temporarily been secured in Baltimore, on the outskirts of which city are the grounds Mr. Hopkins has left for the hospital and university which in future will bear his name. The trustees have already selected the President of the University, and an admirable head they have found in Mr. Henry Gillman, formerly the Principal of the San Francisco University. Mr. Gillman is now in England, maturing his plans and gaining information from various universities in Europe. The dominant wish of the new president is to gather round him a body of professors and lecturers devoted to original research in their different spheres. Only one chair has yet been filled, namely, that of Mathematical Physics, and to this Mr. H. A. Rowland has been appointed. Though still quite a young man, the good work Mr. Rowland has already done in magnetism has made his name well known among English physicists, and in his new position a brilliant career lies before him. It is hoped that students will be received in 1876, and we heartily wish Mr. Gillman every success in his noble work.

SCIENCE IN GERMANY

(*From a German Correspondent.*)

MUCH as may have been written about bone-formation, yet this theme seems still to be inexhaustible, as in the current series of the "Archiv für mikroskopische Anatomie" (of which we gave the contents in a former report) no less than three papers are published on this subject. Two of these, those by Strelzow and by Stieda, speak of the ossification of cartilage and of bone-growth, and arrive at quite contradictory results. The older view on bone-growth starts from the supposition that the bones once formed undergo no further plastic change, that their single parts cannot displace each other, that therefore an insterstitial growth cannot be imagined. If the growing bone, as usual, does not merely show a uniform increase in size, but little by little changes its shape too (the bent bones for instance, the bends of which change during growth), this naturally leads to the supposition that besides the deposit of fresh material, a solution or absorption of those older materials took place, which did not fit the new shape. In opposition to this view, which Stieda also defends, Strelzow tries to prove that the bone grows interstitially, that therefore it can change its shape in an outward direction without reabsorption of any of its parts, that it is useless therefore to suppose the latter to take place, and that there is no reason for such a supposition. Now, with regard to the change from cartilage to bone, it has certainly been proved, for most cases, that the cartilage is first destroyed before in its place a bone grows from fresh materials. But while Stieda thinks this the case everywhere, Strelzow observes that the lower jaw and the shoulder-blade form exceptions to the general rule, the cartilage there passing immediately from its softer state to bone. Hertwig's observations, which he makes with regard to his investigations of the teeth of Reptilia, have a much more extensive range. In Hemibatrachia the teeth form earlier than any other bones of the head, and starting from this basis those bones in the oral cavity are destroyed, which only cover the exterior of the original cartilage skeleton, and are therefore called covering bones. In frogs these bones certainly form without the help of the teeth, which only appear at a later stage; but as frogs (Batrachia) and salamanders (Hemibatrachia) are of the same order, and particularly as the former are the more recent family, Hertwig thinks that in their ancestors the formation of teeth took place in the same way as in the salamanders now, but that in course of time they lost the primitive bone-forming teeth and retained only the bones resulting from them. The formation of teeth now observed in frogs is therefore a secondary phenomenon. Just as the bones of the oral cavity have their origin in the teeth, Hertwig supposes the covering bones on the exterior of the head to result from scales, and states that this is still very evident with certain fishes. What is a rule for lower vertebrata may also be applied to the higher orders, so that *all* covering bones may be derived from scales or teeth, which in sharks and rays are still equivalent and homologous formations. Therefore sharks and rays must be looked upon as the oldest forms of Vertebrata provided with bones; they are succeeded first by salamanders, then by frogs, and finally by the remaining reptiles, birds, and Mammalia.

It is a well-known fact that the gland-cells only absorb certain materials from the blood in order to convey them, more or less changed, into the hollow interior of the gland organ, and thus to furnish useful substances to the organism (secretions), or to remove useless ones from the same (excretions). Wittich demonstrates these relations in a particularly clear manner ("Archiv für mikroskopische Anatomie," 1875). After the injection of differently coloured solutions (carmine ammonia, indigo-sulphate of soda) into the blood of living rabbits, these colours are again excreted by the kidneys. If the animals are killed during this excretion, and the glands are examined, the carmine is only found in the gland vessels, not in their cells; the indigo, however, in the cells also. Such experiments evidently show that the gland-cells have a sort of selective affinity for the two colouring materials, letting the one pass entirely, and partly retaining the other in their interior.

In the same journal Neumann acquaints us with an interesting property of the cells which coat the abdominal cavity of a frog. It is known that some of these cells in female frogs are furnished with cilia, by the motion of which the ova ejected from the ovary into the abdominal cavity are introduced into the openings of the oviduct. Waldeyer, in his book, "Ovary and Ovum," had maintained that as the essential parts of the female genital organs result from the coating of the embryonal abdominal cavity, those ciliated cells physiologically connected with them result from the same basis, viz., the germ-epithelium; while the whole remaining coating of the *later* developed abdominal cavity, with its entirely different physiological signification, must be a formation genetically different from the former. Goette had already proved ("Entwickelungsgeschichte der Unke") that all those formations, together with several others, result from the uniform cell-coating of the abdominal cavity of the embryo. Neumann now specially proves their genetic identity by the observation that these ciliated cells only occur at the time of sexual maturity in the uniform epithelium of the abdominal cavity, and that therefore they represent local transformations of the same. This again confirms the theory, which Goette (*l.c.*) defends for the whole organism, that each embryonal part is not unconditionally intended for certain formations (which has been an accepted belief since Remak), but that from one single and uniform part in the embryo quite different tissues and organs can and may result, solely depending on the locally changing conditions of development. For instance, the coating of the embryonal abdominal cavity, besides the parts already mentioned, also furnishes the fibrous tissue of the intestines, the kidneys, and the heart.

*THE LAWS OF STORMS**

Recent Criticism and Contrary Theories.—The rules referred to in last article are only empirical and are derived from no theory. Mechanics ought to take them in hand and explain them; but it has not been able to do so, for the circulatory movements of both liquids and gases are as yet a closed letter to that science. They are to-day in the same position as were Kepler's laws before

* Continued from p. 403.

the theory of attraction. Why ellipses? said theorists at the beginning of the seventeenth century. And why put the sun in the common focus of all these ellipses? Are there not also other curves followed by these planets in their course around the sun? But once connected with the principle of universal gravitation, these laws, so neglected by contemporaries, became "the immortal laws of Kepler."

Such at present is the position of the Laws of Storms. Despite the adhesion of practical men, meteorologists do not recognise the essential features which *ought*, according to them, to characterise storms. On this account, the practical rules themselves which sailors have followed for thirty years must be rejected; for they are entirely founded, as we have seen, on the circular movement of the air in storms.

These criticisms, more or less direct, based on the theory of centripetal hurricanes or of aspiration, have at the present time all the greater force that mariners themselves have an innate belief in the mere idea of this theory. We even find this belief in the writings of authors who have shown themselves best acquainted with the laws of storms and with the corresponding practical rules. Two examples may be referred to.

The well-known hydrographic engineer, Keller, in his "Treatise on Hurricanes," says that in intertropical regions where cyclones originate, the atmospheric strata underneath the sun dilate and draw up the inferior air of the dilated zone; that if ordinary aspiration, due to the calorific action of the sun, is further promoted by an *electric attraction*, the affluent air will rush with more force into the interior vacuum, &c. Within this space or vacuum he conceives that the water of the sea raised by the central aspiration of a typhoon or a waterspout ascends. When the gyratory column passes from the sea on to the land, it hurls against the shore the water raised by aspiration, and the sea suddenly inundates the low coast to a considerable distance inland. Finally, on land, the force of aspiration of these phenomena exercises its ravages not only by throwing down, but by tearing up trees, and overturning even solid buildings.

M. Bridet, again, asserts that there is formed under the action of the sun, a sort of vacuum resulting from the rapid ascension of masses of heated air. This vacuum is rapidly filled up by the lower currents of air which flow towards it from all directions. These currents, flowing along the surface of the earth, acquire a gyratory motion from the daily rotation. On reaching the base of the ascending column, near the centre of rarefaction, the air carried by these currents gets heated, and expands in its turn; it follows the ascensional movement of the molecules that it replaces, and rises, preserving its rotatory motion.

Persuaded of the reality of this immense draught which the aspiration of ascending columns of heated air must exercise on the lower stratum, in the manner of a chimney, sailors themselves must say that the circular diagram which Reid and Piddington have used for cyclones is scarcely admissible from the theoretic point of view; that already the centripetal movement has been recognised in waterspouts and tornadoes, which, after all, are only cyclones in miniature; that the convergent diagrams proposed recently by Mr. Meldrum, of Mauritius, have perhaps a better foundation, more especially if, as Mr. Meldrum affirms in the cases of two storms which he has recently discussed, these convergent diagrams better represent the true features of the hurricane than concentric circles. Mr. Meldrum's "Note on the form of Cyclones in the Indian Ocean" has been published by the Meteorological Committee of the Royal Society, and is thus well known. We reproduce one of the figures (Fig. 4), and ask the reader to compare it with the circular diagrams of the hurricane in Cuba (Fig. 1); the difference of the two systems will be seen at once.

According to the first the centre is situated perpendicularly to the direction of the wind; according to the second, it will be situated (neglecting for the moment the curvature of the spirals) in that very direction. There is here a difference of nearly 90°.

What will hereafter be the position of sailors in the face of an imminent danger? This is in substance what they are told:—You feel, you see, that a danger menaces you; the aspect of the sky, the state of the sea and of the winds, the steady fall of the barometer, already tell you that there is not a moment to lose if you wish to take the step which may save all. Hitherto you have believed, in the faith of certain empirical rules, that the danger is on your left; not at all—by my theory it is before you.

The captain has no time to search the works of Reid, of Redfield, of Piddington, or to examine the theory of centripetal hurricanes. This is a question which must be quickly answered. Is it necessary, in order to this, to make one's self familiar with all that has been done during the last thirty years in order to *try*, in this repetition of the first investigation, if the centripetal diagrams represent the direction of the wind better than the circular diagrams? This is a labour which would require at least many years.

Happily there is another method of solving the question, which is to examine that theory of hurricanes of centri-

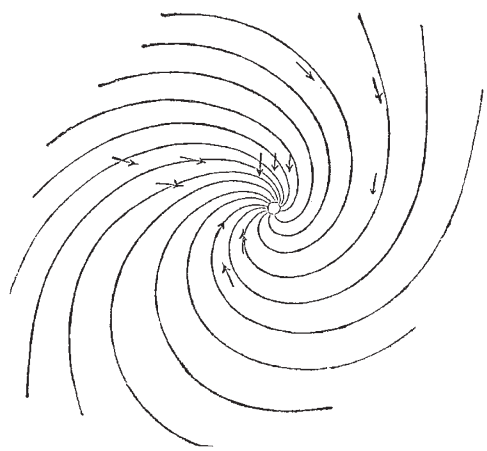

FIG. 4.

petal aspiration which has given rise to all these doubts with regard to the laws of storms. If this theory is found to be true, the authors of the "Laws of Storms" will certainly have been wrong in neglecting its indications. Let us therefore put aside their pretended circulatory movements. The air moves towards a centre of aspiration instead of turning round a point; all will thus be changed, and especially will it be necessary to promulgate practical rules altogether different. But if the theory of aspiration is proved to be false—and, to know what to believe on the subject, long years are not necessary—a rapid examination will be sufficient; if it is false, we say, sailors may continue to place confidence in the rules which have been so serviceable to them for thirty years.

By investigating the whirling movements of which the sun is the theatre, M. Faye was led some time ago to examine this theory without any reference to nautical matters. He has found it completely illusory. On the contrary, that theory which fits into the solar phenomena is found to agree thoroughly with the Laws of Storms; and we need not be astonished at this agreement, for the laws of mechanics are the same everywhere, and the gyratory movements of fluid masses will not vary more in the case of one heavenly body as compared with another than the laws of gravitation. Putting aside solar questions, which interest only astronomers, we shall treat

of the purely meteorological question, and in the meantime place before the reader the conclusions of this essay:—

1. The idea of centripetal hurricanes of aspiration originates in an illusion of the sense of sight; it is an old prejudice whose history it is easy to follow from the most remote times to the present day.

2. The theory of centripetal hurricanes, suggested by this prejudice and the hypotheses which it implies, cannot be accepted. The adoption of similar ideas by enlightened minds is only to be explained by the venerable authority of this prejudice.

3. Bases of the mechanical theory of gyratory movements; agreement of that theory with the Laws of Storms. These ought to be considered as a first but excellent approximation; a means of making further advances.

1. *History of a Nautical Prejudice.*—In the midst of the profound calm which often precedes thunderstorms, the lower strata of the atmosphere are not agitated by the least breath; heavy clouds approach at a great speed and cover the sky—a clear proof that powerful currents prevail above, the influence of which does not extend to the ground. From one of these clouds a sort of bag or end of a tube or funnel is seen to issue, and which gradually descends, lengthening at the same time. It seems to be formed of the same material as the cloud; and in fact is a true fog which envelops the cloud, thus rendering it visible to our eyes.

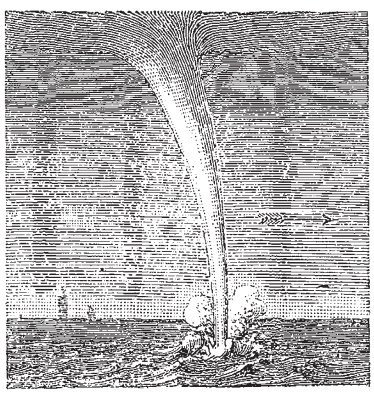

FIG. 5.

Meantime the centre of this funnel is agitated by a violent whirling movement of which the small whirlwinds of dust that are sometimes seen on our roads give a very accurate idea. When the waterspout reaches the ground and encounters obstacles in its way, it sets to work upon these after the manner of a turning machine of great speed at the end of a vertical axis. It raises around its lower extremity a cloud of dust, overturns trees, batters down walls, and unroofs houses. If, instead of land, the waterspout meets with a water surface, it acts upon it like a square-bladed scoop at the end of a vertical axis, and the churned water is thrown to a distance in foam; if it advances on a pool, is empties it in an instant; if on a lake or a sea, the water spurts out all round the foot of the waterspout in clouds of spray.

Look particularly at this long vaporous tube (Fig. 5), which extends from the surface of the earth to the clouds, to a height of from 1,600 to 2,000 feet and upwards; it appears flexible, and has an undulatory movement through its entire length: the least breath of air alters and distorts its form; and its whirling movements are felt down even to its base, which sweeps over the earth, carrying devastation in its train. If it assumes greater dimensions, it is no longer a waterspout, but a tornado. We have here in two words the history of the tornado of Jan. 20, 1854, which occurred in the county of Knox, Ohio, and which in half an hour levelled 50,000 trees with the ground, hewing for itself a pathway through the forest a quarter of a mile broad, which could not have been made in some weeks by a whole army of backwoodsmen.

The tube, which takes the form of a pillar, a funnel, the trunk of an elephant, &c., usually disappears after being as it were broken across, by the violence of its own gyratory movements. Further, the misty vapours which compose it slowly ascend, and the combination of the ascending and whirling motions gives the appearance, when seen at some distance, of a spirally ascending movement, which, however, bears no relation to the internal gyrations of the waterspout. Movements, not real but illusory, are all that are perceived. The spectator supposes he sees objects ascending in the interior of the waterspout. Thus a bit of cloudy vapour looks like a bird caught by the waterspout and rapidly whirled aloft. If the vermicular motion is continuous and along the whole length of the waterspout, the question is asked, what can in this manner ascend in a long tube whose base is plunged into the sea and which violently agitates its surface. At once and without any inquiry the logic of the imagination comes into play, and the conclusion is come to that it is the water of the sea which the waterspout is in quest of; this it pumps up and distributes among the clouds, and its ascent up the tube is plainly seen. No question is put as to how a tube composed of aqueous vapour can hold and sustain deluges of solid water. Moreover, are the clouds not seen rapidly to grow portentously heavier and bigger by the water so abundantly supplied by the waterspout?

It were idle to listen even to observations made under such impressions. For thousands of years sailors have transmitted from age to age tales of waterspouts which have lifted ships into the air, sucked up the water of the sea, and poured it down again on some hapless ship which was unfortunate enough to pass under and break the tube of the spout. Tales like these, unceasingly reproduced with ever-fresh details, powerfully aid the illusion in determining the event before it is seen.

(*To be continued.*)

NOTES

AN interesting service to astronomy has been rendered by Mr. Davidson, the head of the American Transit Expedition to Nagasaki, Japan; he has determined the exact site of Abbé Chappe d'Auteroche's Observatory in 1769, when he observed the transit by order of the French Academy of Science, at St. Joseph, California. As Abbé Chappe died soon afterwards from a fever caught while fulfilling his mission, his narration was completed by people who had never been on the spot; a blank has been left in the records of his observations, which has now been filled up 108 years after the event. The Abbé Chappe was an uncle of the celebrated Chappe who invented telegraphs during the wars of the Revolution.

M. LECOCQ DE BOISBAUDRAN, who is well known in connection with spectroscopic analysis, has just announced the discovery, by means of the spectroscope, of a new chemical element which he calls *gallium* and affirms to be closely allied to zinc. The spectroscopic character of gallium is two violet lines, one corresponding to wave-length 417, and the other to 404, but fainter. The communication was made by M. Wurtz, at Monday's sitting of the French Academy. A commission has been appointed to report on the discovery. Gallium is said to be found in a special blende from Pierrefite mining works, in the Argeles Valley.

IT appears that M. Janssen's observatory is to be built at Fontenay at the expense of 80,000 francs. A sum of 50,000 francs is to be spent on instruments, exclusive of the apparatus used in the transit of Venus. He is to have two assistants, each of