

way of correct determination of free ammonia, viz. the ready breaking up of urea (and other amides) when present, on heating with sodium carbonate, it would be well to ascertain if Schloesing's method for determination of ammonia admits of being applied to such excessively minute amounts of it as the water analyst is concerned with.

In conduction of the albuminoid-ammonia process proper, *i.e.* the distillation with alkaline permanganate, the author would keep the original volume of liquid in the retort constant, by admitting ammonia-free distilled water through a capillary tube, with a glass stop-cock. When there is so much organic matter as to reduce, wholly or greatly, the usual charge of alkaline permanganate, he would first determine at about what a rate the reagent is used up, then progressively supply its solution, so as to keep the original strength as nearly as possible unaltered.

Permanganate Process.—The principle involved in the last paragraph applies also to this process. There should be a constant excess of permanganate all through the process. The process should be carried on at a pretty nearly fixed temperature (say 20° C. if the Tidy method be followed).

In conclusion, the author expresses a wish that more extended biological experiments should be made as to the effects of water variously polluted on the lower animals (other animals as well as rabbits), and that the action of water introduced into the stomach as well as hypodermically injected, should be tested. It would be well to have chemical examinations, on uniform plan, from time to time made of the water supply of the largest cities at periods when the general assent of medical men indicates unusual prevalence of, or exemption from, the classes of disease most probably capable of origination from the organic pollution of drinking-water. The author would especially suggest a combined chemical and biological inquiry as to the possible effects upon living animals of the ferment or ferments of nitrification in different stages of that process. Some minor questions connected with development of nitrites and nitrates from decomposing organic matter also deserve further examination.

LOCKYER'S DISSOCIATION-THEORY¹

IN February, 1880, I took occasion, on the ground of my observations to the spectrum of chemically pure hydrogen, to take objection, to Lockyer's view, that calcium, at a very high temperature, is dissociated.² From the fact, *inter alia*, that of the two calcium lines, H' and H'', only the first is present in the spectra of so-called white stars photographed by Huggins, Lockyer proceeded to lay down the theory that calcium at a high temperature is decomposed into two substances, X and Y, of which the first gives the line H', the other the line H'', and that in the stars referred to, only the first is met with. Against this I urged that hydrogen, besides the four known and easily visible lines, has a remarkable line of very intense photographic power, which nearly coincides with Fraunhofer's H', and that one is the more warranted in regarding the supposed calcium-line observed by Huggins as a fifth hydrogen line, that the hydrogen lines in the spectra of those stars are developed in a striking manner, and also the ultra-violet star lines observed by Huggins, agree with the ultra-violet hydrogen lines photographically fixed by me.³

Lockyer, however, has not given up his idea of dissociation, but sought new proofs of it by the spectroscopic method.

He calls attention to the fact, *inter alia*, that in the spectrum of sun-spots, certain iron-lines appear broadened, and others not; that, moreover, many of them, as λ 4918 and λ 4919.7 do not occur in the spectrum of protuberances, which show other iron lines, but do in the spectrum of spots; that in the latter again, the iron lines are occasionally absent, which the former contain, and he proceeds to say: "there is, accordingly, no iron in the sun, but only its constituents."⁴

This argumentation Liveing and Dewar⁵ have already opposed, having proved that certain spectral lines of a substance, *e.g.* λ 5210 magnesium, and various calcium-lines, are only visible when certain foreign matters are present; in this case hydrogen on the one hand, and iron on the other; that accordingly the

absence of certain iron lines in the spectra of the spots or protuberances may not be attributed to a dissociation, but to the absence of foreign matters which occasion the appearance of these lines in force.

Lockyer now takes his stand, however, on another fact, which is not explained by Liveing and Dewar's experiments, and which certainly seems to afford a firmer basis for his theory of dissociation than the facts referred to above. He says:¹

"The last series of observations relates to the degree of motion of vapours in the sun-spots, which it is known, is indicated by changes in the refrangibility of lines. If all lines of iron in a spot were produced by iron vapour, which moves with a velocity of 40 km. in a second, this velocity would be indicated by a change of the refrangibility of *all* lines. But we find that that is *not* the case. We find not only different motions, which are indicated by different lines, but observe in the degree of motion the same inversions as in the breadth of the lines. This fact is easily explained, if we suppose dissociation, and *I know no more simple way of explaining it.*"

Lockyer cites as an example that in the spots of December 24, 1880, and January 1 and 6, 1881, a certain number of iron lines appeared bent, while others remained straight.

Now I believe it is possible to explain these facts on the basis of numerous observations in spectral analysis of absorption without needing to have recourse to the hypothesis of dissociation.

It is known that the position of the absorption-band of a substance depends very essentially on the dispersion of the medium in which it is dissolved or incorporated. One often observes that in strongly dispersive media the absorption-bands of a substance are displaced towards the red.² Now, the remarkable case often here occurs that certain absorption-bands are displaced with the increase of dispersion of the solvent, while others are not. Thus Hagenbach observed that, *e.g.*, the chlorophyll bands I. III. and IV. lie more towards red in alcoholic than in etheric solution, while the band II. in both solutions shows exactly the same position. I observed similar cases with uranian protoxide salts³ and with cobalt compounds.⁴

Now Kundt has already called attention to the fact, that for absorption-spectra of gases the same rule holds good as for the absorption-spectra of liquid substances. He adds, indeed: "It is only questionable whether, if, *e.g.* hyponitrate gas be mixed with various other transparent gases, the displacements of the absorption-bands are so considerable, that they can be perceived." This doubt, however, does not affect the rule supposed, but merely its experimental verification.⁵ The supposition, then, is permissible that, in the same way as with liquids, added media also affect the position of absorption-bands in the case of gases, and that in this case, as in the other, displacements of certain bands occur, while the position of others remains unaltered.

When, therefore, in sun-spots, certain iron lines suffer a displacement, and others in the same place do not, the cause is not motion, but the admixture of a foreign, strongly dispersive gas, which acts on the displaced lines and not on the others. It follows from this, further, that curvatures of absorption lines of the sun-spots need not by any means be always explained as due to motion of the absorbing gases in the direction of the line of observation, but only where all lines of a matter participate in the curvature.

That bright lines of a luminous gas, also, in like circumstances, "by admixture of another non-luminous vapour, or one giving a continuous spectrum," may suffer a displacement, Kundt has already shown.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MARCUS M. HARTOG, D.Sc., M.A., F.L.S., has been appointed to the Professorship of Natural History at Queen's College, Cork, vacant by the death of Prof. Leith Adams.

¹ Herr Vogel quotes a translation in *Naturforscher*.

² Kundt, *Substanzband Pogg. Ann.*, p. 620.

³ Vogel, "Pract. Spectralanalyse," Nördlingen bei Beck. P. 248.

⁴ *Monatsb. der Akad. der Wiss.* of May 20, 1878.

⁵ Kundt formerly doubted also the possibility of proof of an anomalous dispersion in gases and glowing vapours. Recently, however, he has succeeded in getting such proof in the case of sodium vapours (*Wied. Ann.* 10, p. 321).

¹ A paper by Herr Hermann W. Vogel, read to the Berlin Academy on November 2, 1882. Communicated by the author.

² *Proc. Roy. Soc.*, xxviii. 157.

³ *Monatsb. der Berliner Acad. der Wiss.*, 1880, p. 192.

⁴ *Comptes Rendus*, t. xcii. 904.

⁵ *Proc. Roy. Soc.*, 30, 93. *Wied. Beibl.*, iv. 366.