peak of production was reached during World War I; after 1928, the district was virtually dormant until the outbreak of World War II. At the end of 1944, the output had reached a total of 93,000 tons of lead and 37,000 tons of zinc. By 1943, however, three out of every four lead-zinc properties in the district were too nearly exhausted to be productive, and the total production of lead and zinc together for 1943 and 1944 was less than 10,000 tons.

Although many ore bodies end downward in zones of high-angle faults, very few faulted continuations of the ore bodies exist because most of the faults are older than the ore. Prospecting should search along the conduits—either above or below ore bodies already mined.

C. C. ALBRITTON, JR.
ARTHUR RICHARDS
A. L. BROKAW
J. A. REINEMUND

U.S. Geological Survey
Washington, D.C.

Received March 16, 1954.

Landslide Investigations along the Columbia Valley in Northeastern Washington

Landslides occur in the surficial deposits along the upper Columbia River Valley with such great frequency that their consideration has become an important factor in relation to engineering developments and land utilization. Geologic investigations have been in progress since 1942 in an effort to develop criterions for predicting the probable amount of land that will be affected by sliding. The area of studies extends along the upper 200 mi of the Columbia River Valley in the state of Washington, reaching upstream from Grand Coulee Dam along Lake Roosevelt to Canada and downstream from Grand Coulee Dam along the Columbia River nearly to Chief Joseph Dam. Numerous fresh landslides in a relatively uniform physical setting present an unusual opportunity for a study of geologic processes and for a statistical analysis of landslide data. The application of statistical methods is believed to be a new approach to the study of landslides and the stability of natural slopes.

Early examinations revealed a wide variety in the size and shape of slides, and these differences seemed to reflect the particular geologic setting. Preliminary studies, however, were inconclusive on why a slide would occur in one place and not in another, and on why a slide would cut deeply into one terrace and shallowly into another. Comprehensive research was begun in 1950 to determine the factors underlying these apparent differences.

Investigations consisted of studies and measurements of more than 300 landslides in the Nespelem silt of Pleistocene age. Slides were classified into type groups, so that each type might be analyzed and compared with the others. The geologic environment was subdivided into the classification factors—material, ground water, terrace height, drainage, original slope, submergence, culture, and material removal. These factors were subdivided into quantitative or qualitative categories that could be determined by field examinations.

Elements of the geometric configuration were measured and analyzed with relation to the classification units in important type groups. For the purpose of this study and its practical significance, the key measurement of a landslide has been conceived as the ratio HC/VC, where HC and VC are, respectively, the horizontal and vertical distances from the foot to the crown of the landslide taken at midsection normal to the slope. Of the eight classification factors analyzed by statistical methods, only material, ground water, original slope, and submergence proved to be significantly related to the HC/VC-ratio. By using the various categories of each of these factors, a formula has been developed for predicting the HC/VC-ratio of landslides, thus providing the geologist with a new method of estimating the amount of land that may be affected by impending landslide action in a geologic setting similar to that of the Columbia River Valley.

The stability of natural slopes is being investigated by combining classifications and measurements of slopes on which slides have not occurred with those on which slides have occurred. The analysis includes the variable factors—material, ground water, terrace height, original slope, and submergence. This technique of geologic classification and statistical analysis may be considered a new tool to assist geologists and engineers in estimating whether natural slopes are relatively stable or unstable.

A report describing this work is in preparation. The next phase of the investigations will test the practical application of the slope stability technique and the formula for prediction of the HC/VC-ratio of landslides.

FRED O. JONES

U.S. Geological Survey
Spokane, Washington

Received March 16, 1954.

On "Audiogenic Seizure and the Adrenal Cortex"

THE interesting paper by W. P. Hurder and A. F. Sanders, "Audiogenic seizure and the adrenal cortex," *Science* **117**, 324–326 (1953), is unfortunately marred by a faulty analysis of variance and an unsatisfactory interpretation of that analysis, leading to conclusions which are unjustified and largely erroneous.

By using their published treatment means and standard deviations, a correct analysis of variance can be constructed. It appears in Table 1, in different units and after correction of various errors.

The analysis of variance shows (1) some indication that there is an interaction of all three factors together, (2) a "significant" interaction of test and susceptibility, (3) "highly significant" interaction of

TABLE 1. "Correct" analysis of variance of data reported by Hurder and Sanders.

Source		df	Sum of squares	Mean square	Variance ratio	p
ACTH	(A)	1	249	249		
Test	(T)	1	2	2		
Susceptibility	(S)	1	215	215	10.0	0.01 –
A × T		1	263	263	12.3	.001 –
A × S		1	1	1		
T × S		1	86	86	4.0	.05 –
A × T × S		1	67	67	3.1	.1 –
Within groups		72	1540	21.4		

ACTH and test, and (4) a "highly significant" main effect of susceptibility if the test-susceptibility interaction is considered to be merely a result of sampling variation. Hurder and Sanders concluded that ACTH, susceptibility, and the three-factor interaction were "highly significant."

The erroneous analysis of variance evidently resulted from errors in computing sums of squares for the various interactions. Such errors could have been detected by noticing that the two-factor interaction mean squares are significantly small compared to that for three-factor interaction. This could be a chance result, but will usually lead to detection of errors in arithmetic.

Several biological questions are raised by the correct analysis of these data. Probably the least is whether susceptible animals have larger adrenals than nonsusceptible animals, or whether a difference develops in a few days after audiogenic seizure. The lack of an ACTH effect (in a few hours) on adrenal weight in untested animals is concordant with the present state of knowledge, so far as I am aware. Hence there might be considerable interest in learning how ACTH could affect adrenal weight of animals subjected to seizure tests, remembering the short time in which it could act (20 hr from first injection to death, and only 10 hr from seizure test to death). Lastly, there is the question of how the seizure test can cause a decrease in adrenal weight, a result that appears discordant with other knowledge of such phenomena. Perhaps Hurder and Sanders are already at work on these questions.

HORACE W. NORTON

Agricultural Experiment Station
University of Illinois, Urbana

Received November 20, 1953.

A Correction and Additional Observations

INTERPRETING the revised analysis by H. W. Norton, we regard the interaction between seizure test and ACTH as the only statistically significant interaction. The sequence, audiogenic seizure (hereafter designated AGS), ACTH, final AGS, was peculiarly effective in increasing adrenal weight. Reference to the table in Norton's communication reveals that ACTH alone did not produce a significant increase in gland weight, when the ACTH effect is evaluated in the light of the interaction of ACTH and seizure test. It will further be noted that the variation in adrenal weight attributable to AGS susceptibility is statistically significant. This is as reported in the original article.

A study that introduces data relevant to the present interpretation of our first research has now been completed in our laboratory by W. J. McGovern and will soon be published. In this experiment, 56 40-day-old hooded rats were classified as AGS-susceptible or nonsusceptible, and then further divided into subjects receiving ACTH injections for 5 days (6 mg standard ACTH per day) or receiving equivalent water injections. All injections began 4 days after the initial AGS test, and animals were retested for AGS susceptibility on the 5th day of injection. Except for these details, the procedures of this experiment were the same as those of phase A of the original study.

The 5-day ACTH regimen produced no significant change in AGS incidence. The adrenal glands of these rats were removed 10 hr after the last AGS test. The percentage body weights of these glands are presented in Table 1, for comparison with similar data from the rats of phase A of the original study.

TABLE 1. Means and standard deviations of percentage body weights of adrenal glands.

	Susceptible			Nonsusceptible		
	Mean	S.D.	N	Mean	S.D.	N
ACTH-6 mg	0.0405	0.0037	10	0.0331	0.0050	10
Water	.0313	.0042	10	.0280	.0027	10
ACTH-30 mg	.0373	.0057	14	.0303	.0037	14
Water	.0280	.0046	16	.0278	.0059	12

An analysis of variance of these new data indicates that the interaction of ACTH and susceptibility is statistically significant (1-percent level). Neither ACTH nor susceptibility *alone* is a significant source of adrenal weight variation, although the ACTH means are larger than their control means and the susceptible means are slightly larger than their control means. A striking similarity of the relations among the means of the rats of this study and those of the rats of phase A of the first study is apparent in Table 1. In the absence of a phase B in the 5-day ACTH experiment, we cannot extract from the data the effect of the final AGS. It is our guess that this interaction of ACTH and susceptibility with extended ACTH injections is another instance of the effectiveness of the AGS, ACTH, AGS sequence in increasing adrenal weight. However, neither of these researches permits an answer to the question whether a sequence of ACTH, AGS might not be sufficient to produce a significant increase in adrenal weight.

Our first report raised, but did not answer, the question whether the significantly large adrenal glands of rats susceptible to AGS preceded or followed AGS.