reduced, again picked with the aid of a lens and finally analyzed, with the following results :

	I.	II.	III.
S	15.21	15.27	15.19
Pb	43.94	44.28	44.03
Bi	32.02	33.31	33.89
Ag	5.78	5.49	5.72
Cu	Trace	0.03	Trace
Gangue	0.15	0.14	0.17
	97.70	98.52	99.00

together with traces of Fe and Zn. In our first analysis the Bi is probably too low. The loss in the other two we believe to be due to a slight volatilization of Pb and Bi, caused by reduction of the sulphate and oxide, respectively, adhering to the filter paper, or to an incomplete oxidation of the S.

The formula of the mineral, 3 (Pb, Ag_2) S. Bi_2 S_3, would be that of Kobellite [3 Pb S. $(Bi, Sb)_2$ S_3] differing principally from the latter by the absence of Sb. Similar silver—bismuth minerals, also from Colorado, have been described by Drs. F. A. Genth and G. A. Kœnig, of the University of Pennsylvania, under the names of Schirmerite, Cosalite, Alaskaite and Beegerite.

THE "LALANDE-SPENCE" PRIMARY BATTERY.

BY JAMES H. STEBBINS, JR.

The following extracts are taken from the description of this battery as given by the owners of the patent :

"The cell is composed of a stamped iron tray, on the bottom of which is sprinkled some oxide of copper. The cell is then half filled with a solution of caustic soda at a certain degree of density, and a plate of zinc is immersed in the solution." * * * * * * *

"There is practically no waste going on in the cell, unless work is being done." * * * "All necessity of removing the zinc plates from the liquid is thus avoided. The action of the caustic soda upon the zinc is entirely uniform ; no honey-combing of the plates takes place." * * "A steady current is given off, and there is practically no polarization, so far as can be ascertained. The electromotive force is very nearly one Volt, and this, combined with the extremely low resistance of each cell, gives a remarkably efficient rendering." * * * "All the elements can be utilized and used over again after the electricity has been evolved." * * * "Caustic soda having no action whatever upon iron or copper, the cells which hold the liquid are not attacked in the least. The oxide of copper merely gives off its oxygen, and is found at the bottom of the cell in the shape of pure granules of metallic copper, which can either be sold at the market price, or, by being placed upon a hot plate, will in a few moments be once more transformed into oxide of copper, and this process can be repeated indefinitely. The zinc is, as will be seen above, gradually dissolved by the action of the caustic soda or potash, and it is held in solution in this liquid. When this solution is drained off and allowed to stand for a few hours, the liquid becomes perfectly clear and transparent. By the introduction of carbonic acid gas the zinc is at once separated from the liquid, which then becomes carbonate of soda, and a precipitate of beautiful white powder known as oxide of zinc." * * * *

The above description of the "Lalande-Spence" primary battery having come to the notice of a friend of mine, I was requested by him to investigate the matter, and see whether what the owners of the patent claimed could be fully relied upon. I therefore take the liberty of laying before you the result of my experiments:

RESISTANCE.

The average internal resistance of eight cells measured by a differential galvanometer, bridge and rheostat, was found to be 0.04 Ohms per cell.

ELECTROMOTIVE FORCE.

The E. M. F. was estimated by means of a standard battery of known E. M. F., a differential galvanometer, bridge and rheostat, according to the formula $C = \frac{E}{R} = \frac{E'}{R'}$, and was found to be 0.64 Volts.

CURRENT STRENGTH.

A cell was short-circuited through a resistance of 1.5 Ohms for twenty-four hours and gave the following measurements:

E. M. F.	$= 0.64 \times 1$	$= 0.64$	Volts.
Inside resistance	$= 0.04 \times 1$	$= 0.04$	Ohms.
Rheostat "	$= 1.50 \times 1$	$= 1.50$	"
∴ Total "	$=$	1.54	"

From which we get $C = \frac{E}{R} = \frac{0.64}{1.54} = 0.42$ Ampères.

The total quantity of electricity supplied was 36,288 Coulombs in 24 hours. The weight of zinc consumed was 15.456 grms., which gives a theoretical yield of 45,298 Coulombs. This somewhat large difference between the theoretical amount and that actually found, shows that a slight local action was going on. This is a very important matter, as upon it depends the constancy of the battery. I have no doubt, however, but that, by suitable adjustment, this local action may be reduced to a minimum. The total useful available rendering was found to be $\frac{0.42 \times 0.64}{9.81} = 0.027$ Kilogram meters per second; equivalent 2334.8 Kg. mtrs. per 24 hours. If from this we deduct the amount of internal work, we get $Q = \frac{WK}{9.81} = \frac{.04 \times .4096}{9.81} = .001$ Kg. mtrs. per second. This leaves for outside available rendering .027—.001 = .026 Kg. mtrs. per second.—.001 Kg. mtrs. per second = 86.4 Kg. mtrs. per 24 hours. Therefore the available rendering for outside work per 24 hours is 2334.8—86.4 = 2248.4 Kg. mtrs.

The cost of running (not including plant) for 24 hours amounts to approximately :

Zinc..........	15.45	grams	@ 8c.	per lb.	= 0.24 cts.
Copper oxide.	19.31	"	@ 10c.	"	= 0.38 "
Caustic potash	46.35	"	@ 8c.	"	= 0.74 "
Total..............................					1.36 cts.

In round numbers 1½ cents. This battery is remarkably constant, especially so in the larger sizes, and, provided all local action can be done away with, it ought to last a long while. There is one obstacle in the way of its coming into general use for electric lighting, namely, its comparatively low electromotive force. A large electromotive force is necessary in order to overcome the high resistances of some, in fact most all of the incandescent lamps in the market. This being the case, it will be seen that the Lalande-Spence battery can only be used in connection with lamps of very low resistance, and on decreasing the resistance of a lamp, the illuminating power is diminished likewise. This can, however, be partly overcome by increasing the number of elements in the battery for a given lamp ; but, for household purposes, where space is limited, this, I think, would be a most unsatisfactory arrangement. In regard to the recovery of waste products, I do not think that it would pay, unless the system were introduced upon a very large scale, as the labor involved in collecting them would cost more than could be obtained from the sale of the waste materials. On the whole I think that the battery is a good one for certain purposes, as it is certainly an improvement over most batteries now in use. The larger-sized cells, although giving the same electromotive force, have a much smaller internal resistance, and their constancy is increased largely.