to take the work over. Then some other man could later continue the work. Some of these problems should be carried forward at intervals for hundreds of years. It is a long look ahead, but geology, which gazes far back, should also have courage to plan far ahead.

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GENTLE SOUTHWEST WINDS

THERE had been a chill easterly breeze all day, which to a person perhaps abnormally apprehensive had been a source of fear that his plans for to-morrow's outing might be upset, but the evening paper carried the reassuring forecast: "Fair and warmer, gentle southwest winds." In the morning waking up by the light rather than by the clock one finds it already late with a driving rain against his windows and a northeaster blowing forty to fifty miles an hour in the stead of that five- to eight-mile soothing southwest zephyr. True, the mathematician will tell us that -50 is much less than $+8$, but is it gentler? The plans are indeed upset with only a cynic's humor to relieve the disappointment as he reads in the breakfast newspaper the forecast for to-day: "Fair and warmer, gentle southwest winds."

There are two things to observe about this forecast. First, however it may have been from the viewpoint of the meteorologist who made it, from the viewpoint of the reader it is not a forecast but a plain contradiction of the actual condition. Does not the forecaster unnecessarily expose his reputation by permitting this observation to be made? Should he not take a leaf from the notebook of the long-range weather expert and talk only of the future, that which ordinarily will be future to the reader of the forecast, so that his errors will not strike so many so obviously? And, second, is the forecast properly to be called erroneous; may it not be that, superposed upon the general flux of meteorologic conditions, which is subject to such law as may let forecasting aspire to be scientific, there is an essentially hazardous element of more or less local instability which will forever in part cheat the aspiration of its fulfilment?

Those who watch the typical local thundershowers of the summer play hide and seek with the sun know that the precipitation is brief in time and very spotty in place. Many do not so well realize that even in a general wide-spread rainstorm the precipitation comes often in spurts which last but a short time and are therefore to be presumed to be distinctly local. This phenomenon shows itself on the records even of the annual rainfall.[1] Consider the table of six stations in the city of Providence,[2] R. I., for the years 1921–1925.

The first five rows in the table give the records under municipal auspices at the Hope, Fruit Hill and Sockanosset reservoirs, the Pettaconsett pumping station and the sewage precipitation works. That record which in each year is highest or lowest is marked H or L; that year which at each station is highest or lowest is marked h or l. The yearly means for the five stations and the difference between high and low are next given. This difference varies from 2.7 to 9.4 inches, with a mean of 5.0. Yet if the records for the five years be averaged the difference H-L is only 1.9. The range of the yearly means is 10.5 inches. Furthermore, the highs and lows (H and L) distribute themselves haphazardly among the stations. These facts show that, so far as this brief record of these five stations goes, we may well consider that the variations between the stations are fortuitous each year, that as precipitations are measured to .01 inch the variations between the stations must be regarded as real and of about one half the extent of the variations from year to year, that the driest year was 1924, according to Hope and Fruit Hill, but 1925

[1] See the discussion by A. McAdie, "Dry and Wet Seasons," Blue Hill Annual for 1923.

[2] The figures for precipitation are given in the exhaustive tables by X. H. Goodnough, "Rainfall in New England," J. N. E. Water Works Assoc., 29, 239–432, 1915; 35, 228–293, 1921; 40, 178–247, 1926.

PRECIPITATION IN PROVIDENCE, R. I.

Station	Elevation	1921	1922	1923	1924	1925	Avg.	h–l
Hope Reservoir	162 Ft.	46.5H	49.0h	27.7	37.8Ll	39.0	44.0	11.2
Fruit Hill	275	44.2	53.7Hh	44.7	38.4l	40.0	44.2	15.3
Sockanosset	182	44.6	48.8L	49.3h	42.9H	41.5Hl	45.2H	7.8
Pettaconsett	25	45.1	49.1h	40.4L	42.5	39.2l	43.3L	9.9
Sewage Works	25	43.6L	50.2h	49.8H	42.1	38.8Ll	44.9	11.4
Mean		44.8	50.2	46.4	40.7	39.7	44.3	
High–Low		2.9	4.9	9.4	5.1	2.7	5.0 or 1.9	
U. S. Weather Bur.	182	36.8	44.9	40.8	33.5	33.6	37.9	
Mean—U. S. W. B.		8.0	5.4	5.6	7.2	6.1	6.4	

according to the other three stations, that the wettest year was 1923 at Sockanosset but 1922 at the other four stations. Indeed, the fluctuations from station to station and from year to year are so great that obviously a very long series of years and a considerable number of stations should be available before one has the material necessary for statistical analysis and sound inference. For example, was 1924 or 1925 the drier year in Providence? All the record enables us to say is that we do not know.

When we look at the figures of the Weather Bureau we see at once that they are running lower than those of the other stations. No complicated statistical criteria are necessary or useful for this conclusion. In each year of five they are lower than the means of the other stations; by chance this would happen only once in 2^5 to 32 times, provided there were no systematic difference, and we take odds of 32 to 1. The difference between the Weather Bureau and the means of the other five runs about 15 per cent. Systematic variations as high as 15 per cent. in the measurement of precipitation by different gauges are known[3] and make it necessary that if figures for precipitation are to be compared at different times and in different places a good calibration between the recording instruments should be available, and this calibration should be by direct comparison, because owing to the showery nature of precipitation a very long series of observations at different places even within the same large city would be necessary to establish the calibration by a statistical reduction of the observations themselves, and even then there would be no assurance that part of the residual systematic difference were not due to difference of elevation or other dissimilarities in the configuration of the local terrain.

The six stations in Providence have a seventeen-year record in common (1909–1925). We shall not give the figures[2] in detail here; but some deductions from them may be mentioned.

	Hope Reservoir	Fruit Hill	Sockanosset	Pettaconsett	Sewage Works	Mean	U. S. W. B.
17-year mean ...	44.5	42.4	43.6	43.4	42.4	43.3	37.1
Standard deviation	6.0	5.4	5.0	5.5	4.8	5.3	4.2

The seventeen-year means place Hope highest and Fruit Hill and the Sewage Works tied in lowest place. The standard deviations for the five stations vary from 6.0 to 4.8, about a mean of 5.3. The seventeen-year means have a mean of 43.3 and vary about that with a standard deviation of 0.8. Is there a real difference of significance between the stations? We must bear in mind that we are dealing with a double series. If we take only one station for the seventeen years with the standard deviation from year to year about 5.3, we infer that the means of seventeen-year samples may vary by $5.3/4.1 = (\text{S.D.}/\sqrt{17}) = 1.3$ and thus the value of the mean at that station is not particularly well determined and the five means would be too near together. But the five seventeen-year series are of course highly correlated (and highly correlated with that of the U. S. Weather Bureau, which falls below them by 15 per cent.). The coefficients are:

	Hope	Pettaconsett	Sewage	Sockanosset	Fruit Hill	U. S. W. B.
Hope	—	.86	.85	.84	.81	.83
Pettaconsett	.86	—	.75	.92	.84	.76
Sewage	.85	.75	—	.87	.82	.90
Sockanosset	.84	.92	.87	—	.81	.77
Fruit Hill	.81	.84	.82	.81	—	.83
U. S. W. B.	.83	.76	.90	.77	.83	—

The mean coefficient is .83 and the S.D. of the fifteen coefficients about this mean is .046.

It is the standard deviation of the station values about their yearly means or that of the differences of the values for the same year between the ten pairs of stations which should be examined to find the sampling error as between the stations in the seventeen-year means. The former value is 2.1, the latter 3.2. For the five means the corresponding values are .8 and 1.3. Now random samples of seventeen should differ from the mean by $2.1/4.1 = .5$ or from each other by $3.2/4.1 = .8$. The observed values differ by 50 per cent. more, which indicates that in fact the stations do differ among themselves more than might be expected and that therefore some of the difference observed between them may be real, but the significance of the amount of this difference is very poorly established[4] as even the largest of the ten differences

[3] See Goodnough, *loc. cit.*, 1926, pp. 179–184.

[4] Although, owing to the magnitude of the interstation fluctuations, the quantity by which the Hope Reservoir record exceeds that of the Sewage Works is not very definite, the qualitative fact that Hope is running high is well established by the simplest of criteria. For, if there were no tendency to run high, being one of five stations the chance that it should be highest in a particular year

must be written 2.1 ± 0.8. Such considerations justify the earlier statement that a very long statistical series is necessary to calibrate one instrument against another, unless the observations are performed at the same spot.

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SCIENTIFIC EVENTS

A CHINESE NATIONAL RESEARCH INSTITUTE

THE founding of a National Research Institute modeled on the Smithsonian Institution was one of the first acts of the new Nationalist Government in China. Dr. Chi Li, field archeologist of the Freer Gallery, has issued a statement in regard to the work of the institute, which is in part as follows:

The purpose of China's national research institute is expressed in a phrase borrowed from the Smithsonian Institution—the increase and diffusion of knowledge. The institute has already organized an expedition to the Province of Kwang Si, to study the geology, paleontology, zoology and botany of the province. The expedition hopes also to include eventually anthropology and archeology in its scope. The cost will be shared by the national government and the provincial government of Kwang Si. The institute hopes in this way to develop systematic scientific exploration of every province in China.

The membership of the institute includes thirty well-known scientific men. Dr. Li represents archeology and was the first member of the new organization. He will continue as field representative of the Smithsonian Institution and the Freer Gallery.

The most productive native institution, according to Dr. Li, has been the Geological Survey of China, organized about twelve years ago. Its geological, paleontological and archeological reports are internationally known.

The Smithsonian Institution plans to cooperate actively with the new institute, and Dr. Li will see the Nationalist authorities at Nanking on his return to China to work out a method of cooperation. It is Dr. Li's opinion that the new growth of national self-consciousness has considerably brightened the outlook for foreign cooperation in scientific research in China.

I consider science the most powerful agent for international understanding [said Dr. Li]. In my own case I feel more at home with an archeologist, no matter what his race, than with one of my own countrymen whose interests are not my own.

In sketching the history of modern science in his country, Dr. Li said that the first national activity of importance began with the founding of the Chinese Republic in 1912. Shortly thereafter a science society was organized to diffuse the scientific knowledge accumulated by the western world. In 1920 a biological laboratory was established at Nanking, and a movement is on foot to establish a second laboratory at Peking.

THE BRITISH EMPIRE VEGETATION COMMITTEE

PROFESSOR A. G. TANSLEY, F.R.S., and Dr. T. F. Chip, of the Royal Gardens at Kew, president and secretary, respectively, of the British Empire Vegetation Committee, have sent out a letter announcing the intention of the committeee to put into effect a resolution passed in 1924 by the Imperial Botanical Conference, to the effect that all future work published on the vegetation of the British dominions and colonies should be registered and abstracted, the abstracts being made generally available by periodical publication.

By the courtesy of the British Ecological Society, publication of these abstracts will take place by way of supplement to *The Journal of Ecology*, which is published twice a year, and of which Professor Tansley is the editor, and this supplement will appear as a part of each number. The supplements will also be obtainable separately from the rest of the journal. It is hoped that all botanists will cooperate with the committee by supplying proofs or separates and preparing abstracts of any of their publications that may bear on the subject, beginning with January, 1927. It is requested that abstracts should not exceed in length from three to five per cent. of the book or paper abstracted; in many cases considerably shorter abstracts will be adequate. At the same time it is realized that in the case of new and important results of detailed ecological or vegetational work longer abstracts may be found necessary. A description of the plan for making and despatching abstracts will be mailed on request by the secretary of the committee.

FEDERAL AID TO AGRICULTURE

IN a speech on federal aid for agriculture before the Round Table on Agriculture at the Institute of Public Affairs, University of Virginia, on August 8, which is reported in the *U. S. Daily*, Eric Englund, senior agricultural economist in the Department of Agriculture, pointed out that, although the Depart-

is $\frac{1}{6}$ and the chances of different numbers of highest could be obtained from the expansions of $(\frac{1}{6}+\frac{4}{6})^{17}$. Now Hope was highest in nine years out of seventeen and the chance for a score so high as this is about 1 in 400—even the chance that some one of five stations should have such a score is only about 1 in 80. In a similar way one may examine the fact as to whether a station is above or below the mean of the five by considering $(\frac{1}{2}+\frac{1}{2})^{17}$, but the criterion is not so discriminating.