

## LETTERS TO THE EDITOR

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## Liquid Hydrogen.

THE letter of W. Hampson, which appears in your issue of May 26, can only mean by implication to charge me with having utilised without acknowledgment an idea of his, conveyed through a third party, in my paper on the liquid hydrogen jet, published in 1895. Such a suggestion is absolutely without any foundation in fact. My results would have been attained had Dr. Hampson never existed, just as they have been developed. He certainly in no way contributed directly or indirectly to the success of those hydrogen experiments. Had Mr. Hampson attempted to consult me as to his plans, I should have declined to entertain them, just as I had treated, under similar circumstances, distinguished colleagues engaged in low temperature research; for no other reason than to avoid the possibility of controversy. Further, I never would have allowed my assistant either to consider or advise on the projected scheme of some other person about to engage in the same field of investigation, simply because such a position would be quite unprecedented, and certain to result in misunderstandings. W. Hampson is the only inventor or investigator who has not in a straightforward way approached me directly in such matters, and it is no excuse for his dubious course of action to say he had an "introduction." My assistant has explained his position in the matter in letters addressed to "*Engineering*" within the last few weeks. The paper of 1895, on gas jets containing liquid, has been a fruitful source of recrimination. No less than three patentees of low temperature apparatus—viz. Solvay, Linde and Hampson—have each recognised in its contents part of the essential subject-matter of their respective patents. It will be for these gentlemen to fight the matter out. Suffice it to say, that the statements made in my paper of 1895 remain a correct record of facts. Further remarks on the subject can be found in the *Society of Arts Journal* for March 1898; made during the course of a discussion on the Linde process.

The Hampson patent was not published before April 1896, and the first exhibition of the working apparatus took place towards the end of March of the same year; or some three months subsequent to my *Chemical Society* paper. Mr. Hampson declares in his letter that he "*was afterwards the first in this country to liquefy air and oxygen without employing other refrigerants.*" Now, in my paper of 1895 the following passages occur:—"With such a simple apparatus and an air supply at 200 atmospheres, with no previous cooling, liquid air begins to collect in about five minutes, but the liquid jet can be seen in between two and three minutes." "In the above experiments air is taken at the ordinary temperature, which is a little above twice its critical temperature, and is partially transformed in a period of time, which in my experiments has never exceeded ten minutes, simply and expeditiously into the liquid state at its boiling-point—194°, or a fall of more than 200° has been effected in this short period of time." J. DEWAR.

May 30.

## Printed Matter and Photographic Plates.

IN connection with this subject it does not appear to be generally known that photographic negatives, after they have been developed and fixed, and especially if they have been intensified by means of the bi-chloride of mercury and ammonia process, are often strongly impressed by prolonged contact with printed matter. I first observed this many years ago, and have a large number of negatives in my possession which show the effect very strongly. I enclose a photographic negative taken by myself in 1882, which has remained since 1886 wrapped up in the accompanying advertisement sheet of the *Electrician*. As will be observed, the greater portion of the print in contact with the film is clearly legible. It is, however, worthy of note that it does not appear to be the printer's ink in this case that has produced the chemical action, but rather the paper itself, or some ingredient therein. Those portions of the film protected from contact with the paper by the ink have retained their original colour, while the other portions not so protected

have become very considerably bleached. The printing on the side of the paper removed from the film does not seem to have had any effect.

It has probably been noticed by others that ordinary albumenised and sensitised photographic paper is also strongly affected in the course of time by contact with printed matter. In this case, also, the printing comes out as white lettering upon a darker ground. A. A. C. SWINTON.

## The Transport of Live Fish.

YOUR readers may be interested to know of an experiment with the transport of live fish I am making, and so far successfully. I left Brisbane on April 16, taking with me four specimens of *Ceratodus*. This remarkable fish is doubtless sufficiently well known to your subscribers to render a description on my part unnecessary. D. O'CONNOR.

S.S. *Duke of Devonshire*, Colombo, May 16.

## CEREMONIAL DANCES OF THE AMERICAN INDIANS.

READERS of NATURE do not need to be reminded of the important work being done by the Bureau of American Ethnology, which is conducted under Act of Congress "for continuing ethnologic researches among the American Indians under the direction of the Smithsonian Institution." The value of the researches that are being carried on, and the results of which are issued in the form of annual reports and bulletins, cannot be over-estimated; for the Indian customs and beliefs, which form the subject of the majority of the papers, are not destined to survive for many years. The Indian reserves are gradually being curtailed, the Indians themselves are slowly becoming civilised, and this process is naturally attended with change and decay of their primitive ceremonial and belief. It must be admitted that the Indian nature is slow to change, and retains its tribal instincts under a veneer of civilisation. In fact, the case of a young Arapaho Indian, who, though speaking good English and employed as a clerk in a store, thought it but natural that he should join his tribe in dancing the sun-dance for three days and nights without food, drink or sleep, is far from exceptional. But the change, though gradual, is constant, and at no distant period the American Indian will have ceased to furnish the anthropologist with opportunities for the study of primitive man. When that time arrives the value of these reports, compiled by trained observers in accordance with a scientifically organised plan, will be unique.

The present article is concerned with three of the papers published in the fourteenth, fifteenth and sixteenth annual reports of the Bureau. These papers may be classed and considered together, as they deal with certain ceremonial dances still practised by many of the Indian tribes. The longest of the papers is that entitled "The Ghost-dance Religion and the Sioux Outbreak of 1890," which is contributed by Mr. James Mooney, and is published in a volume by itself as Part ii. of the fourteenth annual report. The underlying principle of the ghost-dance is the doctrine that at some future time the whole Indian race, whether living or dead, will be reunited in a life upon earth untroubled by the fear of death, hunger, or disease. Most Indians hold that this change will be brought about by spiritual powers who will require no assistance from men, but at times of discontent medicine-men have sought to anticipate the Indian millennium by preaching a crusade against the further encroachments of the white population, and persuading their fellow tribesmen that in this resistance they will have the active support of their dead ancestors and relatives. Such a revival took place in 1890 among the Sioux, the largest and strongest Indian tribe in the United States. The cause of the outbreak may be traced to irritation at the encroachments made on their reserve,

and to the neglect of the Government to carry into effect their promises of furnishing supplies. As the area of their hunting-grounds was diminished, they had to depend for subsistence on their cattle and crops and on the rations allowed them by Government. In 1888 their cattle suffered from disease, in the two following years their crops were a failure, and their rations of beef were diminished by half. In 1890 they were on the brink of starvation, and ready to listen to the words of a messiah. In fact there is no doubt that hunger was the real cause of the rebellion, and not the ghost-dance itself, though this ceremonial was adopted as the means of propagating the crusade. That resistance to the whites had no part in the original doctrine of the dance is proved by the fact that in many other tribes which practise it no outbreak has occurred. The Sioux rebellion was put down after a short though costly war, and Mr. Mooney has given a detailed account of the campaign which was brought to a close by the battle at Wounded Knee. We are not here concerned with this somewhat melancholy chapter of Indian history, but will confine ourselves to the interesting account he has given of the ghost-dance with which the rebellion is generally connected.

No one is better qualified to give an account of this ceremony than Mr. Mooney, for he has had exceptional opportunities for studying it. From 1890, when the ghost-dance was beginning to attract attention, to the early part of 1894, he has studied it on several expeditions, his actual investigations among the Indians extending over a period of twenty-two months and entailing some 32,000 miles of travel. Not only has he frequently seen the dance performed, but he has taken part in it himself among the Arapaho and Cheyenne, and by means of his kodak and camera has obtained some valuable photographs. He also visited Wovoka, the messiah who inaugurated the recent revival, and by gaining the confidence of the Indians obtained from a Cheyenne Indian, Black Short Nose, a copy of the messiah's message, embodying the doctrine of the ghost-dance, which he had previously sent to the Cheyenne and Arapaho tribes. Mr. Mooney has given a very full and interesting account of the ceremony of the ghost-dance, but here we have not space for more than a sketch of its most striking features.

The place chosen for the dance is frequently consecrated by the sprinkling of sacred powder. Seven priests lead the dance, and seven women are sometimes added as leaders, the number seven being sacred with most Indian tribes. Those selected as leaders receive two feathers of the crow, the sacred bird of the ghost-dance, or one of the eagle, which is sacred with all Indians; and these feathers they thrust in their hair. Nearly all the dancers wear feathers, the painting and ornamenting of which is attended with great ceremony; while the faces of the dancers are painted with elaborate designs in red, yellow, green and blue. The dance generally begins in the middle of the afternoon, the leaders walking to the spot selected, where they form a small circle facing inwards and joining hands. Then without moving they sing the opening song in a soft undertone, and, having sung it once, repeat it, raising their voices to their full strength, and slowly circling round from right to left. This process is repeated with different songs. Gradually the people of the tribe gather round, and one after another joins the circle until any number, from fifty to five hundred, men, women and children, are in the dance. The object aimed at by all the dancers is to fall into a sleep or trance in which they will see their dead relatives and converse with them. Sometimes a dancer will work himself into the trance-state solely by the influence of the movements of the dance and the singing, but the dancers are generally helped by the medicine-men standing within the circle, who, in Mr. Mooney's opinion, unconsciously exercise hypnotic influence. The first

symptom of the trance-state is a slight muscular tremor, and, as soon as a medicine-man perceives this he fixes his eyes on the dancer, uttering sharp exclamations and twirling a feather or small cloth rapidly in his face. Soon the dancer loses control of himself, staggers and breaks away from the ring, which closes up again. The medicine-man continues his passes, generally keeping the sun full in the face of the dancer, who becomes rigid and finally falls to the ground unconscious. The trance lasts sometimes ten minutes, sometimes for hours; for those who continue dancing are careful not to disturb any dancer in the trance. As Mr. Mooney has taken part in the dance himself, he has observed the various stages in the hypnotic trance, as will be seen from the following quotation:

"From the outside hardly anything can be seen of what goes on within the circle, but being a part of the circle myself I was able to see all that occurred inside, and by fixing attention on one subject at a time I was able to note all the stages of the phenomenon from the time the subject first attracted the notice of the medicine-man, through the staggering, the rigidity, the unconsciousness, and back again to wakefulness. On two occasions my partner in the dance, each time a woman, came under the influence, and I was thus enabled to note the very first tremor of her hand and mark it as it increased in violence until she broke away and staggered toward the medicine-man within the circle."

In addition to his observations of the actual ceremony of the ghost-dance, Mr. Mooney has made very careful studies of the songs employed by the dancers. As with church choirs in civilized countries, the leaders of the dance hold numerous rehearsals of the songs which are to be employed at the next dance; for though each tribe has certain songs which form a regular part of the ceremony, new ones are constantly being added by those who have experienced the trance. Mr. Mooney was often present at these rehearsals, and was thus enabled to take down many of the songs, and some of the airs he has put to music. In fact Mr. Mooney has treated his subject exhaustively, and has prefaced it with a discussion of the various Indian revivals due to prophets who preceded Wovoka. His paper, which runs into some 500 quarto pages, is full of material which will be of the greatest value to the anthropologist and student of religion.

Two somewhat shorter papers on certain ceremonial dances among the Indians are contributed by Mr. J. W. Fewkes to the fifteenth and sixteenth annual reports of the Bureau, which were issued during the course of last year. Like Mr. Mooney's memoir, Mr. Fewkes' papers also are of great value, as they are based on personal observations; he does not, however, enter at any great length into the doctrines which underlie the ceremonials he describes. His paper in the fifteenth annual report is entitled "Tusayan Katsinas," and in it he has given a careful record of the Katsina ceremonials as he saw them performed in the Hopi village of Walpi in Tusayan; his paper is the result of observations made by himself and by the late Mr. A. M. Stephen during the years 1890 to 1894. The word *Katsina* has a twofold meaning. It is used as a name for certain supernatural beings, subordinate to the greater gods, who are impersonated in Hopi ceremonials by men wearing masks; it is also employed as a name for the dances in which these men take part. The Katsina dances are carried on at fixed times during the period between the winter and the summer solstices, and their chief point of difference from the ceremonies performed by the Hopi during the rest of the year consists in the presence of the Tcukú-wympkiyas, or masked figures; the men who wear the masks or helmets are supposed to be transformed for the time into the deities they represent. The times for the ceremonies are determined by the priests of the tribe by observing the points on the horizon where the sun

risers and sets (see p. 111). Of the Katcina ceremonials the most elaborate is that termed Powámú. Extensive preparations are made before the dance, the old paint left from previous occasions being scraped off the masks, which are then carefully redecorated and ornamented with clusters of feathers. The dancers also decorate themselves, using iron oxide for painting their legs, knees and waists a pale red. On the occasion Mr. Fewkes describes, preliminary ceremonies took place at Walpi for a week before the first ceremonial day of the Powámú, in which masked men from the neighbouring villages of Tewa and Hano took part. We have not space here to enter into any detailed account of the elaborate ceremonials performed on this and the succeeding days, including songs, a kind of primitive drama, dances, ceremonial smoking, flagellations, sprinkling of liquids, casting of meal and pollen into liquids, the making of small dolls or images, &c. Mr. Fewkes has not attempted to explain the theoretical significance of the ceremonies, but has contented himself with accurately describing them as they were performed. We may note, however, that in his subsequent paper on the snake-dance he throws out the suggestion that these Katcina ceremonies are to be traced to a totemic origin.

Mr. Fewkes' paper contributed to the sixteenth annual report is entitled "Tusayan Snake Ceremonies," and is based on a comparative study of the snake-dance, which is now known to be performed at five Tusayan villages. At Walpi it is celebrated in its most elaborate form, and lasts for twenty days, though only on nine days do ceremonies actually take place. Sixteen days before the snake-dance occurs it is formally announced at sunrise, the chiefs of the village having been engaged in ceremonial smoking during the previous night. For the next seven days no ceremonies are performed, but on the eighth day the assembly takes place, and for nine days secret ceremonies continue, which close at sunset on the ninth day with a dance, in which snakes are carried in the mouths of the dancers; the four following days are days of purification. Mr. Fewkes admits that the meaning of the snake-dance is obscure, but inclines to the belief that the elaborate ritual is performed for two main objects—the making of rain and the growth of corn. He does not consider that the dance is in any way connected with actual snake-worship.

We have said enough to indicate the great interest of these papers, not only to the student of Indian ritual, but to anthropologists generally. If we may make one criticism, it is that in places they would, perhaps, have gained a little by compression.

ON A NEW CONSTITUENT OF ATMOSPHERIC AIR.<sup>1</sup>

THIS preliminary note is intended to give a very brief account of experiments which have been carried out during the past year to ascertain whether, in addition to nitrogen, oxygen, and argon, there are any gases in air which have escaped observation owing to their being present in very minute quantity. In collaboration with Miss Emily Aston we have found that the nitride of magnesium, resulting from the absorption of nitrogen from atmospheric air, on treatment with water yields only a trace of gas; that gas is hydrogen, and arises from a small quantity of metallic magnesium unconverted into nitride. That the ammonia produced on treatment with water is pure has already been proved by the fact that Lord Rayleigh found that the nitrogen produced from it had the normal density. The magnesia, resulting from the nitride, yields only a trace of soluble matter to water, and that consists wholly of hydroxide

<sup>1</sup> Paper to be read before the Royal Society on June 9 by Prof. William Ramsay, F.R.S., and Morris W. Travers. Received by the Society June 3.

and carbonate. So far, then, the results have been negative.

Recently, however, owing to the kindness of Dr. Hampson, we have been furnished with about 750 cubic centimetres of liquid air, and, on allowing all but 10 cubic centimetres to evaporate away slowly, and collecting the gas from that small residue in a gas-holder, we obtained, after removal of oxygen with metallic copper and nitrogen with a mixture of pure lime and magnesium dust, followed by exposure to electric sparks in presence of oxygen and caustic soda, 26.2 cubic centimetres of a gas, showing the argon spectrum feebly, and, in addition, a spectrum which has, we believe, not been seen before.

We have not yet succeeded in disentangling the new spectrum completely from the argon spectrum, but it is characterised by two very brilliant lines, one almost identical in position with D<sub>3</sub>, and almost rivalling it in brilliancy. Measurements made with a grating of 14,438 lines to the inch, kindly placed at our disposal by Mr. E. C. C. Baly, gave the following numbers. *all four lines being in the field at once* :—

D <sub>1</sub>	...	...	5895.0
D <sub>2</sub>	...	...	5889.0
D <sub>3</sub>	...	...	5875.9
D <sub>4</sub>	...	...	5866.65 + 1.7 to correct to vacuum.

There is also a green line, comparable with the green helium line in intensity, of wave-length 5566.3, and a somewhat weaker green, the wave-length of which is 5557.3.

In order to determine as far as possible which lines belong to the argon spectrum, and which to the new gas, both spectra were examined at the same time with the grating, the first order being employed. The lines which were absent, or very feeble, in argon, have been ascribed to the new gas. Owing to their feeble intensity, the measurements of the wave-lengths which follow must not be credited with the same degree of accuracy as the three already given, but the first three digits may be taken as substantially correct :—

Violet	...	...	4317	Blue	...	...	4834
"	...	...	4387	"	...	...	4909
"	...	...	4451	Green	...	...	5557.3
"	...	...	4671	"	...	...	5566.3
Blue	...	...	4736	Yellow	...	...	5829
"	...	...	4807	"	...	...	5866.5
"	...	...	4830	Orange	...	...	6011

Mr. Baly has kindly undertaken to make a study of the spectrum, which will be published when complete. The figures already given, however, suffice to characterise the gas as a new one.

The approximate density of the gas was determined by weighing it in a bulb of 32.321 cubic centimetres capacity, under a pressure of 521.85 millimetres, and at a temperature of 15.95°. The weight of this quantity was 0.04213 gram. This implies a density of 22.47, that of oxygen being taken as 16. A second determination, after sparking for four hours with oxygen in presence of soda, was made in the same bulb; the pressure was 523.7 millimetres, and the temperature was 16.45°. The weight was 0.04228 gram, which implies the density 22.51.

The wave-length of sound was determined in the gas by the method described in the "Argon" paper. The data are :—

			i.	ii.	iii.
Wave length in air	...	...	34.17	34.30	34.57
" " gas	...	...	29.87	30.13	

Calculating by the formula

$$\lambda_{\text{air}}^2 \times \text{density}_{\text{air}} : \lambda_{\text{gas}}^2 \times \text{density}_{\text{gas}} :: \gamma_{\text{air}} : \gamma_{\text{gas}}$$

$$(34.33)^2 \times 14.479 : (30)^2 \times 22.47 :: 1.408 : 1.666,$$

it is seen that, like argon and helium, the new gas is monatomic and therefore an element.