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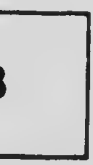

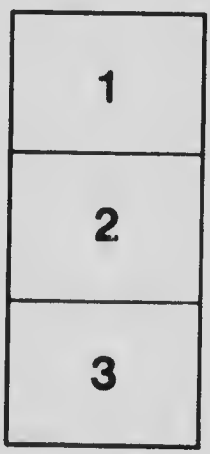

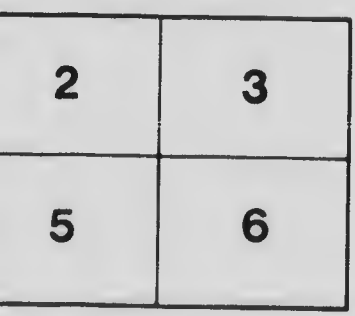

FROM THE TRANSACTIONS OF THE ROYAL SOCIETY OF CANADA
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The Production of Helium from the Natural Gases of Canada

by

Professor J, C, McLennan, F,R,S,

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The Production of Helium from the Natural Gases of Canada[1]

By PROFESSOR J. C. MCLENNAN, F.R.S.

(Read May Meeting, 1919.)

Shortly after the commencement of the war, it became evident that, if helium were available in sufficient quantities to replace hydrogen in naval or military airships, the losses in life and equipment arising from the use of hydrogen would be enormously lessened. Helium, as is known, is most suitable as a filling for airship envelopes, in that it is non-inflammable and non-explosive, and, if desired, the engines may be placed within the envelope. By its use, it is also possible to secure additional buoyancy by heating the gas (electrically or otherwise), and this fact might possibly lead to considerable modifications in the technique of airship manœuvres and navigation. The loss of gas from diffusion through the envelope is also less with helium than with hydrogen, but on the other hand, the lifting power of helium is about ten percent less than that of hydrogen.

Proposals had been frequently put forward by scientists in the British Empire and in enemy countries regarding the development of supplies of helium for airship purposes, but the first attempt to give practical effect to these proposals was initiated by Sir Richard Threlfall, who received strong support from the Admiralty through the Board of Invention and Research, under the presidency of Admiral of the Fleet, Lord Fisher O.M., G. C. B., etc.

It was known that supplies of natural gas containing helium in varying amounts existed in America, and it became evident from the preliminary investigations made by Sir Richard Threlfall and from calculations submitted by him as to cost of production, transportation, etc., that there was substantial ground for believing that helium could be obtained in large quantities at a cost which would not be prohibitive.

The writer was invited by the Board of Invention and Research in 1915 to determine the helium content of the supplies of natural gas within the Empire, to carry out a series of experiments on a semi-commercial scale with the helium supplies available, and also to work out all technical details in connection with the large-scale production of helium and the large-scale purification of such supplies as might be delivered and become contaminated with air in service. In this work he received valuable assistance from his colleagues, Professors John

[1] Communicated by permission of the Admiralty.

Satterly, E. F. Burton, H. F. Dawes, Captain H. A. McTaggart, and from Mr. John Patterson of the Meteorological Office, Toronto, and Mr. R. T. Elworthy of the Mines Branch, Ottawa.

In the course of these investigations, which were carried out with the co-operation of L'Air Liquide Co., it was found that large supplies of helium were available in Canada which could be produced at a cost of about one shilling per cubic foot.

In the preliminary work of development, an experimental station was established at Hamilton, Ontario, to treat the natural gases of Western Ontario. This phase of the work was placed in charge of Professor Satterly, and with him were associated Mr. John Patterson, Professors E. F. Burton and H. F. Dawes and Mr. Lang. In treating the gas considerable difficulty was experienced at first in getting rid of the heavier hydro-carbons but by making suitable modifications in, and additions to the ordinary type of L'Air Liquide oxygen rectifying column, the problem of separating out the helium which was present in the gas to the extent of only 0·33% was solved. In February, 1918, it was found possible to raise the percentage of helium in the gas by passing it through the rectifying column once only. As the gas obtained in this way consisted of nitrogen and helium with a small percentage of methane, the problem of obtaining helium with a high degree of purity was a comparatively simple one.

In one particular set of experiments on this final rectification, helium of 87% purity was obtained. For the actual running of the station and for the technical modifications in, and additions to the rectifying column, Mr. John Patterson was largely responsible. The experimental station was removed in the autumn of 1918 to western Canada, and placed in charge of Mr. Patterson. At this station a new type of rectification equipment was installed. No serious experimental difficulties were experienced and the investigation is now well advanced on the road to production on a moderate scale. The helium content of the richest gases in western Canada was found to be about 0·36%.

In the summer of 1917, when the U.S.A. had decided to enter the war on the side of the Allies, and after the investigations referred to above were well under way, proposals were made to the Navy and Army and to the National Research Council of the U.S.A. to co-operate by developing the supplies of helium available in the United States. These were made on behalf of the Admiralty, through the Board of Invention and Research by Sir Ernest Rutherford and a special Commission, consisting of Commander Bridge, R.N., Lieut.-Commander Lowcock and Professor John Satterly.

The authorities cited agreed to co-operate with Major in supporting these proposals, and large orders were at once placed by them with the Air Reduction Co., and the Linde Co., for plant, equipment, cylinders, etc. The Bureau of Mines also co-operated by developing a new type of rectifying and purifying machine. By July, 1918, the production of helium in moderate quantities was accomplished, and, from that time onward, the possibility of securing large supplies of helium was assured.

During the progress of the development and production stages in Canada and in the United States of America, steps were taken by the Admiralty to institute near London, England, an experimental station under the direction of the writer. This station was designed for purifying supplies of low percentage content helium which might come forward from the base of supplies, or which might have become contaminated with air in service at the front.

Investigations were also set in train to develop industrial and scientific uses for helium, and to work out experimental details of the technical use of helium in aircraft. Among others, investigations were begun on the inflammability and explosibility of mixtures of hydrogen and helium, on the use of helium for thermionic amplifying valves, on the suitability of helium for gas filled incandescent lamps and gas arc lamps, on the permeability of balloon fabrics for hydrogen and helium, on large scale charcoal absorption methods of purifying the gas, on the use of helium for high electrical resistances, and progress was made in the installation of equipment for the production of liquid helium for low temperature research. Steps were also taken to examine spectroscopically all samples which came forward with the object of ascertaining whether any indication could be obtained of the existence of any new and hitherto unobserved gaseous elements.

Those who participated in these investigations were Professors Satterly and Burton, and Captain H. A. McTaggart, Mr. R. T. Elworthy, Mr. V. F. Murray, Mr. E. Edwards, Mr. J. T. F. Young, Mr. H. J. C. Ireton and Mr. K. H. Kingdon, all with one exception members of the University of Toronto.

In the early stages of the investigation, valuable help was secured from Lord Shaughnessy and the members of his staff on the Canadian Pacific Railway, from the President and Board of Governors of the University of Toronto, from the Director of the Meteorological Office, Toronto, and from the Directors of the various natural gas producing companies in Canada, in particular from those of the National Natural Gas Co., of Hamilton, and those of the Canadian Western Natural Gas, Heat, Light & Power Co., of Calgary.

The solution of the problem of producing helium in large quantities was, before the beginning of the war, one which would have been considered by many visionary and chimerical, but through the enthusiastic support and financial aid received from the British Admiralty and from the Bureau of Mines and the Naval and Air Boards of the United States, the possibility of the production on a large scale has been realised.

May 1st, 1919.