Museum at Washington rather than attempt any original investigations of their own, since the proper interpretation of archeological remains is a matter that has been found to require the greatest caution and the most extensive knowledge.

MAURITIUS—METEOROLOGY AND CROPS.

We note that the annual report for 1895 of the Royal Alfred Observatory, on the Island of Mauritius, comes to us with the signature of F. F. Claxton, assistant in charge of the Observatory, he having been appointed first assistant at the close of the year and entering on his duties on February 10, 1896. Since that date Mr. Claxton, who was formerly an assistant at Greenwich Observatory, has been appointed to the position of director, succeeding Meldrum, whose life work has made this Observatory so famous. In this annual report, for 1895, Mr. Claxton gives a table showing the mean annual rainfall for four stations on the Island as compared with the total crop of sugar for the corresponding calendar year, from 1880 to 1895, which we reproduce in the following table, except only that we have rearranged the figures in the order of the annual rainfall:

Rainfall.	Sugar crops.	Year.
Inches.	*Kilograms.*	
42.52	102,376,271	1886
54.35	119,731,492	1880
59.27	127,784,339	1884
59.86	115,299,039	1885
62.84	139,751,810	1893
66.52	117,809,610	1881
68.11	113,795,319	1894
69.40	124,073,140	1887
70.59	130,220,273	1890
72.10	135,564,900	1895
75.67	120,396,358	1883
76.13	68,718,573	1892
78.28	113,813,075	1891
91.71	124,564,951	1889
98.35	116,719,997	1882
106.23	132,172,988	1888

If we divide this series of figures into three groups of five each, omitting the year 1892, when a disastrous hurricane occurred on the 29th of April, we obtain the following averages which give us some idea as to the importance of the

Five year averages.

Rainfall.	Sugar crop.	Date.
55.76	120,968,590	1885.6
69.34	124,292,648	1889.4
90.05	121,533,574	1886.6

annual quantity of rainfall. These averages, as will be seen by the dates of the average crop year, partially eliminate any progressive change in the area devoted to the sugar crop, the style of agriculture, or any other slow change that is going on, and we may infer that the increase of annual rainfall from 55 to 90 inches has had approximately no effect in increasing the total crop. But this must not be misunderstood as implying that rainfall has nothing to do with crop production. The fact is that the sugar cane requires about eighteen months for ripening from the time of planting. A field that is planted in September will be gathered in June of the second following year. The crop then gathered must be compared with the rainfall during those eighteen months, and, more especially, during the middle portion of that interval. It is evident, therefore, that the comparison which we have been able to make, as suggested by Mr. Claxton's figures, is not a fair one, and that the subject must be pursued with more detail, very much as was done by Rawson and Walcott in their studies upon the sugar crop of Barbadoes.

A similar remark must be made with regard to the majority of the compilations of statistics that have been made by those who would elucidate the relation between climates and crops. The rainfall, temperature, humidity, sunshine, and the condition of the soil must be discussed separately for the four divisions of the plant's life. The matter is too complex to be treated by means of crude statistics without an intellectual perception of the laws of plant growth.

As the drought of 1896 in Mauritius was but one item in the destructive drought that prevailed all over the South Pacific, as well as over parts of the Northern Hemisphere, the Editor reserves his discussion of that important subject for the next REVIEW.

PRACTICAL SCIENCE IN GERMANY.

In the MONTHLY WEATHER REVIEW for April, 1895, Vol. XXIII, p. 131, we have dwelt upon the importance to the farmer, and for that matter to the whole country, of the establishment of some Government office—a bureau where the useful efficiency and relative value of machines for agricultural purposes may be thoroughly and officially determined—analogous to the Bureau of Weights and Measures and the offices for testing seeds, investigating fibres, testing the strength of woods, extirpating dangerous diseases, etc.

Somewhat analogous to these latter various bureaus that have from time to time been established in the United States, is the one central institution that has been founded in Germany under the name of the Physical-Technical Institute, which is located at Charlottenburg (formerly a suburb but now included as a part of the city of Berlin), the province of which is to carry out scientific investigations and practical tests that are beyond the reach of the ordinary laboratory, and that are of fundamental or general importance to the whole country.

The following is an abstract of a report prepared by the United States Consul-General at Frankfort, Germany, Frank H. Mason, and published in the number for July, 1897, of the Consular Reports of our State Department:

From the series of expert investigations that have been made during the past two years by English economists and commissions to ascertain the underlying causes of Germany's rapid and ominous advance as a manufacturing nation, one definite conclusion has been convincingly drawn. This is, that, putting aside all questions of protective duties, comparative wages, supply of native materials, etc., Germany, as an industrial nation, enjoys in two respects distinct advantages over Great Britain and every other European country. These are, first, the wide diffusion and high standard of technical and industrial education provided in this country; and second, the liberal and intelligent support that is given by the imperial and various state governments to the development of theoretical science and the higher and more scientific forms of industrial enterprise.

In support of the latter of these propositions, and as an illustration of how far a moderate expenditure of money, under Government authority, can be made to reach in the advancement of scientific investigation and the promotion of engineering and kindred enterprises, the Imperial Physical-Technical Institute at Charlottenburg, Berlin, is cited as the highest existing example of its class, and a model for the study and imitation of other governments which are seeking, as Germany has done since 1856, to prepare and equip their people for the industrial struggles of the future.

The introduction into Congress of a measure like the Hale engineering experiment station bill is a sign that in our own country the need of Government aid in this direction is recognized, and the following brief account of the plan and functions of the great parent institution at Charlottenburg is submitted as a contribution to a movement that has been already initiated.

The Physikalisch-Technische Reichsanstalt, to use its German official designation, was founded in 1887, mainly through the influence of the eminent electrician Werner von Siemens, who gave for the purchase of the site of the institute 500,000 marks ($119,000). The first president of the institution was the renowned physicist, Prof. Hermann L. F. von Helmholtz, who, since his death in 1895, has been succeeded by Prof. Dr. Friedrich Kohlrausch.

The institution comprises two sections, as follows: The physical department, which has for its field the advancement of pure science, or, in the language of Professor Helmholtz, "the prosecution of scientific

investigations which present a practical or theoretic interest, and which involve the employment of methods, apparatus, and prolonged duration of study which are beyond the command of individual investigators or schools of instruction."

The second or mechanico-technical and experimental section is under the chief direction of Prof. Dr. A. Martens, and has for its object "to develop the theoretical results acquired by the physical section, render them useful for practical purposes, to test and certify materials used in manufacture and engineering operations, and to rectify and attest, in accordance with established standards, instruments of measurement and precision."

The institute is governed by a board of eight directors appointed by the Imperial Government, and the working force includes about seventy persons, of whom thirty are expert engineers and other specialists, and the remainder skilled artisans and workmen.

Through the courtesy of Professor Kohlrausch, this report is enabled to give in detail the construction and equipment account of each section of the institute:

I.—PHYSICAL SECTION.

1. Cost of site, gift of Herr von Siemens	$119,000
2. Buildings:	
(*a*) Observatory	92,106
(*b*) Engine and machinery house	11,900
(*c*) Laboratories	23,800
(*d*) President's residence	23,622
(*e*) Grading, paving, and planting grounds	2,492
(*f*) Paving half of adjacent streets	7,205
(*g*) Building for accumulator batteries	2,023
3. Docorations and furniture for *a*, *b*, and *c*, above	13,804
4. Machinery and instruments	19,590
Total	315,534

II.—TECHNICAL SECTION.

1. Cost of land for site	$88,774
2. Buildings:	
(*a*) Main building	219,436
(*b*) Laboratory building	51,884
(*c*) Engine and machine house	42,840
(*d*) Residence building for officers	33,320
(*e*) Subsidiary buildings, outhouses, etc	82,824
(*f*) Furnishing *a*, *b*, and *c*, above	19,278
3. Machinery and instruments	86,558
Total	624,914

or an aggregate cost for sites, construction, and equipment of both sections of $940,448. The current expense of maintenance, including salaries, wages, materials, repairs, etc., which is partly repaid by fees collected for services rendered, amounts in all to $68,391 per annum.

To describe the work of the *physical section* of the Reichsanstalt would be to give a résumé of the scientific research of Germany during the past six years. * * * As early as 1890 the Imperial Chancellor was able to lay before the Reichstag a memorial written by Dr. Helmholz, summarizing the labors of the previous year, which at that period had been devoted in the physical section to the perfection of thermometers, to barometric observations, and to laying the foundations for the exhaustive study of electrical science which has since been continued with such valuable results.

The second, or *technical section* is divided into sub-departments, according to the nature of the work to be undertaken. One of these provides for the testing of metals, chains, cordage, belts, and woods; another is devoted to the investigation of building material, such as natural and artificial stones, bricks, tiles, slates, timber, glass, lime, cement, mortars, pipes for water, gas, and sewerage; while a third department examines all forms of paper, textile fibers, and fabrics; and a fourth is assigned to the investigation of lubricants and illuminating oils, the chief of that sub-department being recognized as the highest authority in Germany on that subject.

The equipment of these several departments of the technical section includes all the standard instruments used or recognized elsewhere as authoritative, and, besides, a large number of original devices and machines specially invented and constructed by officers of the institute for the particular operations with which they are charged. A description of machines and apparatus would lead into technicalities far beyond the scope of a consular report, and would, moreover, be unintelligible without the aid of illustrations, but a summary of the number in each department will give some idea of the completeness with which the technical section is equipped for its varied and important work:

1. Department for testing metals, under direction of Prof. A. Martens. Here the metal to be tested is put through every conceivable operation—bent, stretched, crushed, punched, planed, chiseled, sheared, welded, cast, alloyed, polished, etched with acids, microscopically examined, chemically analyzed, and photographed in all aspects, many of these operations being performed repeatedly at different temperatures and in reflected or transmitted light. The whole study of a given metal is thus sometimes extended through months and even years, and the equipment for these processes includes forty-one separate machines, ranging in character from a dynamic engine measuring a tensile strain of 500 metric tons to the most delicate microscopic apparatus for studying the behavior of metallic fibers under various forms of physical stress.

2. Department for testing building materials, under direction of Chief Engineer M. Gary. Here every species of material used in building and engineering operations is crushed, stretched, analyzed, split, sawed, cut, polished, and subjected, when both wet and dry, to all temperatures; in short, to all the influences of deterioration, except prolonged time, that are encountered in actual use. For these purposes twenty different machines are provided, and the tests applied to the various forms of cement and mortar occupy in some cases several years, during which a continuous record is kept of every phase and result developed under changing conditions of temperature and humidity.

3. Department for the examination of paper, textile fabrics, yarns, and threads, under direction of Dr. W. Herzberg, chemist. This division includes fifteen machines and sets of apparatus for making every known test of textile fibers, fabrics, and all forms of paper. Its tests and decisions form the standard for the textile industries of Germany, and it has played an important part in the scientific development of that branch of industry that has brought such anxiety to Leeds, Manchester, Bradford, and Roubaix.

4. Department for testing lubricating and illuminating oils, with reference to their lubricity, inflammability, luminosity, and power to protect metals from oxidation. This division is under the direction of Dr. D. Holde, and contains eleven different sets of apparatus for testing oils, besides a complete chemical laboratory for their analysis.

All these departments and the services of their officers and employees are at the service of manufacturers, merchants, engineers, architects, or whoever wishes to obtain complete and exact knowledge concerning the qualities of any material that he may desire to use, purchase, or sell. Pamphlets of instruction are issued, containing minute instructions as to how specimens of materials intended for examination shall be selected, packed, and forwarded to the institute. The fee charged for each examination and certificate depends upon the nature of the inquiry involved and the time and labor required to reach a complete result. For investigations which require a very long time an advance deposit may be required, from which prescribed discounts are deducted under certain circumstances. Results that are of general interest are published in the organ of the institute, the Zeitschrift für Instrumentenkunde, edited by Prof. Dr. St. Lindeck and printed by Julius Springer, at Berlin. Reprints of special reports are published from the Zeitschrift for general sale and distribution.

Another important function of the institute is the testing and sealing of instruments of measurement and precision for private persons, universities, municipalities, and especially for the local testing stations, of which there is one each at Frankfort, Munich, Magdeburg, Mulhausen, and Hamburg. In this, as in all other functions, the institution furnishes the ultimate standards of accuracy for the German Empire. The more important instruments used at the branch testing stations are usually sent to Charlottenburg once a year, where they are tested, adjusted, and stamped with the imperial seal, which is the mark and certificate of standard accuracy.

To illustrate the importance of this service, it may be stated that there were tested and certified at the institute during the ten months from April 1, 1895, to February 1, 1896, 9,780 thermometers, 98 instruments for testing petroleum, 576 alloys of metals, 16 spring manometers, and 20 barometers. Out of all these, 848 instruments were condemned as untrustworthy, 36 were found to have been fatally injured in transit to the institute, 31 were spoiled during the tests, and the remainder were approved and certified.

One of the most interesting features of the whole system is found in the results demonstrated by tests of chains, cables, screws, springs, and other articles of manufacture. As an instance of this, a firm at Neuwied, which manufactures steam hoisting apparatus, submitted in 1895 a lot of 60 iron and steel chains of different sizes and variously formed links. The tests in this case occupied several months, and the report thereon forms a standard treatise on the strength and endurance of chain links of different metals in various forms and sizes under all probable conditions of temperature, friction, and strain.

In view of the important and far-reaching influence of the institute at Charlottenburg upon the scientific and industrial progress of Germany, it should not be too much to hope for that the Government of the United States, representing as it does a people so alert and deeply interested in scientific and industrial progress, may find in the admirable institution herein described a suggestion and inspiration toward a similar enterprise. As competition in manufacture for export becomes more keen and determined, exact and definitely attested standards in materials become more and more important, and the engineers and scientists of our country would gladly welcome and utilize such an institution as one means of keeping abreast of their foremost competitors in Europe.

* * * * * * *

Of all public expenditures in Germany, none are more liberal, more willingly paid, or more wisely dispensed than those which are devoted to the cause of public education and the advancement of the sciences. The universities, the technical and the trade schools are on a scale and

of a character not yet attained by those of any other nation, and as such they are the foundation and safeguards of the national prosperity. For every dollar expended on an institution like the Imperial Institute at Charlottenburg, the people receive the rich dividends that come from supremacy in the physical sciences which exalt human industry and constitute the permanent wealth of nations.

As the institute at Charlottenburg represents the needs of the practical and business interests of the whole community, so would the recognition of engineering and mechanics at the agricultural colleges represent the needs of many farmers and progressive agriculturists.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Mariano Bárcena, Director, and Señor José Zendejas, vice-director, of the Central Meteorologico-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the *Boletin Mensual;* an abstract translated into English measures is here given in continuation of the similar tables published in the MONTHLY WEATHER REVIEW during 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for August, 1897.

Stations.	Altitude.	Mean barometer.	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inch.*	° *F.*	° *F.*	° *F.*	%	*Inch.*		
Arteaga (Coahuila)	.....	.....	90.1	59.2	74.1	.....	7.56	.....	.....
Barousse	5,414	.....	83.3	59.4	72.7	.....	5.71	.....	.....
Colima	1,656	.....	.....	.....	80.6	.....	.....	.....	.....
Leon	5,934	24.30	86.2	55.4	67.6	68	3.55	ssw.	e.
Linares (New Leon)	1,188	.....	101.3	66.2	81.5	.....	8.86	se.	.....
Magdalena (Sonora)	4,948	.....	91.4	77.9	85.5	.....	7.95	ne.	ne.
Merida	50	29.93	97.3	69.8	82.2	75	10.52	e.	e.
Mexico (Obs. Cent.)	7,472	23.10	79.7	51.8	63.5	69	6.06	nw.	ne.
Mexico (E. N. de S.)	.....	23.04	79.3	47.3	62.1	59	6.07	ne.	.....
Monclova (Coahuila)	1,926	.....	100.8	71.6	83.7	.....	5.48	.....	.....
Monterey	1,626	23.20	104.0	61.0	82.2	68	5.76	e.	w.
Morelia (Seminario)	6,401	24.00	77.5	77.5	60.1	78	4.19	sse.	e.
Oaxaca	5,164	25.08	89.8	54.0	72.7	76	6.48	nw.	e.
Parras (Coahuila)	3,986	.....	90.9	64.8	76.3	.....	8.46	.....	.....
Puebla (Col. Cat.)	2,168	23.37	81.7	48.2	70.3	46	10.19	ne.	ne.
Queretaro	6,070	24.21	84.2	57.8	66.2	65	5.37	e.	.....
Saltillo (Col. S. Juan)	5,399	24.82	87.8	60.8	73.0	70	4.06	n.	n.
San Luis Potosi	6,202	24.17	85.5	57.2	68.0	70	3.56	e.	ese.
Sierra Mojada (Coah)	.....	.....	95.7	54.1	77.4	.....	3.74	.....	.....
Tampico (Hos. Mil.)	38	29.92	91.4	73.8	82.0	79	8.64	se.	se.
Toluca	8,612	21.95	77.4	48.2	59.4	79	5.22	e.	.....
Torreon (Coahuila)	3,720	.....	100.9	71.8	84.9	.....	7.09	.....	.....
Trejo (H. d. S., Gto.)	6,011	.....	73.4	.....	.....	.....	11.05	se.	.....
Vaqueria (Coahuila)	.....	.....	89.6	56.1	72.9	.....	11.10	.....	.....
Zacatecas	8,015	22.55	78.1	49.6	62.4	70	7.28	e.	e.
Zapotlan (Seminario)	5,125	25.08	84.7	59.0	71.1	71	5.95	se.	se.

CLIMATOLOGICAL DATA FOR JAMAICA, W. I.

Through the kindness of Mr. Maxwell Hall, of Montego Bay, Jamaica, the meteorological service of that colony has acceded to the request of the Editor for the prompt communication of an abstract of the very interesting climatological records of that highly important West Indian service. The climatological summary for August, 1897, furnished by Mr. Hall, through his assistant, J. F. Brennan, of the Meteorological Office, is reproduced in the following table.

The stations Kings House, Hope Gardens, and Stony Hill Reformatory are near Kingston, and are not supplied with mercurial barometers. The barometric pressures, as given for these Jamaica stations, are reduced to the standard instrumental temperature (32° F.) and standard gravity (latitude 45° and sea level), and all except Hill Gardens are also reduced to sea level. The thermometers are exposed in Stevenson screens, and their readings have been corrected for instrumental errors. The wind movement is measured by Robinson anemometers, assuming the factor 3. The amount of cloud is given in tenths of the whole sky; the lower clouds are for the most part fracto-stratus; the middle clouds, cumulus; and the upper clouds, cirrus or cirro-stratus.

The observations at 7 a. m. and 3 p. m. at Kingston and Hill Gardens are also communicated in detail by Mr. Hall, but are not published at present, although eventually this may be done, as Hill Gardens is, like Blue Mountain, an interesting mountain station, for comparison with its near neighbors, Castleton Gardens and Kingston. If a mountain summit station can be obtained this also will be published. Many details with regard to the climate of Jamaica will be found in Mr. Hall's contributions to the official handbook published by the Government of that island in 1881.

The important mutual relations between the meteorology of the West Indies and the southern portion of the United States must stimulate the study of these records from Jamaica.

Jamaica, W. I., climatological data, August, 1897.

	Morant Point Lighthouse.	Negril Point Lighthouse.	Kingston.	Kings House.	Castleton Gardens.	Hope Gardens.	Stony Hill Reformatory.	Hill Gardens (Chn. Plant.)
Latitude	17°56′	18° 16′	17° 58′	.....	18° 12′	.....	.....	18°05′
Longitude	76°10′	78° 23′	76° 48′	.....	76° 50′	.....	.....	76°39′
Elevation (feet)	8	33	50	400	580	600	1,400	4,907
Mean barometer 7 a. m.	29.956	29.954	29.965	.....	.....	.....	.....	25.405
Mean barometer 3 p. m.	29.918	29.916	29.904	.....	.....	.....	.....	25.393
Mean temperature 7 a. m.	.....	78.5	76.3	74.3	72.0	73.4	73.6	69.7
Mean temperature 3 p. m.	.....	88.8	86.8	88.8	83.4	86.4	79.7	68.4
Mean of maxima	.....	88.2	89.5	92.7	87.4	90.3	87.3	72.5
Mean of minima	.....	73.3	74.0	68.3	67.5	70.3	68.4	60.0
Highest maximum	.....	92	94	97	92	97	91	78
Lowest minimum	.....	71	71	65	63	67	65	56
Mean dew-point 7 a. m.	.....	73.7	70.4	71.3	69.8	70.3	70.0	58.6
Mean dew-point 3 p. m.	.....	74.8	72.9	79.7	77.3	71.5	74.0	63.0
Mean relative humidity 7 a. m.	.....	85	88	90	90	90	88	88
Mean relative humidity 3 p. m.	.....	75	64	74	79	68	83	81
Monthly rainfall (inches)	5.00	6.71	2.13	5.95	9.09	4.82	6.02	5.38
Average daily wind movement	.....	200.5	89.5	.....	.....	.....	.....	55.4
Average wind direction 7 a. m.	ne.	ene.	n.	.....	.....	.....	.....	.....
Average wind direction 3 p. m.	ne.	ene.	se.	.....	.....	.....	.....	.....
Average hourly velocity 7 a. m.	5.4	6.0	1.0	.....	.....	.....	.....	.....
Average hourly velocity 3 p. m.	8.0	12.6	7.1	.....	.....	.....	.....	.....
Average cloudiness (tenths):								
7 a. m. Lower clouds	2.9	0.3	0.8	.....	.....	.....	.....	.....
7 a. m. Middle clouds	2.2	1.0	0.6	.....	.....	.....	.....	.....
7 a. m. Upper clouds	1.7	6.0	3.5	.....	.....	.....	.....	....
3 p. m. Lower clouds	2.6	3.6	1.5	.....	.....	.....	.....	.....
3 p. m. Middle clouds	1.8	3.5	1.1	.....	.....	.....	.....	.....
3 p. m. Upper clouds	1.0	1.9	4.0	.....	.....	.....	.....	.....

CYCLONE IN NICARAGUA.

A report from Mr. M. J. Clancy, United States Consular Agent at Bluefields (received through Mr. Thomas O'Hara, United States Consul at San Juan Del Norte), states:

On August 15 a cyclone passed over the banana district on the Bluefields River and destroyed 20 per cent of the plants and suckers.

On account of the widespread misuse of the word "cyclone" it may be questioned whether this refers to a tornado or to the smaller West Indian hurricane or to such destructive winds as accompany thunderstorms.