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EQUIPMENT OF THE MANILA OBSERVATORY.

It is well known that the Manila Observatory enjoys a well-earned reputation because of its accurate reports and weather forecasts. However, as few men in America have an accurate or extensive knowledge of the instruments used by the Observatory staff, it is the purpose of the writer to give a brief description of the equipment for the benefit of the BULLETIN readers.

The Observatory is the Central Office of the Weather Bureau. Every day a weather forecast is published and, when there is a typhoon in the vicinity, warnings are also given to the public as often as it is necessary. To obtain this information, a daily weather map is made out. All observations required for this map are sent to the Observatory directly from the central postoffice (in charge of the telegraph system of the Islands) to the telegraph operator in the Observatory. These telegrams come from forty-two stations in the Islands and twenty-six stations in China, Indo-China and Japan. Information is received from observations of "atmospheric pressure; temperature; direction and force of the wind; amount, form, and direction of upper and lower clouds; state of the sea and weather; rainfall; earthquakes, of any occur shortly before or after the time of the reported observations; the maximum and minimum temperatures" (copied from "Practical Instructions and Regulations for the Observers of the Weather Bureau"). This shows the nature of the equipment of the stations. The Central Office takes care of the maintencance of these instruments and of requisitions for material used at these stations. A staff of men is employed for adjusting and repairing all instruments that do not function properly. At the Observatory itself, the instruments used for the daily observations are very interesting. There are eleven mercurial barometers, all of the best quality, and purchased in England, France and America. The French instruments are used for daily observations; the others used for comparing and testing. There are five anemometers, two made in England, one in France and three from America, the latter being the same as those used by the U.S. Weather Bureau. There are rain gauges, both recording and direct observing. Thermometers, both maximum and minimum, like those at Woodstock, have their place here. An interesting instrument is the recording wet-and-dry-bulb thermometers made by Richard of Paris. Daily observations are taken of the ground at various depths. The amount of evaporation is measured with an atmidometer, (a graduated tube, filled with water, inverted and its lower end covered with special blotting paper.) At Manila and a few other stations, the Quadruple Register, an instrument used by the U.S. Weather Bureau, is installed. It is an instrument that on one sheet of paper, gives a continuous record of wind velocity, wind direction, rainfall and duration of sunshine. These are some of the instruments in use at the present time, a great contrast to an old and venerable piece of apparatus in their midst. This is a Universal Meteorograph, designed by Father Secchi and purchased by Fr. Faura in 1868. This instrument has two sheets of paper on which to record various phenomena. Temperature, pressure, direction of wind, velocity of wind and rainfall are recorded on one sheet; pressure; temperature (on a scale five times larger than on the other sheet),

humidity of the air and time of rainfall are recorded on the second sheet. This instrument, in its day, was a marvel and was the forerunner of modern recording instruments. A similar instrument is kept in one of our Colleges at Cincinnati. This is not a complete enumeration of the instruments of the meteorolgical department, but, even though it is somewhat general and rather brief, it shows why the quality of the work done in this most important department of the Observatory is of a high standard.

The instruments of the astronomical department are of the same quality as those in the meteorolgical department, but they are also more spectacular. The most imposing piece of apparatus is the large equatorial telescope. It is a refracting telescope, with an objective of 48 cm. in diameter, with a focal length of seven meters, the handiwork of the German optician, Merz. The mounting and clock movement was made by Geo. N. Saegmuller, Washington, D.C., in 1892. Besides the eyepieces (one of which is fitted with a prism for horizontal observing), colored glasses and filar micrometer (which can be used only in a direction E-W), there are two spectroscopes which can be attached to the telescope. One of these, made by Vogel, is for use on the telescope alone. The other spectroscope, made by A. Hilger, may be used on the telescope or independently. Its prism is in the form of an equilateral triangular prism, 11 cm. on each side of the base and 7 cm. in height. Instead of the prism, a plane diffraction grating, on a special mounting, may be used. The value of this grating, 8 cm. by 5 cm. in size, is evident from these inscriptions scratched on the metal: "Ruled on Prof. Rowland's Engine, John Hopkins University, Baltimore Md. U.S.A., 1892"; "Plate prepared at the Astronomical and Physical Instrument works of J.H. Brasher, Allegheny, Pa., U.S.A."; "14438 lines to one inch, 568 lines to one mm." Both of these spectroscopes have attachments for spectra as well as eyepieces for direct viewing of the spectra. For direct measurement of the distances between lines, a micrometer is supplied, but its use is restricted to the E-W direction. There are special micrometers for measuring spaces on photographs of spectra, one of which can measure directly (with a vernier attachment) to 1/1000 of a mm. The instruments for determining the time are excellent. A meridian telescope, made by A. Repsold & Sohne, Hamburg, and purchased in 1913, is used to determine the rate of Riefler Precision Siderial Clock. The meridian telescope is a "broken" telescope, that is, with a prism to reflect the light at right angles to the axis of telescope thus enabling the observer to see the image of the star through the hollow horizontal axle of the telescope. The instrument has the usual reversing attachment found on Repsold instruments and also has a special attachment between the level parallel to the horizontal axle and the telescope for determining latitude by the Horrebow-Talcott method. One division of the level tube parallel to the horizontal axle equals 1.378" of arc and the value of the micrometer screw thread is 87.8385" of arc. The rate of the Riefler Clock is seldom over0.10 seconds per day (gaining) whereas its usual rate is 0.03,0.04,0.05 seconds per day. There is also a Riefler Clock for civil time. The clocks used before the acquisition of the Riefler clocks are still used and are very reliable. A standard clock for time signals is regulated according to the Riefler clock and at 10:55 A.M., signals are sent to all the post office stations throughout the Islands, the post-office department being in charge of all telegraph communication. At 9:55 P.M. the signals are sent to the stations open to receive them. At both times, the signals are relayed to Cavite and transmitted by wireless to ships and other receiving stations. Chronometers are rated and adjusted at the Observatory for use on shipboard. The equipment of the astronomical department places the Observatory in a very advantageous position for astronomical work, as there is no other observatory in the Far East with equipment to equal it.

Another department that has attracted the attention of scientific men is the magnetic division. Due to the proximity of electric light wires and especially to the car line adjoining the property, the magnetic instruments were moved from the Observatory to a special building at Antipolo, about fifteen miles from Manila.

The purpose of the magnetic department is to determine the value of magnetic declination in all parts of the Islands, an object practically attained before the American occupation and with the instruments at Antipolo, to determine the variations of magnetic intensity together with the horizontal and vertical components of the same. Variations of the magnetic declination are also observed and measured. The instruments at Antipolo are photographic and give a continuous record of the variations. The position of the Observatory near the magnetic equator gives a very favorable opportunity for these investigations. When the Carnegie, the non-magnetic ship touring the world in connection with magnetic research work, visited Manila, a comparison of the instruments at Antipolo with the instruments on the Carnegie confirmed the reliability and confidence placed in the equipment.

The seismological instruments are complete and an enumeration of the various pieces of apparatus in the order in which they have been acquired will show the policy of the Observatory and give an idea of the work it has done.

Before 1880. Two simple pendulums, with points for indicating the movements of the earth on the concave surfaces of spheres over which they are suspended, formed the seismological equipment. The study and publication of the records of these "seismographs" after the destructive earthquake of 1880 drew much attention to Fr. Faura.

1881. A microseismometer of "Tromometric Pendulum", an instrument designed by Bertelli, was acquired. In the same year, two seismographs, designed by Fr. Secchi were bought. One is called "Sismografo Cecchi"; the other, "Micresismografo Registrador."

1884. A "Sismoscopio de Rossi" was purchased. Another seismograph of Fr. Secchi's was added to the equipment this year.

Sometime between 1884 and 1902, a Gray-Milne seismograph was acquired. All of the above instruments have only an historical interest now. The instruments in use are the following.

1902. A Vicentini Universal Microseismograph took its place in the Observatory. The name plate reads: - "Micresismografo Vicentine, A. Gagnato, mechanico dell instituto Fisico, P. Universita Padua." The vertical pendulum is 100 kgm. in weight; another weight, (about one half the volume of the larger pendulum, probably 50 kgm. in weight) is suspended by a strong steel "spring" for recording vertical movements. Horizontal movements are magnified 100 times, vertical movements 112 times.

1906. A seismograph, modeled according to the Omori seismograph, was constructed in the Observatory. It magnifies about 6 times.

1911. A Wiecheart inverted-pendulum seismograph, made by G. Bartels, Gottingen, was purchased. The weight of the steady mass is one ton and the movements are magnified 500 times. It records only E-W and N-S movements.

These instruments show that the Observatory has kept up to date and has studied seismic phenomena in the best manner possible.

A few insturments not classified in any of the above departments, are the pyrheliometers and the apparatus for measuring the height of clouds. The Observatory possesses an Angstrom pyrheliometer and an Abbot Silverdisk Pyrheliometer. Mention should be made of Father Algue's invention for measuring the velocity of clouds and also his transit telescope for obtaining the transits of stars by photography.

This brief description of the equipment is not complete nor detailed. It claims, however, that it gives a definite idea of the main instrumental equipment utilized by the Observatory staff, more certain knowledge of the activities of the various departments and gives one reason for the well known thoroughness and accuracy of the work done at the Manila Observatory.

Bernard F. Doucette, S. J.
Manila, Philippine Islands.

PHOTOGRAPHIC NOTES IV.

An unavoidable underexposure can scarcely take place in the studio, but it may occur outside and consequently a developer that will coax everything out of a plate or film may be worth noting. The following formula was worked out in the Eastman loboratory and the resulting solution is intended to develop an underexposed plate or film very quickly. Fast plates give a grained image and still more grained if kept in the developer a long time.

Metol 140 grains.
Hydroquinone 140 grains.
Sodium Sulphite (dry) $1\frac{1}{4}$ oz.
Potass. Bromide 88 grains.
Sodium Hydroxide 88 grains.
Water 20 oz (fluid).
Methyl Alcohol 1 oz (fluid).

The best way of getting the various ingredients in solution is the following: take 18 oz. of very hot water, add the Sulphite; when this is dissolved add the Metol and Hydroquinone. Have the Bromide and Sodium Hydroxide dissolved in 2 oz. cold water; add this to the first solution and when the whole has cooled add 1 oz. of Methyl Alcohol. This solution should be made up when it is to be used, not long before.

One special exposure should also be explained. It may be necessary to make a slide of a plain black line map or diagram printed on white paper, 24 inches or more on the side. The lines in a well made map are rather fine, varying from 1/50 to 1/100 of an inch in width. If one were to make a negative, slide size, directly of such a diagram, these lines would be brought down to about 1/8 of their width, showing on the ground glass and sensitive plate as very thin lines 1/400 or 1/800 of an inch wide. Now when the light waves beat on the emulsion of the sensitive plate, they do not merely sweep through the film perpendicularly to the plate but they also act laterally, due to the scattering action of the particles in the emulsion. So we should have a thin line on the surface of the plate, say 1/500 of an inch wide, attacked on both sides by surging light waves. Moreover, some of the light which penetrates the film is reflected from the back of the plate and these new waves tend also to flood the defenseless line. This last effect, from reflection, with a given illumination on the subject and a given transparency of emulsion, will vary with the thickness of the emulsion carrier, being greater with thick glass and less with thin celluloid. It may be avoided by "backing" the plates. But the lateral light action, more fatal to very thin lines or small dots, will always take place. So this seems to be the best solution of the problem: do not reduce the diagram to slide size directly; make it at least six inches square. Use a slow "cut film", say a "process" film, give a correct exposure and develop just to the point of shading the lines which should be clear on the negative. In this way, the lines will remain open, and points only 1/50 of an inch apart on the subject will not fuse together on the plate. If the resultant negative is not strong enough, intensify it (to be explained immediately) and make the slide by camera reduction.

Let us now suppose we have a set of negatives, all of proper size for slide making by contact printing. They must first be sorted for "treatment".

All negatives from line work should be harsh, i.e. high in contrast, the lights of the subject very dense on the plate and the blacks practically clear glass. From such negatives you will make clean hard slide, good to look at and easy on the eyes. Natural object negatives or those having continuous shading, should have moderate strength, fair contrast and full detail. If the line negatives are weak and the natural object negatives lack the needed contrast, both classes should be intensified. By this means, contrast is heightened.

One very simple process, harmless to negatives, and working moderately well, is this: soak the negative in cold water for half and hour, then place

it in a tray containing 3 or 4 oz. of water to which a "teaspoonful" of red ink has been added; rock for 5 minutes, drain, and without washing, place on the rack to dry. A more formal and stronger intensifier is the following, in two solutions:

(A).	Mercury Bichloride	600 grains.
	Ammonium Chloride	600 grains.
	Water	30 fl. oz.

This may be kept in stock. For actual work, fill an 8 oz. bottle from the stock and use this over and over again till it becomes a cloudy or weak.

(B).	Ammonium Hydroxide (Conc. sol.)	1 oz.
	Water	8 oz.

This also may be used over and over again.

Procedure: be sure that the negative to be treated has been properly "fixed" and washed, otherwise, staining may result. Immerse the dry negative in 4 oz. of (A) and rock until the black silver deposit becomes white; remove the plate and place it in running water for at least 5 minutes. Then put it in another tray which contains (B). Rock the tray till the whitened image turns black, remove and wash for 3 or 4 minutes and place on drying rack. If the "weak" negative is very valuable and cannot be replaced do not intensify by this method, for the life of the negative is usually shortened. Natural object negatives may have another fault, less common than weakness; some parts may be altogether too dense, so that a slide must be overprinted (and spoiled) in the shadows to have any detail in the high lights. This is more apt to take place with slow plates and underexposures. The cutting down of density is called reduction. Fortunately there are two classes of reducers; one destroys faint lines first, increasing contrast; the other, more useful, attacks the strong deposit in preference, diminishing contrast. Both reducers should be used with caution, as it is nearly as easy to ruin the negative as to improve it.

A good example of the first type is Farmer's reducer. The ingrediants are Potassium Ferricyanide and ordinary plain Hypo solution. Potassium Ferricyanide does not keep well in solution; so it is best to dissolve it when needed and as the amount to be used is small and only "approximate", the balance may be neglected; add enough to two oz. of water to give a fair color; to this add two oz. of plain Hypo solution (fixing bath strength), immerse the wet plate and rock to insure evenness of action. Watch the reduction carefully and just before it "looks right", take out the plate, wash it well, put it in the fixing bath for a minute or two and then wash for 5 or 10 minutes.

The second reducer for lessening contrast, is made up as follows:

(A)	Ammonium Persulphate	15 grains.
	Water	1 oz (fl.)

This solution will not keep; it must be made up immediately before using and should be thrown away after the operation. Immerse the clean wet negative in a tray containing 3 or 4 oz of (A), rock and examine (frequently) the treated plate; before the reduction seems complete, remove the plate and put it as soon as possible in another tray, containing:

(B)	Sodium Sulphite (dry)	1 oz.
	Water	10 oz (fl.)

Rock in (B) for two or three minutes, remove, wash for 5 minutes, and place on drying rack. Solution (B) may be used over and over again.

There are other reducers and different combinations making what is called a proportional reducer, giving uniform lessening of density without changing the contrast materially. This last is not needed for our use, as a longer exposure or an exposure to a stronger light when printing the slide, will have the same effect, as thinning down the negative.

Intensification and reduction may be used "locally" that is, applied to part of a negative only, by means of camel hair brushes and not by tray immersion. Local intensification, spotting and blocking out will be treated in the next issue.

FR. J. Brosnan, Weston, Mass.

(Reprint)

ANALOGY BETWEEN A SEISMOGRAPH AND A RADIO RECEIVER.

Until you stop to think, it may strike you that the similarity between a seismograph and a radio-receiver is a little far-fetched, but upon further consideration it dawns upon you that the resemblance is more than superficial.

We might of course begin with a comparison of the wave motions themselves. Here, it would seem that there must be a divergence because the ether admits only a transverse wave, whereas the earth, an elastic medium to be sure, presents three, a longitudinal, a transverse, and a surface wave. The difference is not so great as it would seem because in the ether we have to have an equation that says it is incompressible, and that equation is nothing more than the expression for a longitudinal stress which has been set equal to zero, and inside the earth we do not have a surface wave to consider. We might pursue this into the properties of wave motion but the development is rather obvious and we are more interested in the instruments themselves.

A wireless receiver is an oscillating device which apart from detecting devices and accessories consists of three essential elements, an inductance, a capacity, and resistance, or as we might say a sustaining element, a storing element, and a smothering element. When we have an excess of electrons on one plate of the condenser and a deficiency on the other, flow naturally takes place. The inductance serves to sustain the flow, and on account of this action, the flow does not stop at the right instant but continues until the sustaining power of the inductance is overcome by the back pressure due to the excess of electrons on the other side of the condenser. Then the process reverses. In the seismograph the sustaining element is the inertia of the pendulum, the storing element is the rise of a weight against gravity, or the strain of a spring, or the twist of a wire. Gravity, or the recoil of the spring, or the torque of the wire sets the boom in motion. The motion is sustained by the inertia of the boom, and thus carried past the equilibrium point, until the motion is arrested by the forces on the other side. In the radio receiver oscillation would never cease were it not for the resistance which more or less quickly dissipates the energy of the circuit. The seismograph would never come to rest were it not for the damping in the form of friction or otherwise that more or less quickly destroys the motion of the boom.

But the analogy does not stop with these fundamentals. When you turn the handle of your radio receiver, by adjusting the relation between inductance and capacity, you change the frequency of the circuit. While you do this you notice that the sound is at first faint, then when you get frequency of your set near that of the broadcaster it is quite loud, and then becomes very faint again. You have the same thing in the seismograph, except that the period of the instrument remains fixed and that of the incoming wave varies. The magnification of the seismograph varies the same way that the magnification varies in the radio set, so that the response of the seismograph is greatest when in tune, and the further the natural period of the seismograph is from the period of the incoming wave, the smaller the magnification. That is why it is necessary for a correct interpretation of a seismograph to measure the period of each wave in our record, to find its magnification from our tables or curves and to correct the trace amplitude for the variable magnification. As the preliminary waves are most important in the detection of distant earthquakes and as they generally have a period 10--12 seconds, the designers of the Milne-Shaw adopted 12 seconds for the period of their machine. Galitzin preferred to take the period of the surface waves 18--20 seconds for his instrument.

This variable magnification which gives so much trouble in a seismograph is a great virtue in a radio set and every effort is made to encourage it. Hence the reduction in the size of the antenna, the use of the indoor antenna, loose couplings. The idea is to make the set respond to as narrow a band as possible. With the seismograph we try to get as tight a coupling as possible, a concrete pier going down to bed rock making the frame of the machine as nearly as possible a part of the earth itself. Broadening the band of frequencies to which

an oscillating system is sensitive, or in other words decreasing the selectivity, is possible if we increase the smothering action, increase the resistance of the radio set, increase the damping of the seismograph. The effect of this procedure is two-fold. The band of frequencies through which a response is obtained is broadened. This represents a loss in selectivity, but a gain in sensitivity except for waves in tune. At the same time, a general flattening of the magnification curve takes place reducing the magnification. This is an advantage to the seismograph except for the loss in magnification, because the seismologist is not so much interested in tuning things out. In the earlier instruments, however, before the introduction of optical recording, the loss in magnification was too great a sacrifice. Now with the perfected methods of optical registration, we can afford to push the damping up until the system just ceases to oscillate.

In the radio set on the other hand it is selectivity and not broad sensitivity that is desired, low resistance wire is used. Braided wire is used. Connections are made as short as possible and kept tight by soldering. It is all to make the set as selective as possible, to make it sensitive to as narrow a band as possible.

In spite of all efforts to the contrary some selectivity is obtained in a seismograph. The speed of the paper means that vibrations that are too quick will be lost due to the thickness of the pencil or the overlapping of images where optical recording is employed. You have something similar to this in the limited sensitiveness of the diaphragm of your telephone receiver, or loud speaker. According to Galitzin quick vibrations are generally due to industrial operations and therefore not of interest in a natural science. If this is true, selectivity of this kind is a virtue in a seismograph. With regard to close earthquakes, Woods and Anderson regard even this much selectivity as a vice, and so they have designed a machine with a short period and a high paper speed.

It is the usual practice in radio reception to secure an increase in magnification or amplification, by connecting the first oscillating system to another through a transformer. In these sets there is more than one circuit to be tuned, but we have increased amplification with an increase in selectivity. Galitzin, to secure increased magnification does a similar thing, and he does not regard the increased selectivity as a disadvantage. On the end of the boom he has placed a coil that moving in a magnetic field generates a current. This current operates a galvanometer which is itself an oscillating system whose motion is recorded optically. There are here two circuits to be tuned just as in the radio set. Even the coupling is similar for a transformer consists essentially of two electric circuits linked by a magnetic circuit, whereas Galitzin's coupling consists essentially of two magnetic circuits linked by an electric circuit.

The resemblance between a seismograph and a radio set extends even to the defects. The howling and squawking of a radio set is the distortion produced by the internal oscillation of the set, and so it is precisely the distortion of the record by the proper motion of the seismograph that creates the great problem for the makers of these instruments. And just as radio manufacturers quite justly insist that purity of tone is the greatest factor in deciding between one instrument and another, so Woods and Anderson appeal to the purity of the record as the crucial point to be settled in determining the superiority of one seismograph over another.

Mr. F. W. Sohon, Valkenburg, Holland.

THE AUDIFFREN PROCESS OF REFRIGERATION.

At 90 West St., New York City, there is located the Audiffren Refrigerating Machine Company. This is the American Branch of a French concern which, until comparatively recently, handled their American business through the Johns-Manville Company. Several years ago a Sales Agent of this latter company, in discussing his machine with one of the extern professors of Chemistry at Fordham, told a very interesting story regarding the origin of the apparatus.

The story as I got it, was something like the following.

A certain French Jesuit, named Audiffren, was engaged in teaching physics in a Jesuit school in some small French town. He was a dexterous technician, and invented and applied a clever device to illustrate to his class the principles of refrigeration. Though the apparatus was more or less of a toy, it also served a very practical purpose in that it proved an excellent means of cooling the wine for the Community Refectory, A short time later, however, some kind of a political rumpus occurred with the result that the Community of which Father Audiffren was a member lost their house and all their belongings. Now Father Audiffren had a brother, an extern, who besides being of a practical turn of mind also had a good legal training. This man, in taking an inventory of his brother's confused assets and liabilities, discovered the toy, saw the possibilities in commercializing it, and eventually put it on the market.

Such was the story, more or less, as I received it. The man who told it to me succeeded in obtaining two booklets from the Company describing the Audiffren System. In one of these booklets there appeared a picture of M. L'Abbe Audiffren. I then asked the Company to send me something of the history of their machine, but I never received an answer to my letter. They have been a bit skeptical of the S.J. after my name.

I then looked up the old catalogues of the French Provinces, but was unable to find the name Audiffren in any of them. However, I did find the name of a certain Father Louis Audiffret, born Dec. 4, 1825, entered the Society in the Province of Toulouse on September 2, 1868, and died at Toulouse on Sept. 14, 1891. But nowhere was he listed as professor of physics.

The machine, as far as I can ascertain, is very simple, efficient and satisfactory. I am told it is about as fool-proof as could be desired. The booklets, however, gave no hint as to the principle on which it works, except that in one place mention was made of sulfur dioxide. I have tried several times and from several different sources to get more information on it, but so far I have not been successful. Perhaps one of the readers of the BULLETIN can enlighten me, through its pages, both as to the history of the apparatus as also regarding its principle.

Mr. G.J. Shiple, Woodstock, Md.

SEISMOLOGICAL NOTES.

Congratulations to Georgetown on the acquisition of the only, (as far as I could find out) Galitzin on the North American Continent, -- and to Fordham on the completion of its Milne-Shaw equipment! Still heartier congratulations to both directors on the splendid upkeep of their stations and the lavish praise and recognition they are receiving on this side of the ocean.

The following problems might be use ful as usggesting lines of investigation in modest seismological research, and might serve those hunting a subject for an M.A. Essay at Weston or Woodstock, a Paper for next year's Science Association Meeting, or an Article for the BULLETIN.

1. <u>POSSIBLE PREDICTION OF LARGE QUAKES</u>. An examination of the large quakes of 1925 revealed the fact that a large quake is often heralded by several feeble shocks, occurring even a considerable time in advance, several years sometimes. To take an example: The quake of Aug. 7, 1925, with epicentre 30° E. 38° N. (suggested by Strasbourg), was preceded by the following series of smaller shocks at or near the same place--April 2, 1920, Nov.13,1918, June 19,1918, June 13, 1918, Aug. 8, 1917, etc., all these shocks being feeble. The question naturally suggests itself--Would a study of these feeble anticipatory shocks give us any clue to the possible prediction of a man sized quake?

2. <u>UNEXPLAINED PHENOMENON</u>. On Sept. 20, 1920, a quake occurred at 20°.6 S. 168°.8 E. off Tonga Island at a sea depth of 3000 meters. The records of this quake are peculiar and have not been satisfactorily explained. Oxford, DeBilt and Paris, record activity at 15h. 20m. ca., while Uccle, Strasbourg, Stonyhurst

and other stations fail to record this activity but record one some ten minutes earlier. All however, agree in their record of the beginning of the quake. Why for instance should two such well equipped and equally well staffed stations as those of Uccle and DeBilt (differing only one degree from the scene of the quake) behave so differently in their recording of it? The Uccle Director suggests that his activity, (ten minutes earlier than that of DeBilt) is the activity of another quake. But this merely doubles the difficulty - Why did not Debilt record this activity even though it were that of another quake? And why did not Uccle record the later activity felt by stations all round it? I have the Uccle record of the quake before me and it is a perfect blank at 15h. 20m. while there is no mistaking the activity ten minutes earlier. What is the explanation of this different behaviour of the earth's motion at certain places? A study of the International Bulletin will show that this phenomenon is constantly occurring.

3. SUGGESTION FROM DOCTOR TURNER. Asked what he would suggest as the most useful piece of research on a modest scale in seismology just now, he replied: "A re-reading of the records of our stations, in the light of the data now published and almost up to date in the International Summary." When the present readings of our stations were made, the epicentre and time of origin of the quake had not been determined, and readings were to a certain extent made in the dark. Now both epicentre and time of occurrence have been fairly accurately determined, and a re-reading of the records in the light of this acquired data would yield profitable results. By re-reading, is not at all meant a correction of the readings formerly made, but additional notes of phenomena of importance not noted before, or the noted absence of phases that one would expect to find - peculiarities akin to that mentioned in the preceding paragraph. Doctor Rothe has started this re-reading at Strasbourg, and his interesting results may be found in the Travaux Scientifiques for 1925.

Mr. J. Lynceh, Valkenburg, Holland.

NOTE ON SOME RECENT DEVELOPMENTS OF THE BOHR THEORY.

For some time past, there has been growing the conviction that, in spite of its phenomenal success in many lines, the Bohr theory as it stands is unable to face the facts. It meets with very serious difficulties when it attempts to get the intensities of spectral lines, the interpenetrating orbits it postulates, cannot seem to be made stable, it is baffled by the X-ray doublets, it cannot give a satisfactory model even of the helium atom, etc. About a half year ago, Heisenberg resolved to try to formulate the theory anew, dropping everything that was very uncertain, dropping also a physical picture of the atom, and using only the following: - the observed frequencies of the spectral lines, their intensities, and phases. He dropped the use of the orbital frequencies of the revolving electron entirely. With the aid of energy levels, one or two very simple quantum conditions, and the use of finite and infinite matrices, as his mathematical vehicle, he, with the aid of Born and others, has developed his theory so as to explain satisfactorily dispersion, the simple oscillator, the rotator in the circular orbit, etc. The theory, as far as it has been developed, for it is still in its infancy, gives all that the Bohr theory did, and succeeds in many cases where the Bohr theory did not. Bohr favors it; but in a letter to Nature some months ago said it heralded the failure of any attempt to get a physical picture of the atom, and that we must be content with the Heisenberg, Born mathematics. But as usual, just as soon as an eminent physicist despairs of a physical picture, and declares that we must abandon our ordinary mechanics and turn to mysterious forces, etc., he is promptly made aware that it is not safe to be so dogmatic. For, shortly afterwards, Uhlenbeck and Goudsmit came forward with the idea of a spinning electron, which had been suggested by Compton in 1921, but had met with no favor until now. With this spinning electron Uhlenbeck and Goudsmit, and Pauli also, have met with quite some success in the explanation physically of many of the formulae Lande and others have used quite arbitrarily in the explanation of the fine structure of spectral lines. The success of

Uhlenbeck is marred by the presence of a factor 2 in their results which should not be there, but Bichowsky and Urey, at "opkins, now claim they have gotten over this difficulty. You see, therefore, that a new phase in atomic physics has commenced. I have not had the time to read the literature on the subject, especially since it is still in its infancy and laboring with the manipulation of finite and infinite matrices. Let's hope that it may dispense with its unwieldy mathematical apparatus soon. Born, in his lectures on the subject at the Univerwity of California, hopes to be able to simplify the mathematics considerably before long.

I welcome the new idea heartily. In fact, at Hopkins, it was my firm conviction that either the proton or the electron was a magneton (which of course a spinning electron must be), and I wanted to make my research on an attempt to prove this experimentally, but was told it would be too ambitious a project for a beginner. May I venture another prophesy? If the spinning electron meets with success, it is only a step back to the vortex, and the vortex theory of matter may soon come back to its own.

If any one cares to read the present literature on the subject, here it is: Many other articles, however, will soon have to be added to the list, for the big mathematical physicists are all interested and at work on it:

Heisenberg, Zeitschrift fur Physik, 33, p. 879, 1925.
Born and Jordan, " " " 34, p. 858, 1926.
Heisenberg, Born and Jordan, same, 37, p. 557, 1926.
Kramers, Physica, 5, p. 369, 1925.
Uhlenbeck and Goudsmit, Die Nat., Nov. 20, 1925.
" " " and Bohr, Nature, Feb. 20, 1926.
H.A.Compton, Journal Franklin Institute, 192, p. 145, 1921.
Bichowsky and Urey, Proc. Nat. Acad., Feb. 1926.

Father C.E.Deppermann.

A PROPOSED HALL OF ASTRONOMY IN NEW YORK.

The American Museum of Natural History of New York City is planning a large hall of Astronomy for students of all grades. During the summer of 1925 Dr. G. Clyde Fisher was sent abroad to visit observatories and similar institutions and to confer with their directors and other astronomers in order to obtain suggestions for the project. SCIENCE for January 22 contains an abstract of his report. One of the observatories visited was that of the Vatican. He discussed plans with the director, who as is well known , was for a number of years director of the Georgetown Observatory and did important work there on variable stars. He says: "The director of the Vatican Observatory, Father J. G. Hagen, who by the way is a naturalized American citizen, strongly recommended the installation of a small telescope which could be used by visitors for viewing objects in the sky. This would not be for professional astronomical work, however, as or institution should not be an observatory, but rather a museum of astronomy. The objective lens of this telescope need not be larger than five or six inches in diameter. The advice of Director Hagen is strengthened by the popularity of the so called "Uranias" of Europe. I am convinced that this is an excellent proposal and hopes that place can be found for a small dome in which can be installed such a telescope."

Dr. Fisher gives an enthusiastic account of a projection Planetarium made by the famous Zeiss Optical Works of Jena. The first instrument of the kind was made for the astronomical museum at Munich. The second is mounted on the roof of one of the buildings of the Zeiss works. It consists of a hemispherical dome sixteen meters in diameter, capable of seating about 280 persons. It is white inside and at the centre is a projection apparatus which throws on the inside surface images of the sun, moon, all the planers and some 4,500 fixed stars including the milky way. The projected images move just as the real bodies seem

to move in the heavens. By means of special projectors the names of the constellations can be shown on the sky. By means of a flashlight showing an arrow-pointed light any star or other heavenly body can be pointed out. Regular lectures are given, which are very popular. The mechanism is so perfectly designed that one imagines that one is outdoors under a clear night sky. A number of these planetaria have been sold to various German cities. One in Dusseldorf will have a dome thirty meters in diameter. If, as seems likely, such a large planetarium is to be erected in New York by the American Museum it should prove of great interest to the students of our various schools in the metropolis. Instructors of astronomy will find it worth while to take their students there to clarify their notions about the celestial sphere and to make them realize the various motions of the heavenly bodies. It may be noted that the preliminary astronomical hall of the Museum containing paintings and transparencies was opened on March 24.

FATHER MACELWANE FIRST CHAIRMAN OF THE NEWLY FOUNDED EASTERN SECTION OF THE SEISMOLOGICAL SOCIETY OF AMERICA.

The Seismological Society of America is a national organization having its headquarters in California. As eastern seismologists have found it difficult to take part in its meetings an eastern section was recently formed whose purpose is to arouse interest in earthquake study from every viewpoint. A quarterly bulletin will be published containing articles of interest to the layman as well as to the men of science. The first meeting will be held in Washington on May 1. Father J. B. Macelwane in charge of the central station of the Jesuit seismological association at St. Louis University who took an active part in the organization heads the list of temporary officers as chairman. Father Macelwane spent some time late in February studying the constants of the seismographs at Georgetown and Fordham. We were also glad to welcome him at Weston.

ANATOMICAL AND TECHNICAL MODELS.

Mr. J. Lynch of Valkenburg calls attention to a series of so-called models for instruction published by Pestalozzi Verlags-Anstalt of Wiesbaden, Germany. They are sectional colored charts of the human body, the eye, head, etc., and also of engines motors, etc. They are moderate in price and should prove useful in class instruction. The fact that the descriptive matter and key are in German may perhaps lessen their usefulness in our schools.

OUR FORMER SECRETARY ORDAINED DEACON.

"Aus der Provinz" the German Province News for March informs us that Mr. Joseph Lynceh, formerly professor of physics and director of the Seismological Observatory at Fordham University and Secretary of our Association, was among those ordained at Valkenburg on March 25. The BULLETIN sends its congratulations.

LECTURES ON SEISMOLOGY IN NEW ENGLAND.

On April 11, Father F.A. Tondorf of Georgetown University lectured in Boston on Earthquakes under the auspices of the Catholic Alumni Sodality. On the 9th. he visited Weston and gave the philosophers an illustrated lecture on the same subject. He also lectured in Providence on the 12th.

Mr. J. S. O'Conor Director of the Seismological Observatory at Fordham gave a lecture on Seismology at Holy Cross, Worcester, on March 19th.

LECTURE ON ST. PETER CANISIUS.

Mr. H. Bihler, Professor of Chemistry at St. Joseph's High School, Philadelphia, gave an illustrated lecture on St. Peter Canisius in Philadelphia in connection with the celebration of the canonization of the latest doctor of the Church.

NOTICE OF CHANGE OF ADDRESS. Subscribers of the BULLETIN are requested to notify the editor, Fr. H.M. Brock, Weston, Mass in due season of any change of address. Necessary corrections can then be made to our mailing list.
