experiments, and finds it much smaller than Herapath did, namely, 1·557.

Prof. Mayer also gave formulæ of transmission of Röntgen rays through glass, tourmaline and herapathite. To determine whether rays just go through or nearly go through, he uses a wire grating which will appear in the picture if rays go through. Transmission depends on the thickness of the glass plus the time of exposure. Glass of various thickness is used, one plate being superposed upon another in successive gradations. The eye cannot distinguish a difference less than about 1/100, and this is what passes through glass of five millimetres thickness. If we begin with glass 1/10 millimetre thick, it absorbs 1/10 of the rays, and each superposed 1/10 millimetre absorbs 1/10 of the residue, so that the formula in general is $I' = Ia^t$. It is evident, therefore, that there is no constant ratio of comparison of absorption by different materials, because the successive powers of "a" have not the same ratio to each other that the first powers have. In the case of herapathite the absorption (a) is found to be ·9382, so the formula becomes $I' = I \cdot 9382^t$. The formula for tourmaline is the same as for glass, so tourmaline is a very imperfect substance to use.

Prof. Ogden N. Rood read a paper detailing his experiments in reflecting the X-rays, which have enabled him to reflect 1/260th part of the rays incident on platinum at an angle of 45° (see NATURE, April 30, p. 614).

Prof. Arthur W. Wright read a paper on the relative permeability of magnesium and aluminium by Röntgen rays. He reported experiments showing that magnesium is much more permeable than aluminium. Magnesium is also more readily wrought than aluminium, thus making it much more desirable to use in the investigation of these rays.

Prof. T. J. J. See, of Chicago University, read a paper on double stars, giving results of three years' observations. He concludes that at the end of 115 years we know accurately only forty; that there is only evidence of disturbing bodies in a few cases, which are indecisive; that great eccentricity of orbit prevails, the average being twelve times as much as that of planetary orbits, and that the law of gravity is rendered probable and may be hereafter confirmed by spectroscopic investigation.

Among other papers read are:—The geological efficacy of alkali carbonate solutions, by E. W. Hilgard, read by G. Brown Goode; on the colour relations of atoms, ions, and molecules, by M. Carey Lea, read by Ira Remsen; on the characters of the Otocœlidæ, by E. D. Cope; on the determination of the coefficient of expansion of Jessop's steel, between the limits of 0° C. and 64° C., by the interferential method, by E. W. Morley and Wm. A. Rogers; on a remarkable new family of deep-sea Cephalopods (*Opistotenthis*), and its bearing on molluscan morphology, and on the question of the molluscan archetype, by A. E. Verrill; on *Pithecanthropus erectus* from the Tertiary of Java, which was discovered by Dubois in 1895, by Prof. Marsh; on the separate measurement, by the interferential method, of the heating effect of pure radiations and of an envelope of heated air, by Wm. A. Rogers; judgment in sensation and perception, by J. W. Powell; exhibition of a linkage whose motion shows the laws of refraction of light, by A. M. Mayer; location in Paris of the dwelling of Malus, in which he made the discovery of the polarisation of light by reflection, by A. M. Mayer. Ira Remsen read a paper on some studies in chemical equilibrium, and several papers were read by title.

The Academy adjourned to meet at New York, November 17, 1896.

WM. H. HALE.

THE MANUFACTURE OF ARTIFICIAL SILK.

LANCASHIRE is on the eve of some important expansions of the textile trades, for, from an interesting article in the *Times*, it appears that the manufacture of artificial silk from wood pulp will shortly be added to her industries. At present the wood-silk comes from France, large works having been established at Besançon under patents granted to Count Hilaire de Chardonnet, who discovered the process, and first established in 1893 the fact that it might be made into a commercial success. The demand for the new commodity increased so considerably that the idea of introducing its manufacture into England was mooted, with the result that a number of silk and cotton manufacturers met to discuss the question, and finally sent out to Besancon a deputation, consisting of some of their own number, an engineer, a chemist, and a lawyer, to investigate the subject thoroughly. This was done, and the outlook was found to be so promising that certain concessions have been secured and a company is now in process of formation, and, to begin with, a factory, which will cost £30,000, is to be built near to Manchester for the manufacture of artificial silk yarn from wood pulp, for sale to weavers, who will work it up by means of their existing machinery. The way in which wood pulp can be converted into silk yarn is explained in the *Times*. The pulp, thoroughly cleansed, and looking very much like thick gum, is put in cylinders, from which it is forced by pneumatic pressure into pipes passing into the spinning department. Here the machinery looks like that employed in Lancashire spinning sheds, except that one of the pipes referred to runs along each set of machines. These pipes are supplied with small taps, fixed close together, and each tap has a glass tube, about the size of a gas-burner, at the extreme point of which is a minute aperture through which the filaments pass. These glass tubes are known as "glass silkworms," and some 12,000 of them are in use in the factory at Besancon. The effect of the pneumatic pressure in the cylinders referred to above is to force the liquid matter not only along the iron tubes, but also, when the small taps are turned on, through each of the glass silkworms. It appears there is a scarcely perceptible globule. This a girl touches with her thumb, to which it adheres, and she draws out an almost invisible filament, which she passes through the guides and on to the bobbin. Then, one by one, she takes eight, ten, or twelve other such filaments, according to the thickness of the thread to be made, and passes them through the same guides and on to the same bobbin. This done, she presses them together with her thumb and forefinger, at a certain point between the glass silkworms and the guides. Not only do they adhere, but thenceforward the filaments will continue to meet and adhere at that point, however long the machinery may be kept running. In this way the whole frame will soon be set at work, the threads not breaking until the bobbin is full, when they break automatically, while they are all of a uniform thickness. The new product is said to take dye much more readily than the natural silk. The chief difference in appearance between the natural and the artificial silk is in the greater lustre of the latter. The success already secured by the new process in France is such that the introduction of the industry into Lancashire is expected to produce something like revolution in the conditions of trade there, not only by bringing into existence a new occupation, but also by finding more work for a good deal of the weaving machinery that is now only partially employed.

A THEORY OF THE X-RAYS.[1]

THE principal facts, which any satisfactory theory of the X-rays is called upon to explain, may be summarised as follows:

(1) The production of the rays by electric impulse, at the kathode,[2] in a highly exhausted enclosure.

(2) Propagation in straight lines and absence of interference, reflection, refraction and polarisation.

(3) The importance of density of the medium as the determining factor in the transmission of the rays.

(4) The production of fluorescence and actinic effects, and the action on electrified conductors.

Two theories have been proposed to account for these remarkable phenomena: (1) the theory of longitudinal waves; (2) the theory of projected particles.

In reference to the first theory it may be said that unless it is proved that an oscillatory discharge is essential to the production of the X-rays, there can be no reason for supposing that these rays are of a periodic nature—that they are wave-motion as commonly understood. The absence of interference, reflection and refraction is also a very formidable difficulty. Attempts have been made to account for the absence of these invariable accompaniments of every known form of wave-motion, but, as I think, with very indifferent success.

The most serious difficulty in the second theory is the attempt to explain the passage of the electrified particles of the residual gas (or of the electrode) through the walls of the

[1] From the *American Journal of Science*, April.

[2] Even should further experiment prove that the X-rays proper originate at the first obstruction encountered by the discharge, the fact remains that this discharge originates at the kathode.