increased; terms of admission to the professions should provide a greater incentive to pupils to reach sixth-form standard. In clerical and office careers, there should be a more effective system of grading linked with minimum ages of entry and differential scales of pay.

The report also makes suggestions for administrative action within the schools. These include treating the whole work of the school, including the sixth form, as continuous, and introducing some transition to sixth-form ways of working earlier in the school course; providing more science facilities for girls and experimenting more widely in such courses for boys; providing comparable courses for pupils of similar ability in grammar and modern schools; maintaining regular personal contact with the home and increased co-operation with the Youth Employment Service and employers.

T. H. HAWKINS

CENTENARY OF ALUMINIUM

DURING June 1–11, at the Royal Festival Hall, London, the aluminium industry is presenting a Progress Exhibition, not only to mark the centenary of aluminium as a commercial metal but also to demonstrate how the present vast output and unique experience already gained are now being applied to every great industry in increasing measure. It was at the Paris Exposition in 1855 that the French scientist, Prof. St. Claire Deville, who had succeeded in extracting aluminium from clay by a chemical process, exhibited samples of the metal. Aluminium was rated a precious metal, since it cost £60 per pound to produce. The first article to be made of the new metal was a rattle for the child of the Emperor Napoleon III, who ordered aluminium cutlery to replace the gold plate at the Tuileries banquets. An aluminium watch-chain was also presented to the King of Siam, when on a State visit to France. Attracted by its light weight, the Emperor commissioned Deville to produce aluminium on a large scale so that, with its cost reduced, it could be used for equipment for his soldiers. However, only ten tons of aluminium were produced in the whole world in the next ten years, its lowest price being £3 per lb.

In 1886, Charles Martin Hall in the United States and Paul Heroult in France, working independently, simultaneously patented the electrolytic process for extracting aluminium from its oxide. To-day, using basically that same method of extraction, 30,000 tons of pure aluminium are produced in Britain alone, at the great hydro-electric plant in the Scottish Highlands, and world production in 1954 has probably exceeded three million tons and is still increasing. From £144,400 per ton its price is now £165 per ton, and aluminium has the distinction of having increased in price to a less extent than any other important commodity. In 1907 came the discovery by a German scientist, Alfred Wilm, that by alloying small quantities of other metals with aluminium, its strength could be greatly increased. Further research and development in Britain produced a wide range of alloys which made possible the development of the aircraft industry and of the internal combustion engine.

The ten years that have followed the Second World War have been years of remarkable progress when research results have been applied to problems in every industry. First came the aluminium prefabricated house, 70,000 of which were built; to be followed by the adoption of aluminium in permanent building construction. In shipbuilding its success was never more strikingly demonstrated than by the great American liner *United States*, which has more than two thousand tons of aluminium in her superstructure, lifeboats and many fitments; less spectacular applications of aluminium to ships had already become a commonplace in Britain. The world's first aluminium bridges have been built in Britain, and aluminium coaches of London's Underground trains, and aluminium bus bodies on London's streets, provide ample evidence of the faith of the engineer in aluminium.

Its light weight and its resistance to corrosion, symbolized by Gilbert's famous aluminium statue of 'Eros'—now more than sixty years old—have made this the 'Light Metal Age'. If the progress, especially in the past ten years, has been remarkable it is still only a beginning; for the future of aluminium is boundless in its possibilities.

THE VICUNA

IN a recent issue of *Oryx*, Dr. G. Dennler de la Tour has described the characteristics, habitat and behaviour of the vicuna (11, No. 6; December 1954).

In form the vicuna resembles the guanaco, but it is smaller and slenderer. Its colour varies from pale fawn, through vermilion and golden to strongly fulvous. The vicuna has no black on its face, as has the guanaco. From the throat to the knees there is a pure white tuft, the belly and inner sides of the limbs being white also. The vicuna stands 28–35 in. high at the shoulder, its average size decreasing from south to north in its South American range. Its wool is shorter but much finer than that of the guanaco and is probably the finest and lightest wool in the world. Vicunas are found in small droves of five to fifteen females led by an adult male which watches over the flock. Young males are expelled from the flock by their mothers when they are eight to ten months old and unite into herds of from twenty to a hundred or more.

The mating season lies between April and June and, as the gestation period is ten months, parturition occurs between January and March. The vicuna almost always produces one offspring; in confinement it does not breed readily.

Vicunas feed on grasses of *Poa*, *Bromus*, *Agrostis*, *Stipa*, and other alpine genera. They drink only every two days and always use the same track to water.

The vicuna, generally speaking, lives at higher altitudes than the guanaco. It enjoys humid meadows which lie adjacent to the eternal-snow summits of the Andes, many of which reach and pass the 6,000 metre mark.

Vicunas occur in the high plateaux of the Andes between 3° S. and 30° S.; that is, in the extreme south of Ecuador, in Peru and Bolivia, in the extreme north of Chile and in north-western Argentina. Their southern limit is in Argentina at about the Agua Negra River, while their Chilean range does not go so far southwards. Where man has advanced with his sheep and goats, alpaca and lama breeding and his mining, the vicuna has receded to higher altitudes.

The vicuna was plentiful throughout its range in the era of the Inca Imperium. Hunting was only allowed every four or five years under official control, and only adult males were killed, the females being sheared and freed. Under the Spanish Colonial regime, hunting was free and, according to reports, about 80,000 vicunas were killed each year in Peru and northern Chile, leading to a considerable decline in numbers. After liberation from the Spaniards, the natives returned to the earlier practice of shearing and then freeing the animals. Later the decline of the vicuna began again, for the export market demanded vicuna skins, vicuna robes and vicuna wool. The use of firearms destroyed whole flocks, the hunters taking advantage of the females' habit of remaining near the male after he was killed. Thus a whole drove could be slaughtered one after another, and, in this manner, thousands were killed. The wool output of one vicuna gives an average of 500 gm. The superstition that the bezoars (stomach-stones) have a medical and aphrodisiac value may have contributed to the practice of killing the animals, instead of just shearing them.

It is difficult to estimate the number of vicunas living to-day. In Peru the total number in 1940 was calculated at nearly a million ; neither from Bolivia, Chile nor Ecuador has it been possible to get reliable data.

Dr. de la Tour doubts whether the total number of vicunas reaches a million, and estimates that it is probably not half a million.

The first protection measures were carried out by the Inca Imperium when hunting was allowed only every four or five years and then under the strictest control. Only the members of the Inca clan were allowed to wear clothes made of vicuna wool or use vicuna robes. After liberation from Spain, Bolivar accorded protection to the vicuna by a decree in 1825. During the present century, Peru issued a decree in 1920 prohibiting the sale of vicuna skins and the making of goods from its wool, and Bolivia prohibited the export of vicuna skins.

Argentina issued a decree in 1926 prohibiting the hunting and exportation of vicunas as well as the transportation and sale of their skin and fur.

There is pressing need for joint action between all five countries to see that existing laws are tightened up and carried out.

A NEW IDENTIFICATION OF THE FLAME SPECTRA OF THE ALKALINE-EARTH METALS

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THE characteristic flame spectra given by the alkaline-earth metals have been used extensively in analysis of these elements for many years, despite doubts as to their nature. In the cases of calcium and strontium they are made up predominantly of two narrow regions for each metal, for calcium at 5560–5470 A. and 6400–6000 A., and for strontium at 6100–6000 A. and 6900–6850 A. They have been ascribed tentatively to gaseous calcium oxide (CaO) and strontium oxide (SrO) respectively by Pearse and Gaydon[1], although other possible ascriptions have been made by King[2], and by Mahanti[3]. Evidence to be given here supports strongly a new hypothesis —that they arise from the radicals CaOH and SrOH, and further that a considerable portion of the radiation in the green given by barium arises from BaOH.

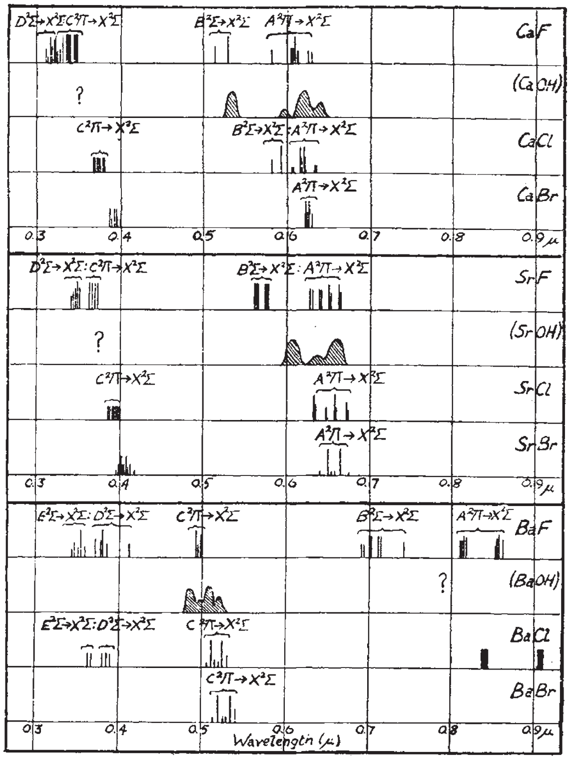

Fig. 1. Diagrammatic spectra of the alkaline-earth halide radicals compared with the intense portions of the flame spectra of the alkaline earths

Fig. 1 shows diagrammatically the main features of the spectra of the halide radicals of the type of CaF, as listed by Pearse and Gaydon, each system falling into a narrow region presumably because of similarity between the potential energy curves of the contributing states. We have inserted between the fluoride and chloride in each case a diagram of the spectrum obtained from these elements in a hydrogen/air flame, using a photoelectric recording device of low resolution in conjunction with a Hilger *E*3 medium quartz spectrograph. The correlation of the two regions of strong emission for calcium and strontium with those of the neighbouring halides ($A^2\Pi \rightarrow X^2\Sigma$ and $B^2\Sigma \rightarrow X^2\Sigma$) is very evident.

In the case of barium, the corresponding transitions are in the infra-red, and have not been considered. Flames containing barium, however, show a zone of diffuse structure, as depicted, near 5000 A., superposed on a background of a much more widespread band system, with more detailed structure. This latter, almost certainly due to barium oxide, has been analysed by Mahanti; but the superposed system shows a correlation with the $C^2\Pi \rightarrow X^2\Sigma$ of the halides (Fig. 1). Since the hydroxyl group in many ways resembles a halogen atom, it is suggested that the spectra noted arise from the radicals CaOH, SrOH and BaOH.