towards the moon is very small. On the other hand, the diminished illuminated area of the earth turned towards the moon, makes the lunar indications in another way more definite, as the moon then reports the cloudy condition of a much narrower area, east and west, of the earth's surface. Allowance would, of course, require to be made for the more or less clearness of our atmosphere.

If we wish to get the amount of cloud during the last half of the moon, we can observe it as during the first half; but now it will give us the cloudiness to the east and not to the west of us as before. So that if we wish to know the condition of the atmosphere to the west of us over the Atlantic, during the last days of the moon, we must have the observations made and telegraphed to us from America.

These suggestions are here offered in an extremely crude state; but as they appear to have a germ of truth in them, they are offered in the hope that some one with the proper means of observation may take them up and put them to a practical test.

2. The Acids of Opium. By D. B. Dott.

The acids which have been described as existing in opium are meconic, sulphuric, lactic, and acetic acids. It is not certain that the two latter are always present. In any case they exist in small amount, and are of little importance. For many years after its discovery in 1805 by Sertürner, meconic acid was regarded not only as the peculiar acid of opium, but as that with which the morphine and some of the other bases are wholly combined. In later years it has become known that the morphine exists partly as sulphate, but I do not find that any analyses have been made, showing to what extent this is the case. The subject has indeed received but little attention, as is evident from the fact that in many of the most recent publications it is assumed that the morphine exists naturally entirely as meconate.

In 1878 Dr C. J. H. Warden of the Bengal Staff published an interesting analysis* of Behar opium ash, obtained by preserving the ashes of all the samples analysed at the Government Opium Factory for several years. The chief feature of interest in the

* *Chemical News*, xxxviii. p. 146.

analysis is the large percentage (23·14) of sulphuric anhydride found, mostly combined with potash. Mr J. Scott, in his *Manual of Opium Husbandry*, gives analyses of poppy plant ash, in which the sulphuric anhydride varies from 5·93 to 10·08 per cent. Mr Scott points out that the larger the amount of sulphuric acid in the plant, the smaller is the yield of morphia :—

SO ₃ in Plant Ash.	Morphia in Opium.
5·93	8·66
7·64	6·47
10·08	4·65

Referring to these results, Dr Warden remarks :—“ It would be interesting to ascertain whether or not there is a similar correlation between the SO₃ in the opium ash and the amount of morphia contained in the drug. Possibly the SO₃ in opium may be directly proportionate to its richness in morphia.”

In order to determine whether this surmise is correct, the sulphuric anhydride in a number of opiums was estimated by exhausting the drug with water, adding large excess of hydrochloric acid, and then precipitating with chloride of barium. It was found that this method avoided the precipitation of meconate. In the table below are given the percentages of sulphuric anhydride and morphia found in various samples of Turkey and Persian opium. As it cannot be pretended that any process for assaying opium gives absolutely accurate results, the figures under *morphia* are only considered comparative, and as an approximation to the truth.

	SO ₃ per cent.	MH ₂ O per cent.
a,	2·08	8·5
b,	2·01	15·3
c,	1·97	12·3
d,	1·94	12·1
e,	1·74	9·8
f,	1·72	12·2
g,	1·65	7·9
h,	1·50	9·5
j,	1·49	11·1
k,	1·07	2·0

It is evidently impossible to deduce from these results any general

law relating the proportions of sulphuric acid and morphia. The most that can be said is that if an opium is rich in sulphuric acid it will probably be rich in morphine; but the determination of the amount of sulphuric acid could not be used as a means of ascertaining the value of the opium. The interesting fact revealed by these estimations is the large proportion of sulphuric acid existing in opium. So far as I am aware, this has not been previously pointed out. It becomes important to know in what manner the acid is combined. In order to determine this we must know what bases and acids exist in opium. The only alkaloids that need be taken into account are morphine, codeine, thebaine, papaverine, narcotine, and narceine, and of these only codeine and thebaine excel morphine in basic power. The principal mineral base present in opium is, as might be expected, potassium oxide. Biltz, in his careful analyses* of Turkey and of German opium, gives the percentage of potassium sulphate as 2.0 to 2.5. By exhausting fine Turkey opium with water and incinerating the extract, I obtained 2.50 per cent. of ash, which indicated $0.95 \text{ SO}_3 = 2.06 \text{ K}_2\text{SO}_4$. This confirms Biltz's results. We may safely leave out of consideration all acids except sulphuric and meconic. It might almost be assumed that sulphuric would replace meconic acid in any of the latter's combinations, but to make quite sure, I dissolved a weighed quantity of morphia meconate in water, added an equivalent of standard sulphuric acid, and gently evaporated. When the solution became filled with crystals, these were examined, and found to consist entirely of sulphate. Taking then, the sample (b) in the table above given, we find that it yields 15.3 per cent. of morphia hydrate and 2.01 SO_3 . Of this amount 0.95 per cent. is in combination with potash and 0.13 per cent. in combination with the stronger alkaloids (as nearly as can be estimated), leaving 0.93 to unite with the morphia. This amount of anhydride is equivalent to 7.04 per cent. of morphia hydrate, or *nearly half the morphia in the opium*. It would be confirmatory evidence if the proportion of meconic acid in opium were found insufficient to neutralise the morphia. This fact is proved by the following experiments:—

(1) 100 grs. of opium, indicating 11.1 per cent. of morphia, were exhausted with water, slight excess of ammonia added, and the solu-

* Buchner's *Repertorium*, xxxix.

tion filtered. The filtrate was rendered faintly acid with acetic acid, and then excess of barium nitrate added. The precipitate, after being washed with the minimum of cold distilled water, was dried in the water-bath, and found to weigh 10.31 grs. This was treated with nitric acid to remove the meconate, and then ignited, leaving 4.36 grs. BaSO_4 . The 5.95 grs. meconate of barium considered as $\text{C}_7\text{H}_2\text{O}_7\text{Ba.H}_2\text{O}$ is = 3.37 grs. $\text{C}_7\text{H}_4\text{O}_7$ = 8.0 grs. morphia.

(2) From a quantity of good opium the morphia and meconic acid were prepared with as little loss as possible. There were obtained 627 grs. morphia hydrate and 186 grs. crystallised meconic acid. The proportion demanded to form the normal meconate is 262 grs. Experiments with other opiums were conducted as in (1), with similar results, the proportion of meconic acid to morphia being even less than that there described.

It is evident that if the morphia salts could be made to crystallise from a simple extract of opium, much light would be thrown on the matter under discussion. With this end in view, 500 grs. of opium were exhausted with alcohol, the alcohol driven off, and the extract treated with water. The aqueous extract was digested with purified animal charcoal, and then concentrated. After some days, a small quantity of crystals had appeared. These consisted of morphia sulphate. (It should be noted here that while the neutral meconate readily crystallises, the acid meconate has never been obtained in the crystalline state.) This cannot be regarded as an altogether satisfactory experiment, on account of the small yield of sulphate, but considering that the extract is charged with substances which hinder crystallisation, the result is not surprising; the use of any purifying agents which would cause decomposition being, of course, quite inadmissible.

To thoroughly elucidate the question would require an enormous number of experiments; but judging from the facts ascertained, I am of opinion that morphia exists in opium, partly as neutral sulphate and partly as acid meconate.

3. Direct Observations of the Effect of Pressure on the Maximum Density-Point of Water. By Professor Tait.