of determining phosphoric acid when iron or alumina are present, or when the solution is a nitric acid one.

The only drawback I have found—that of determining with quickness the final point of the reaction—has been very largely overcome by the happy idea of Prof. Caldwell, illustrated in his paper above.

It is evident that this little portable Bunsen filter can be used with advantage in many other volumetric methods of direct precipitation, and would doubtless give a practical nature to a variety of processes otherwise difficult or tedious.

HENRY PEMBERTON, JR.]

SIZE OF DROPS AND THE U. S. DISPENSATORY.

By PROFESSOR CHARLES F. HIMES, PH.D., Carlisle, Pa.

In the recent edition, the 15th, of the U. S. Dispensatory, among other modes of approximate measurement, in the administration of medicines given, is that by drops, and in calling attention to the conditions affecting the size of drops, the statement is made, that "the drops from a full bottle should be less than from one more or less emptied." There is no indication that the statement rests upon direct tests, and it is so decidedly at variance with the results of experiment, that it seems but proper that attention should be called to it. Other conditions remaining the same, drops diminish in size as the bottle is emptied, and to such a degree that any one can satisfy himself of the fact in a few minutes. The circumstance which first directed my attention to the subject will illustrate also the degree of variation in size. It was assigned to a student in the laboratory, as an exercise, to ascertain how far drops might be substituted for more precisely measured quantities of liquids in making comparative determinations for domestic or even commercial purposes. As a preliminary test of the degree of uniformity of results, the hardness of a constant quantity of the same sample of water was destroyed by dropping into it standard soap solution, from the same bottle, and the same portion of the lip. The number of drops of course varied, but, after some skill had been acquired in using the method, in a series of experiments, the number of drops reported as required, indicated regularly increasing hardness for four experiments, then a sudden diminution, succeeded by regular increase. Upon watching the procedure of the student, there seemed to be no condition varying with the same regularity except the amount of liquid in the bottle, and consequent size of the drops; and upon

performing the experiments by filling the bottle up to the same mark for each trial, the previous periodicity disappeared, and the uniformity of results was greater than had been anticipated. Subsequent experiments with different bottles, and different liquids, demonstrated that the differences in size of drops occasioned by the variation in the amount of liquid in a bottle were not such as might in all cases be overlooked with prudence in the administration of medicines, and that the method of drops, untrustworthy at best, was rendered much more so from this fact. Upon reference to an older edition of the Dispensatory, on hand at that time, no allusion to the effect upon the size of the drops of the amount of liquid in the bottle was made, and it seemed hardly necessary to call attention to a fact presumably known to any who had employed the method.

Since sending the preceding hastily prepared note upon the size of drops I have taken the opportunity to run over the literature of the subject as given in the *American Journal of Pharmacy*, not then at my command, and am surprised that, with the painstaking character of the investigation of the conditions affecting the size of drops, this one of the degree of fullness of the bottle is practically uninvestigated, and left among the undetermined conditions.

In 1830, Durand* called attention to a series of experiments by Dr. Shuttleworth, and their appreciation by the College of Physicians of London, and gave as the conclusion from experiments of his own, "that the practice of prescribing fluid medicines by drops is altogether objectionable," and that ignorance of the conditions affecting size of drops may lead to serious consequences. After summing up the usual conditions of density of liquid, cohesion of particles, shape of the mouth of the vessel, etc., he remarks, "besides, in every instance, the first drops poured from any vase are always smaller than those subsequently obtained." There is no indication whatever that he, in the most indirect manner, intends to allude to the condition of the bottle as to fullness, but simply to a fact, which the author has not verified, that the few drops *first passing* over the lip of the vessel are smaller than the subsequent ones.

In 1858, Bernoulli† gave results of investigations with great accu-

* *American Journal of Pharmacy*, vol. 1, p. 165.

† *Schweizer. Zeitschr. f. Pharm.*, 1858, pp. 97—100; *Am. Jour. Phar.*, vol. xxxi, p. 441.

racy, "keeping in view the nature of the vessel, the temperature, the rapidity of dropping, and other circumstances calculated to affect the weight."

In 1860, Proctor* calls attention to the well-established variation in size of drops, with form and size of vessel, with density and viscosity of liquids, "and according to some other of its qualities not yet well understood."

In 1864, Quin, in the *Druggist and Chemist*,† prefaces an abstract of very careful and exhaustive investigations by Guthrie of the conditions affecting the size of drops by a remark upon "the difficulty of obtaining a standard drop, a difficulty which is still more increased by the knowledge that even when the same vessel and liquid are used the differences are almost as great as those already cited."

Parrish, on experimenting with ounce vials of water, found, in seven trials, the drops required for a fluidrachm to vary between thirty-two and sixty-five.

Guthrie investigates most fully "the physical relations existing between the matter on which the drop is formed, the liquid constituting the drop itself, and the medium through which it passes," a condition not clearly expressed before; but, after enumeration of the other usual conditions, as given by Guthrie, Quin remarks: "The condition, however, which has the greatest effect upon the size of the drop is the interval which takes place between the successive drops, and called by Prof. Guthrie the *growth-time*."

The careful experiments by Prof. Guthrie upon the influence of this condition are quoted, with his conclusion that, "on the whole, the law seems to be, the slower the dropping the smaller the drop." This was regarded as a most interesting fact to the pharmacist, as showing "the influence of rate in dispensing drops."

The paper of Prof. Guthrie is highly commended for its exhibition of talents and patience in investigation, and this "enormous and evidently most fruitful field" of investigation commended to him. But although growth-time may in some way be involved in the degree of fullness of the bottle, in not the remotest manner is the latter condition alluded to.

In an editorial of the *American Journal of Pharmacy*, Feb., 1877, vol. 49, differences in size of drops, of from 30 to 100 per cent., from

* *Lon. Pharm. Jour.*, July 2, 1860; *Am. Pharm. Jour.*, vol. xxxii, p. 428.

† *Am. Jour. Phar.*, vol. xxxvi, p. 522.

the same vessel, is remarked upon, and the experiments of Durand, before mentioned, are alluded to.

In 1880, Talbot* gives an account of experiments upon this subject, alludes to those of Durand and Bernouilli, and, in summing up his results, gives the opinion that "the administration of powerful medicines by drops is always dangerous," that "a single bottle is inconstant" as to size of drops, that "cohesion exerts the greatest influence upon the bulk of drops, temperature very little effect, and rapidity of dropping almost none,"—the last conclusion being at variance with that of Guthrie, previously given.

In none of these papers has the condition mentioned and illustrated in my first note, been alluded to.

NOTES ON THE METALLURGY OF NICKEL IN THE UNITED STATES.

By WILLIAM P. BLAKE, F. G. S., New Haven, Conn.

[Read at the Boston Meeting of the American Institute of Mining Engineers, Feb., 1883.]

The metallic element Nickel, discovered by Cronstedt the mineralogist, in the year 1751, as a peculiar metal in kupfer-nickel, remained for a long time comparatively unknown in its true characters. It was at first obtained as a secondary or by-product, in the manufacture or extraction of cobalt, being found concentrated in the cobalt speiss left in the pots when smalt or cobalt-blue glass was manufactured. Cobalt at that time was the product chiefly sought, and nickel in its applications was unknown. Since the discovery of the artificial ultra-marine blue, the demand for cobalt has been lessened, while the increasing uses of nickel have made it of first importance, and the conditions are thus reversed.†

But the nickel so produced from the residues was contaminated with copper, iron or arsenic, and in this condition it entered into the composition of the familiar alloy commonly known as German silver, but properly known as nickel silver.

The so-called nickel or nickel bronze was a complex, irregularly constituted alloy, in which less than one per cent. of arsenic was sufficient to greatly modify its physical properties. And it was difficult to

* *Am. Jour. Phar.*, vol. lii, p. 337.

† See Daubrée, *Substances Minérales*, p. 158.