One may even go farther; if two neighboring springs flowing from the same geologic earth, seemingly independent, show the same conductibility, it may be safe to affirm that they are identical. The author, after two experiments requiring half an hour, predicted the identity of two such springs which passed for distinct, and a subsequent chemical analysis showed an almost complete identity, the only divergence being that for the silica and oxide of iron (present only in minute quantity), and it is known that these substances exist in the waters almost entirely in the colloidal state and non conductor. In another case he showed considerable variations in the composition of a mineral spring of which an analysis was about to be commenced, and made it evident that such an analysis would have no value.

NATIONAL PHYSICO-TECHNICAL LABORATORIES.*

BY H. PELLAT, PROFESSOR AT THE UNIVERSITY OF PARIS.

Industry is making an increasing demand on science, not only for its discoveries, but for the exactness of its measuring processes; it depends upon the precise data found in the laboratories. If the largest companies can support the expense of testing or research laboratories and have a personnel of engineers and scientists, the greater part of the manufacturers cannot go to this expense, especially for the tests relating to physical measures, which most often demand very costly apparatus. Even the scientists cannot have in their laboratories all the apparatus necessary for the verification of measuring instruments, as many of these are cumbersome and of a very great cost. For this reason, some of the governments have aided their manufacturers and scientists by establishing national physico-technical laboratories provided with the most improved measuring instruments where verifications of great precision and useful researches are carried on, these being of benefit to science and industry. Germany has commenced this movement, and possesses now in the Physikalisch-technische Reichsanstalt, founded about 1890, the most important of the national physico-technical laboratories. This establishment, situated at Charlottenburg, near Berlin, occupies an immense edifice which has been especially built for the purpose, in the middle of a park, which is an excellent position to guard the instruments from trepidations. The director has under his orders a corps of eighty persons. The Reichsanstalt is divided into two sections. The first has for its object the solution of problems of metrology proper; it is occupied with problems of a high interest and has especially rendered service to pure science. For instance, its researches have related to the normal thermometric scale, the rotative power of quartz for the light of sodium, the standard of resistance, etc. It also makes determinations of the unknown or ill-defined physical constants of bodies presenting a scientific or industrial interest. It is thus that during 1898 this section took up the study relative to the density of water vapor between 1 and 20 atmospheres to the maximum pressure of water vapor at low temperatures, the comparison of thermometric bodies with the normal thermometer at high temperatures, the heat conductibility of several metals, the luminous radiations emitted by certain substances, etc.

The second section, the most important of the two as far as the personnel is concerned, is charged with verifying the instruments of precision and the measurement of certain physical properties which have a less scientific character than those of the first section. The section is subdivided into six sub-sections, whose names indicate their field of work: 1. Mechanics of precision. 2. Electric measurements. 3. Optical measurements. 4. Thermometric measurements. 5. Chemical work. 6. Workshop. An example may be given by a resumé of the work done in the space of one year by the first and fourth sub-sections. The first, with three workers, has made about 200 researches relative to the determination of the errors of division of various scales, to the measurement of exterior dimensions of calibrated pieces, to the evaluation of the dilatation coefficient of metallic rods, the verification of tuning-forks, etc. The fourth sub-section, with seven workers, has verified 16,329 thermometers, including 14,910 medical, 81 apparatus for determining the inflammability of petroleum, 116 viscosimeters, 4 pressure gages, 35 barometers, 116 thermo-elements of the Lechatelier type and 400 feet of wire for the same, 50 fusible safety-plates for boilers, and has made besides a number of different tests. The verification of alcohol and density gages, etc., has remained in charge of an older institution known as the Normal Aichungs Kommission, and which verifies also the secondary standards for weights and measures.

England has already three standardizing establishments. Two of these are under the direction of the Board of Trade. The first, the Standards Department, has had the keeping of the standards (length, weight, money, gas meters, petroleum inflammation apparatus, etc.) and makes comparisons with these standards. It is besides at the disposition of the Board of Trade for all the scientific researches which it may require. The second, the Electrical Standardizing Laboratory, founded according to the law of 1889, is devoted to standardizing and verifying all the electrical measuring instruments and the keeping of the standards for these. Besides these two official laboratories there is a semi-official laboratory, the Kew Observatory. Besides the meteorological service, this establishment has, in fact, a standardizing laboratory, where each year are verified about 30,000 instruments of different kinds, such as thermometers, barometers, theodolites, sextants, compasses, telescopes, watches and chronometers, photographic lenses, etc. Not content with these three establishments, the government is now founding a national physical laboratory upon the plan of the German institution. Parliament has voted the necessary funds for its construction and maintenance; into it will be absorbed the Kew Observatory.

In Belgium, the founding of a Meteorological Bureau, distinct from the Bureau of Standard of Weights and Measures, and closely resembling the Reichsanstalt in character, was decided eight years ago; various circumstances have retarded up to the present the voting of the necessary funds, but it is expected that this vote will take place before the end of this year. In Russia, the Central Chamber of Weights and Measures possesses vast laboratories very well fitted up, and its extensive functions permit it to render in part the same services as a physico-technical laboratory. This chamber has, in fact, the following functions: 1. The keeping of the prototype of the Russian standards of weights and measures. 2. The making and verification of the copies of these standards made for the use of local standardizing bureaus or for the government bureau. 3. The verification of all special instruments serving to measure the temperature, light intensity, consumption of gas or electric energy, etc., and in general it verifies upon demand all the measuring instruments in use in commerce, industry, arts or sciences. 4. The fixing of the limits of error admissible for the weights and measures, in standardizing and in practical use. 5. The examination of all questions relating to weights and measures. 6. The direction of the local bureaus, etc. The chamber occupies at St. Petersburg a solid building of three stories, situated in the middle of a large space; a pavilion for electrical measures is shortly to be added. The establishment is provided with a complete assortment of the best meteorological apparatus existing. An idea of its importance will be given when it is stated that its personnel consists of fourteen persons, not including laboratory assistants, etc., and that its annual budget is about $46,000. It is under the control of the Department of Commerce and Manufactures of the Minister of Finance. The chamber is not the only standardizing establishment which Russia possesses; the instruments which serve for determining the tax upon certain substances are verified by the Technical Committee, which has this in charge; it is also under the Minister of Finance. In consequence, the Technical Committee is required to verify the alcohol and density instruments, thermometers, saccharimeters, etc. For the alcohol measures a special section is devoted, and it is provided with standards of length and weight verified at the International Bureau of Weights and Measures and the most improved apparatus. This section occupies a separate building at St. Petersburg. Again, the Central Physical Observatory of the Imperial Academy of Sciences also verifies metrological instruments.

In other European countries there are no national physico-technical laboratories and the functions of the service of weights and measures are in general much too limited to supply their absence. Nevertheless, in Austria the Normal Aichungs Kommission has about the same functions as in Germany, being devoted to verifying measures and weights, thermometers, etc. In the United States the principal cities possess, in their universities and colleges, splendidly organized laboratories where are carried out the tests and standardizing needed in the sciences and industry.

In concluding his address, M. Pellat points out the immense advantages of such institutions and the desirability of founding them in countries which, like France, do not yet possess them. As in the case of Germany and England, such a laboratory should be independent of the Bureau of Weights and Measures, as each responds to a different need. The buildings should be away from the centers of cities to avoid trepidations.

* Lecture delivered before the Congres de Physique. Reported by special Paris Correspondent of the SCIENTIFIC AMERICAN.

THE WORK OF THE EGYPTIAN EXPLORATION FUND.

BY OUR ENGLISH CORRESPONDENT.

The annual exhibition of the year's work of the Egypt Exploration Fund was held recently in London. The investigations of Egyptologists during the years 1899 and 1900 were productive of much interesting information regarding the kings of the First Dynasty, approximately 4715 to 4514 B. C.. and "the Ten Kings before Menes." Mr. Maciver, who has explored two large cemeteries at El Amrah, states as the result of his researches that one of them belongs to the first half of that remote age and the second extends from the First Dynasty. Hitherto our information concerning this period has been very vague, so that additional interest and value attaches itself to this Egyptologist's investigations in this direction. There were on exhibition models of the bracelets found on the mummy of the Queen of Zer at El Mehesna and now jealously preserved in the museum at Cairo. There are four bracelets in all, the first consisting of a row of façades with the royal hawk alternately reproduced in gold and turquoise. The second has a gold centerpiece copied from the center of a lotus flower with a group of turquoises and a large ball amethyst on each side. Skillfully woven into the back of this bracelet are strands of human hair and gold thread set with gold and turquoise. The third bracelet is of gold, lapis lazuli, and amethyst beads. The work is beautifully executed, each bead having its precise position in the scheme of decoration, while there is no excess of color. There is also the scepter of King Khasekhemui, comprising a slender copper rod with pierced cylinders of sardonyx or carnelian united by broad and heavy gold bands strung over it, bead-wise. From El Amrah were exhibited specimens of prehistoric pottery, dolls, and primitive and crude models in clay of various animals. The excavations at Abydoes and the surrounding neighborhood are now practically completed and this collection of ancient handiwork is further valuable, since this district was supposed to have been thoroughly explored some time before, but the work on that occasion was but indifferently accomplished, without the assistance of trained workmen, which has enabled the present explorations to be carried out so thoroughly and systematically.

SCIENCE NOTES

The Government is constructing a new machine for calculating the tides which, it is said, will do the work of thirty mathematicians. The most complicated problems of tidal variations are easily worked out with it.

The exhibits of agatized wood in the Mines Building of the Pan-American Exposition is very important. It is generally conceded that this agatized wood came from a tropical tree transformed in a prehistoric era from a living, growing forest to its present state. Silicified wood is found in many localities, but the coloring of this wood has never been equaled.

Prof. Koch, of Berlin, who discovered the bacilli of phthisis, stated at the Tuberculosis Congress at London that he had demonstrated that meat and milk from tuberculosis-infected cattle may be consumed with absolute impunity. He has arrived at this conclusion after most practical tests. He believes that human and bovine tuberculosis are of a totally different species, and that phthisis is not hereditary. The discovery is of the utmost importance, especially as regards milk. His views are warmly combated by other medical men.

Dr. Barton's war balloon is of cigar shape, and has a platform and machinery suspended from the balloon. The propellers are driven by a high speed motor, and there is a horizontal aeroplane for causing the balloon to ascend and descend, and at the rear there is a vertical aeroplane steering to the right and left. The difficulty which arises from moving the center of gravity is overcome by 2½-foot water tanks at each end, water being automatically pumped from one to the other as either end of the machine becomes heavier.

Alcohol is made in solid form by heating a liter of it in a vessel of double capacity over a water bath at a temperature of 60 deg. C. Twenty-eight to thirty grammes of Venetian soap, very dry and cut fine are added, as well as two grammes of gum lac. After a complete solution has been obtained, and while it is still warm, it is poured into metallic receptacles which are closed immediately and left to cool. The presence of the gum lac assures the preservation of the material and prevents too quick evaporation. The soap incorporated in the alcohol is left as a residue after burning.

John Arbuckle, of Brooklyn, has started a novel floating hotel enterprise. It consists of a small fleet of especially equipped ships which will carry people on short ocean cruises, the vessels being run as floating hotels. The vessels leave late in the afternoon, put out to sea and remain outside until early morning. The fleet consists of a thousand-ton sailing ship, a yacht, an ex-pilot boat and an ocean tug. The large sailing ship is a full-rigged three-master and has accommodations for 250 passengers. The upper deck, which is protected by a watertight awning, is fitted with bunks, and there are also bunks surrounding the dining room deck. There are a considerable number of staterooms in addition, and many of them are provided with bathtubs.