TORPEDO WARFARE.

The Russian operations on the Danube are now inviting attention to this destructive arm of the service. We offer some illustrations of the chief of the present recognized systems. In so doing, it may be well to remark that experiments have rather been directed to the use of torpedoes at sea than to their employment for holding a river such as the Danube, about half a mile wide, against an immensely superior force. But the late daring feat of planting a torpedo against the side of a Turkish ironclad gunboat, will probably be followed by other equally hazardous and perhaps successful attacks, if the Turks are unwise enough to permit their ironclads or other vessels of deep draught to remain within those narrow waters. It will be observed, however, on the other hand, that the more recent failure of a similar attack on a Turkish ship at the Sulina mouth of the Danube, and the sinking of two Russian torpedo boats by the ship's guns, has moderated some of the opinions that were expressed a week or two ago concerning the irresistible power of this novel instrument of warfare.

In the annexed engravings, from the London *Illustrated News*, we illustrate several of the most improved forms of torpedo vessels. The Whitehead fish torpedo is separately depicted in Fig. 4. This machine is a cigar-shaped steel cylinder, 14 feet to 19 feet in length, and from 14 inches to 16 inches in diameter. It is to be sent, requiring no crew, against the ship to be destroyed; and if one torpedo fails to deal the death-blow, another and a third can be sent after the enemy without much trouble or expense. This torpedo consists of three compartments—head, center, and tail. The head contains the explosive, say 360 lbs. of gun cotton; the central chamber holds the machinery and mechanism for regulating it, so as to remain at the depth at which the torpedo is to travel under the water line; and the third part holds the supply of compressed air for the engine. The motive power is supplied by a small engine, capable of indicating 40 horse power, but so compact that it can be made to weigh only 35 lbs. The working pressure of the air in the tail is usually about 1,000 lbs. per square inch; and the quantity carried is sufficient to propel the large torpedo 200 yards at a speed of twenty-five miles an hour, or about 1,000 yards at a speed of seventeen miles.

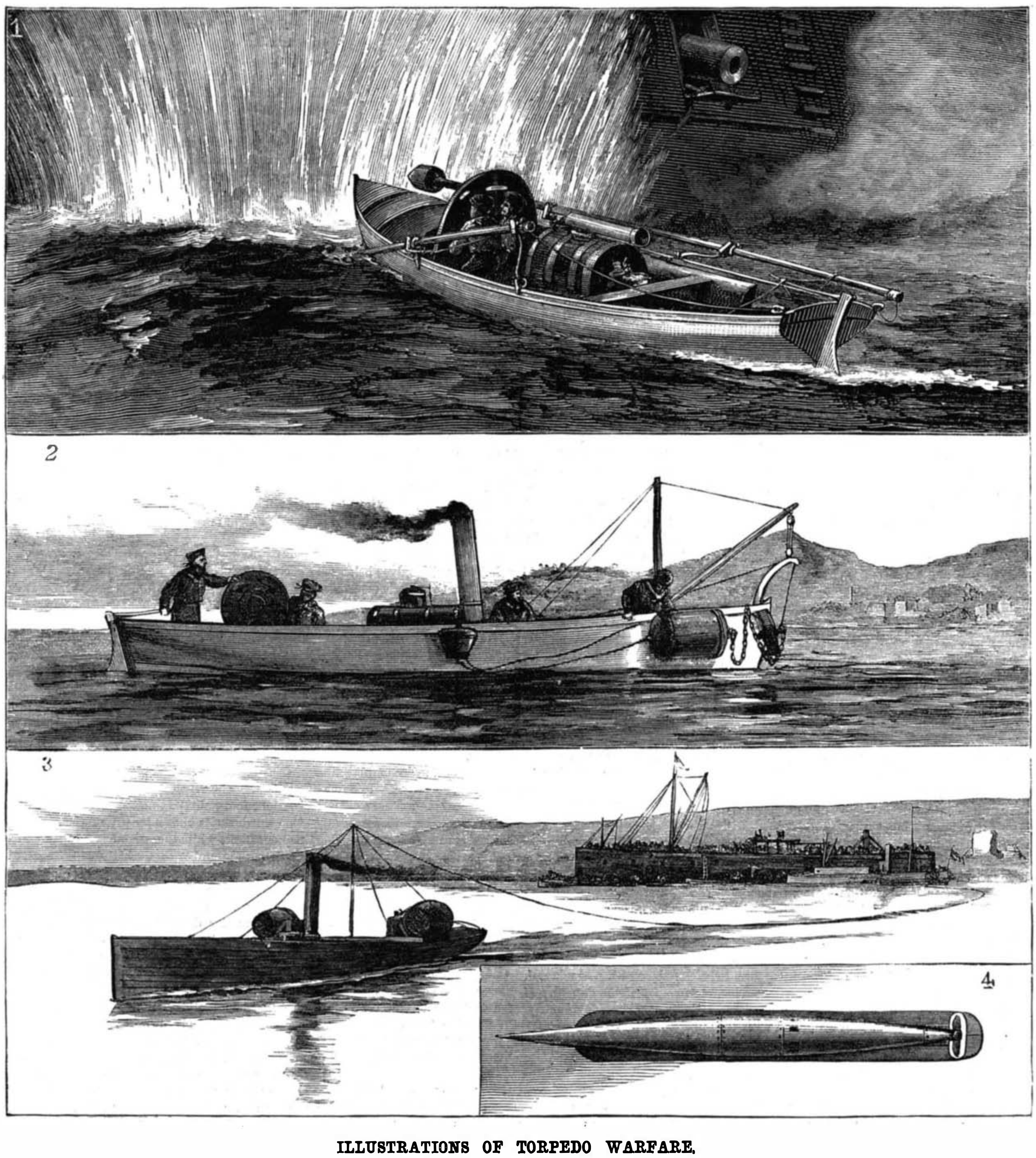
A fish torpedo should be capable of piercing the protective nets that are suspended from booms around an ironclad. Whether such nets, made of rope and wire or any other material, will effectually keep off the torpedo remains to be seen. But probably, if the net is sufficiently strong to keep out the Whitehead torpedo, or to divert its course, this net will be so heavy as seriously to impede the manœuvering power of the big ship, and expose her to the equally great danger of being rammed. Outrigger torpedoes, made of wood or steel, may be carried by large vessels over the bows or sides, either attached to booms above water or propelled through cylinders below the water line, as just described. They can be fired on contact, or at will, by electricity.

Small steam launches, Fig. 3, propelled by steam, or other motive power, and steered by electricity, either from the shore or from a large vessel, or by one man on board the launch, and carrying one or more of these torpedoes, will prove most formidable. They may be used even in a general fleet action, fought in mid ocean, if the water be sufficiently smooth. Generally they will be manned by a crew, and, under cover of gunsmoke or the darkness of night, will be likely to render a good account of their work.

It has been suggested that Holmes' distress signal, capable of emitting a very strong white light at a distance of more than a mile, or some other illuminating power, may be employed by the enemy's ships to discover the movements of torpedo attack. But it is most unlikely that any of the big ship's guns could hit one of these steam launches. And the mere fact of the big ship having to fire these shots would disclose her position, and would, instead of being a detriment, aid the approach of the torpedo boat armed with these infernal machines. It is difficult enough by daylight to hit one of these fleet little vessels; but in comparative darkness, or with a flickering light, it becomes the merest chance whether the gunner, even when thus forewarned, could bring his gun sights to bear upon them. As means, therefore, of defence against the most powerful ships of war, it may be sufficient for ordinary vessels to carry one of these torpedo boats either at their davits or in special compartments, with a few torpedoes, keeping them in readiness to detach at a moment's notice.

The explosive—usually gun cotton—held in a tin receptacle, and secured to the boom end of the torpedo, is fired on striking the vessel's side, Fig. 1, or by electricity, when within a few feet of it; the length of the spar being so arranged that the explosion does not injure the launch carrying it. For this purpose a bow screen is fitted to prevent the upheaved water coming on board the launch. A charge powerful enough to sink an ironclad can be fired at a distance of 20 feet from the bow of the launch without damage to the launch or its crew.

Another illustration, Fig. 2, shows a launch placing torpedoes or submarine mines. Such defences are of great use in protecting a harbor or shipping of inferior force from the



ILLUSTRATIONS OF TORPEDO WARFARE.

fire of an enemy. This class of torpedo consists of an iron cask, part of which contains the charge and fuse, and the remainder is the air space for buoyancy. It is held in position, a few feet beneath the surface of low water, by a chain, which is secured to an iron mooring block. Two or more lines of mines are necessary: they can be fired by the enemy striking them, or by electricity at the desired moment when two observers, stationed at points well situated for getting lines of intersection, note the enemy exactly over the position of a mine. Each torpedo might contain 250 lbs. of gun cotton. We may suppose 100 feet spaces to exist between neighboring mines on the same line, and some 500 feet spaces between each of the lines crossways, over which series of two or three independent lines an enemy would have to pass before entering the harbor. Should the first explosion fail, the torpedo on No. 2 line will be fired as soon as the vessel crosses, and finally, if necessary, the torpedo on No. 3 line. The inside line would usually be supplied with circuit closers in addition to the means of firing them on cross bearings and signal; these circuit closers being always rendered active when darkness or thick weather sets in. To insure the greatest accuracy in firing the torpedoes by cross bearings, telescopic firing keys have been designed, so that all that is necessary is for the observers to watch the approaching vessel through the spyglass, and, whenever its movement brings the firing key over one of the points, the position of a mine, to press it down to close the break in the circuit.

The only way to clear an entrance into a harbor through this defence is by means of countermines suspended from casks or buoys, drifting them either by the current or the wind into the desired position, and then exploding them. A charge of 500 lbs. of gun cotton is calculated to destroy all submarine mines within an area having a radius of 120 yards.

ARE THE ANILINE DYES INJURIOUS TO HEALTH?

This important and interesting question has been answered in various ways, affirmatively, negatively and equivocally. H. Seidler, technical director of the mineral water establishment at Riga, delivered a lecture recently before a scientific society of Riga, from which we abstract a few important points:

In testing whether aniline colors are poisonous the following questions may be asked:

1. Are the dyes made of materials which are of themselves poisonous ?

2. Does a certain quantity of these injurious substances remain in the dyes when finished ?

3. Can the chemically pure dye itself act as a poison?

4. Is food colored with the pure dye poisonous?

5. Do fabrics (such as clothing and carpets) dyed with these dyes, exert a poisonous influence on the body?

1. In answer to the first query, he says: In the manufacture of aniline dyes, or more correctly, of rosaniline dyes, crude products are employed which do exert a very poisonous effect upon the animal system. Nitrobenzol, aniline oil, and the different oxidizing agents, such as mercurial and arsenical compounds, are extremely poisonous substances.

2. By careless purification, the dyes, when finished, can contain one or more of these poisonous substances. The dye may, under some circumstances, act as a poison and produce forms of disease due to aniline, mercury, or arsenic poisoning. Numerous cases like this have already been noticed. If the aniline dyes come into market in a more or less amorphous state, *en pate*, or in solution, we can almost always assume with certainty that they contain more or less of those poisonous substances employed in their manufacture. If they are sold in a dry state, either in powder or beautiful crystals, they are more likely to be pure, although arsenic may always be present, as the purification of dyes made with arsenic acid is tedious and involves inextricable difficulties and expense. The most carefully purified brand of dye, the Oa of Gehe & Co., Dresden, contains $\frac{1}{80000}$ part, or .00125 per cent of arsenic.

A number of technical chemists have attempted to drive out arsenic acid and other poisonous metallic compounds from the aniline manufacture, and have sought to work without the use of these substances. This problem was in greater part solved by Coupier of Poissy in 1869. Coupier made the aniline red by allowing pure aniline, nitrotoluol, hydrochloric acid, and a little metallic iron, to act upon each other at a suitable temperature. Commercial aniline oil, which is a mixture of aniline and toluidin, mixed with commercial nitrobenzol and nitrotoluol, may be employed with the hydrochloric acid and iron. The red obtained in both cases is identical with ordinary red. Meister, Lucius & Brunnig in Höchet, near Frankfort-on-Maine, have overcome the difficulties that opposed the introduction of the nitrobenzol process into practice. The Berlin Actiengesellschaft fuer Anilinfarbenfabrication uses Coupier's process exclusively, and makes 200 kilos (440 lbs.) of rubin daily.

3. Numerous experiments have been made in regard to the effect upon the animal system of pure aniline dyes, which contain no poisonous substances mechanically mixed, and are not the salts of a poisonous acid combined with the base rosaniline. First of all must be mentioned the experiments of Prof. Sonnenkalb, in Leipsig, made upon animals with aniline red and aniline blue, and which prove that pure aniline dyes never are of themselves poisonous. Seidler has now repeated the experiments upon the action of aniline red upon the system, and indeed upon himself, for he did not then know that experiments had been made with aniline red upon human beings. In his experiments he employed aniline red (Rubin from Brueckner, Lampe & Co., Leipsig) made by the nitrobenzol process. A qualitative analysis showed the absence of any metallic compound whatever. Doses of 0.05 grains (.75 grains) or of 0.1 grain produced no uneasiness, and when $\frac{3}{4}$ grain was taken every morning for five weeks, not the slightest injurious consequences were perceptible. Experiments were made on two other persons with like results. This proves pure aniline dyes to be innocuous. The experiments permit of the supposition that Rubin (aniline red) passes through the animal system as indifferent matter, and is removed in a short time (two or three days) with the excrement undecomposed.

4. The answer to the query whether food colored with a pure aniline dye is poisonous is answered by the above. If the pure dyestoff is *per se* non-injurious, liquors and lemonade colored with it cannot exert any injurious effect upon the body. We have only to consider how extremely dilute these dyes are when used for coloring. Aniline dyes are never used to color drinks in such concentration that their consumption would approach any such quantity as that taken by Seidler, without injury.

The divisibility of this dyestuff is very extraordinary, a solution of 1 part aniline red in 1,000 parts alcohol, is very dark red; 1 part aniline red in 10,000 parts alcohol, is very red; 1 part aniline red in 100,000 parts alcohol, is red; 1 part aniline red in 1,000,000 parts alcohol, is distinct pink; 1 part aniline red in 10,000,000 parts alcohol, is pale pink; 1 part aniline red in 100,000,000 parts alcohol, gives an imperceptible coloration, which can be seen by holding a white screen behind the vessel containing the solution.

This divisibility is employed for the greater part in coloring drinks, as lemonade, liquors, etc.

In 100 liters of lemonade, which contains 135 whole bottles of lemonade, there are 13 c. c. of a 1 per cent. solution, so that there is less than a milligram (or $\frac{1}{70}$ grain) of aniline red dissolved in a bottle of lemonade. Hence, a man would require to drink 100 bottles of lemonade to obtain as much aniline red as Seidler and another person took at once in a concentrated form.

The question involuntarily presents itself, can the arsenic in fuchsin be injurious, if the aniline colors are employed in such extreme dilution for coloring drinks, etc.? This is best answered by a simple example. Suppose a manufacturer colored his spirituous liquors with fuchsin containing 10 per cent. of arsenic, a case which never happens. A person that consumes 100 c. c. (nearly a gill) daily would take only 0.02 milligrams (.003 grain) of arsenic. This quantity cannot be considered injurious.

If a careless manufacturer colored his lemonade with analine red containing 1 per cent. of analine, each bottle of lemonade would contain ·01 milligram (·00015 grain) arsenic.

For coloring eggs, aniline red is employod in a concentrated form. Here it is ordered that the purest possible dye, free from arsenic, must be employed, and druggists are only allowed to sell pure wares for this purpose. The presence of 0·00125 per cent. of arsenic could do no harm.

5. Have fabrics dyed with aniline a poisonous influence on the body ? In general it is to be assumed that pure dyes, of themselves, exert no injurious effect on the epidemics, and this supposition is justified in so far as this, that as yet, in none of the workmen in the large aniline factories, nor the laborers that use aniline colors for dyeing or printing, have any illness or skin disease been observed, although the skin, hair, and nails of these people are so deeply dyed that the ordinary articles used in washing are unable to remove the intense coloration.

We have farther to consider that the aniline dyes belong to the class of so-called substantive dyes, that is, themselves possess the power, without the aid of mordants, of attaching themselves to the fibers, and cannot be dusted away by mechanical means, as for example, ball dresses, curtains, carpets, etc., dyed with arsenite of copper—Paris green.

Farthermore, we have as yet no perfectly-well authenticated cases where experience could justify the supposition that wearers of clothing of wool, silk, or cotton, dyed with aniline dyes, although their use is very extensive, have really suffered injury to their health thereby.

Even if dyes containing arsenic and aniline are employed in dyeing fabrics, no danger need be apprehended. In dyeing, it is well known, that all kinds of goods are very carefully washed before they come in the market ; and, farther, it does not seem probable that fabrics dyed with these would contain aniline as such, or metallic salts, after such washings, in quantities sufficient to injure the skin.

If the fabrics dyed with these dyes afford no cause for uneasiness, the same is not true of goods printed with aniline colors. In the latter case, the dye is employed in a more or less concentrated form, and it is quite possible that it might be rubbed off mechanically, and thus enter the mouth, stomach, and intestine canal. Chemically pure dyes are, of course, free from danger. If, however, the aniline dye contains a considerable quantity of arsenic, or poisonous acids, like picric or oxalic acids, or if the dye is fixed on to the goods by means of a poisonous mordant, like the arsenite of soda, or of alumina, the skin, and even the whole body, may be poisoned.

Printed goods and carpets must always be regarded with some mistrust, and in order to be on the safe side, their harmlessness must be proven by a chemical analysis.

If a chemist wishes to test an aniline dye, or fabrics dyed or printed with aniline colors, in regard to their effect on the health, he should not be satisfied with testing for arsenic or other metallic poison, but must also test whether the dye in question is not combined with a poisonous acid, like oxalic or picric.

Novelties Before the French Physical Society.

At a recent session of the French Physical Society, papers, of which the following are abstracts, were presented:

RESISTANCE OF THERMO-ELECTRIC BATTERY.

M. Rolland has studied by Thomson's method the resistance of the clamond thermo-electric elements. His observations are represented by a curve having for abscisa the time and for ordinates the resistance of the element. During the first twenty minutes the curve rises, describing several sinuosities and then becomes parallel to the axes of abscisa. When the heating ceases the curve rises at first very rapidly and then descends oscillating. M. Rolland remarks that the method employed supposes the electro-motive force to be constant, and that consequently the curve may be the result of the variation of the resistance and of that of the electromotive force. The progress of the temperature similarly observed on a copper-iron pile is represented by an analogous curve.

A NEW SYSTEM OF ELECTRIC TELEGRAPHY.

M. Thomasi presented a new system of electric telegraphy applicable to submarine cables of great length, which is essentially as follows: There is a new relay, the sensitiveness of which is such that 5 per cent only of the current of a single Minotto element, after having traversed a resistance equal to that of 2,520 miles of transatlantic cable, and a plate of wood lightly moistened (which represents a much greater resistance), suffices to cause it to act on the printing receiving instruments with the greatest rapidity. A second relay termed interrupter, automatically interrupts the current of the local battery after each emission, hindering a spark from being produced in the first relay. This spark, which may occasion inconvenience in a very delicate apparatus, such as the first relay, produces none in the second, because of the energy of the contact, which renders the consequences of the spark absolutely inoffensive. This relay acts in turn on the printing apparatus and on another local battery. The receiving instrument (Morse system, modified) is composed of two electro-magnets, which operate converging metallic points. One point impresses a red and the other a blue trace on the same band of paper, according as the operator transmits the Minotto current in positive or negative direction. Different combinations of these red and blue marks indicate numbers, letters, words, and even entire phrases. The transmitting apparatus automatically reverses the current after each emission, and the emissions are exactly of the same duration.

NEW STELLAR SPECTROSCOPE.

M. Mouton presented a spectroscopic telescope designed for stellar observation. The instrument is quite small, and may be adapted to telescopes of any kind. It consists essentially of a small telescope containing one or more direct vision prisms between the eyepiece and objective. Near the objective and outside is the slit. Finally, outside the slit is another cylindrical telescope which produces on the slit a linear image of the star. The collimator is suppressed and the objective of the spectroscope projects upon the eyepiece simply the image of the slit. The loss of light is said to be much less than is the case with ordinary spectroscopes.

New Investigations on Electro Deposition.

At a recent session of the French Academy of Sciences, M. Jamin presented, in behalf of M. Gramme, a note containing many new facts relative to the weight of galvanic deposits which may be obtained per unit of mechanical work by using the magneto-electric machines of which M. Gramme is the inventor. Four series of experiments are summarized. In the first the baths, in variable number, were coupled as for quantity. The results showed that the deposit per foot-pound of energy expended does not vary with the augmentation of the surfaces of the anodes. In the second series the baths were connected as for tension. Their number varied from one to forty-eight, but all had electrodes of like extent. The results obtained prove that the deposit of copper per foot-pound augments with the number of baths. In the third series the intensity of the cement was maintained constant, while the surface of the anodes and, at the same time, the number of the baths were augmented. These experiments demonstrated that the expenditure of work in eletrolysis may be considered as null when soluble anodes are employed. In the fourth series, insoluble anodes were used. A smaller deposit per foot-pound and considerable polarization resulted.

M. Gramme's note throws some new light on the question of galvanic deposits, and his experiments will be of much service to the industries in which magneto-electro-machines are rapidly supplanting galvanic batteries. The first apparatus densed by the inventor gave a deposit of 123 grains of silver per hour and per kilogrammeter (7·04 foot-pounds). At present Mr. Wohlwill of Hamburg reports that he has a Gramme machine that deposits 94 6 pounds of silver with 15 horse power, which corresponds to 616 grams of silver per hour and per kilogrammeter. M. Gramme considers that by the aid of his recent investigations he will be able to obtain a deposit above 3,080 grams per same units.