the weight of the structure during a lift was taken upon this cross beam, under which two large jack screws were operated. When the structure had been lifted four feet (the length of one cell) all the weight was taken