noises are compared with subjective and sound-level meters showing less errors than the latter.

A mains-driven meter operating on the same principle was described by Mr. D. A. Nutt. This instrument conforms to the standards of the Acoustical Society of America but also incorporates peak/R.M.S. measurement. It is intended for routine factory use.

M. P. Baron gave his paper on objective noise measurement in French. He feels that objective meter readings and summations from analyses are unreliable and should be confined to comparing similar noises.

In his paper, Mr. Maurice, of the B.B.C., deals with a different aspect of noise, namely, interference with broadcast reception. He has correlated subjective assessment of interference with readings by various meters and finds a weighted energy meter gives the closest correlation.

The paper by Lord Halsbury describing a rapid wave analyser was read in his absence by Mr. D. G. Jaquess. The instrument is a heterodyne analyser covering 0–30 kc./s. with provision for sweeps of $\frac{1}{4}$ to $\frac{1}{8}$ sec. and maximum resolution. It also permits more detailed examination of a 2 kc./s. band.

In his paper on the reduction of noise in aircraft, Mr. N. Fleming, of the National Physical Laboratory, deals with the contributions from the engine, propellers, aerodynamic flow and auxiliaries. He has studied octave frequency bands in each case and he shows the effects of power, tip speed and air velocity.

M. P. Chavasse read his paper describing an apparatus to produce complex sounds and artificial voices for acoustic tests in French. It is based on valve noise with suitable modulation to simulate the voice. Results obtained with it agree well with those for the natural voice.

In the discussion after this session, Dr. Beranek described recent work in the United States tending to confirm the level high-intensity equal loudness contours. He questioned the differences between pressure and field sensitivities of the ear, hinting at an obscure effect. He also asked for terminological agreement on 'random' and 'white' noise. Mr. Fleming objected to the indiscriminate use of phons for decibels, and Dr. Furrer asked about the calculation of loudness from analyses.

For the final session Mr. Kirke was again in the chair, and papers covered a wide range of applied acoustics. First, Dr. L. Cremer, who had only just arrived from Munich, read his paper on sound insulation at oblique incidence. Consideration of the travelling waves along a panel with a sound at oblique incidence suggested to him that grooves in the panel would improve attenuation. His paper gives the theory and experimental confirmation.

Dr. Kosten had had to return to Holland, so the joint paper on sound absorption in layers of material was read by J. van den Eijk. The paper gives the theoretical performance of such layers and includes experimental confirmation.

In his paper on noise in air ducts, Dr. Grunenwaldt gives the results of noise measurements on several ventilation systems with various air velocities and duct lengths. These data enable him to design duct systems for given room noise conditions.

The paper by Dr. A. Schoch, of Göttingen, on absorption by gradual transition gives the theory for successive layers of material of increasing density, leading up to the modern wedge construction. He takes as an example a linear wedge structure and gives curves for its performance.

Mr. C. A. Mason described the development of quiet chokes for use with fluorescent lamps. His paper examines the essential causes of the noise—magnetostriction and bad joints—and shows the stages followed in their reduction. He also considers the noise of a number of chokes.

In his paper on the elastic properties of rubber, Dr. E. Meyer, of the University of Göttingen, describes an elegant method using a sample in a resonant column of liquid. This gives bulk modulus and dissipation, while Young's modulus is given by longitudinal resonance or travelling waves. The frequency range covered is 10 c./s. to 20 kc./s. Effects of temperature and load are also discussed.

Mr. C. H. Bradbury's paper discusses the noise of machines, especially Diesel engines. He gives noise spectra and considers the pitched and unpitched components. He emphasizes the shock excitation of damped systems and uses a loud speaker to show up resonances. He also considers the effect of background noise.

Owing to the unavoidable absence of Prof. P. Bruel, Dr. V. L. Jordan, Mr. E. N. Storr and Mr. R. S. Hogben, their papers were not read but will be published in the *Proceedings*.

There were many contributors to the closing discussion. Among them, Mr. Fleming quoted work at the National Physical Laboratory disagreeing with Dr. Cremer on grooves and he also suggested that 'frequency of troubling' should be included in Mr. Allen's questionnaire. Mr. Mason asked about the critical frequency between dynamic-static properties of rubber, and Dr. Meyer gave it as 1 or 2 c./s. Dr. King said he was investigating the matter and thought it would be nearer 0·1 c./s. M. Brillouin gave a humorous contribution suggesting that the phon is insufficiently defined for practical purposes, but Mr. Fleming, chairman of the British Standards Institution Committee on Noise Measurement, gave a convincing reply.

A. J. KING

MIDDLE EAST OIL

THE name of that distinguished American geologist and statistician, Dr. Everette de Golyer, has been proverbial in international oil technology for many years past. He has an almost uncanny flair for predicting correctly the trend of events in the petroleum world, and his forecasts on developments in those countries comprising the Middle East are no exception. So long ago as 1925 the writer remembers de Golyer saying that "he expected from Persia a continued increase in production, as handling and marketing facilities are increased, so long as the fields may last". Nearly twenty years later, when leader of the United States Petroleum Commission to the Middle East, he stated that "the centre of gravity of world oil production is shifting from the Gulf – Caribbean area to the Middle East and is likely to continue to shift until it is firmly established in that area". That this has actually happened is probably not generally appreciated: the economic, technical and political implications of the fact have yet to be assimilated by the public, quite apart from the industry itself. To this end an up-to-date, straightforward survey of the position is essential to its understanding, and the *Petroleum Times* has rendered signal service by publication of its "Review of Middle East Oil" (London, June 1948, 7*s.* 6*d.*).

This review is not a mere compilation. It presents 'eye-witness' accounts of the shape of things concerning oil in Iran, Iraq, Bahrein, Saudi Arabia and Kuwait as they are to-day. It is based fundamentally on a two-months tour of the oilfields at the close of 1947 undertaken by Dr. C. T. Barber, joint editor of the *Petroleum Times*, with reinforcements by Dr. G. M. Lees, chief geologist of the Anglo-Iranian Oil Company, Ltd., Max Weston Thornburg, war-time petroleum adviser to the U.S. State Department, Christopher Holme, well-known writer and broadcaster on Middle East affairs, and T. D. Weatherhead, technical manager, Hunting Aerosurveys, Ltd.

Consider first some vital statistics that emerge from this survey. In 1936 the proved oil reserves of the world were proportioned as follows: U.S.A., 48·1 per cent; Middle East, 21·1 per cent; U.S.S.R., 12·9 per cent; Caribbean and Mexico, 9·7 per cent; and the rest, 8·2 per cent. In 1944 the figures were 33·9, 42·3, 9·0, 10·0 and 4·8 per cent, respectively. Thus in eight years Middle East reserves were doubled. Next are the production figures. In 1936, the U.S.A. produced 60·7 per cent, Middle East 5·4 per cent, U.S.S.R. 11·9 per cent, Caribbean and Mexico 13·2 per cent, and the rest 8·8 per cent of the world total output of crude oil. In 1947 the figures were 63·6, 9·8, 5·5, 17·3 and 3·8 per cent, respectively. Again, in the intervening years, Middle East nearly doubled its production. Further, with 42 per cent of world reserves, the Middle East produces 10 per cent of world output and in 1947 was drawing on reserves at the rate of 1·14 per cent per annum. By contrast, the United States with 33·9 per cent reserves produce 64 per cent of world output and are drawing on reserves at the rate of 9·25 per cent per annum. Still more striking, as Dr. Barber shows, is the fact that in 1947 Middle East production of 306 m. barrels was obtained from 223 wells, an average of 1·37 m. barrels per well, whereas the United States production of 1,985 m. barrels was obtained from more than 425,000 wells, an average of 4,660 barrels per well.

It is commonly believed that the present drastic rationing of petrol in Great Britain is a post-war legacy and a dollar-saving necessity. Why, it is asked, if we control such enormous oil production in the Middle East, is petrol so short in Britain, and why import from the Americas? The fact is that dollar-saving is not the whole story by any means. All over the world people are using more and more oil. In 1947 the American demand was 73·1 per cent more than in 1938; the demand in Great Britain was 45·3 per cent more; the British Commonwealth as a whole consumed over 100 per cent more, while other countries increased their demand by 17·2 per cent. In other words, the world oil demand has increased more than 50 per cent in the nine-year period, accounted for largely by heavily increased requirements of the United States for military, agricultural, domestic and transport purposes. C. J. Bauer has estimated that world demand in 1951 will be 23·4 per cent greater than that for 1947, and to meet this unprecedented rise the Middle East fields will have to increase production by 100 per cent by that year. From all that transpires in the present "Review of Middle East Oil" there appears to be no reason why this should not happen, particularly as the European Recovery Plan allows for 82 per cent of Western European demands for petroleum being met from Middle East resources in 1951.

Besides the purely economic aspects, technical developments of a high order of efficiency will be essential if the 1951 target is to be reached. In this direction optimism is well sustained, if past history of this great oil province is anything to go by. The achievements of the oil companies concerned, not excepting the cultural and social evolution of the native populations, constitute alike a fine record and a model of how things should be done in all spheres of exploiting mineral resources in virgin territory. The "Review" covers these activities and illustrates them, too, in a most convincing manner. It is a valuable publication, one to be commended to all who wish to understand the present problem of oil supply and its vital incidence on international politics in these critical times. H. B. MILNER

CONCENTRATION OF COBALT BY MICRO-ORGANISMS AND ITS RELATION TO COBALT DEFICIENCY IN SHEEP

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WORK on wasting diseases in Australia[1,2] and New Zealand[3], and 'pining' in the United Kingdom[4,5], has established that cobalt is an essential factor in ruminant nutrition. Deficiency of cobalt results in various wasting diseases, the literature of which has been adequately reviewed[6,7,8,9]. In contrast to the ruminant, it appears that non-ruminants, for example, the rat[10] and the rabbit[11], require very little, if any, cobalt in the diet, for they can thrive on diets containing cobalt in concentrations much below those which would cause wasting diseases in ruminants.

Recent work[12,13], in which radioactive cobalt was injected intravenously into adequately fed cattle, showed that most of the isotope injected was excreted in the urine, and that only small amounts were found in the milk and saliva and none in the rumen content; radioactive cobalt introduced directly into the rumen was excreted chiefly in the fæces, and none was detected in the blood, saliva or milk, thus suggesting relatively poor absorption of the element. Although it is known that the liver is the storage organ for cobalt in sheep[14] and cattle[13], and that the cobalt content in the liver of a cobalt-deficient sheep is considerably lower than that in a healthy sheep on good pasture[14], the mechanism of the action of cobalt in animal nutrition remains still unknown. Using an as yet unpublished procedure[15] for the separation of rumen micro-organisms and other fractions of the rumen contents, and after chemical concentration[16] applying a spectrographic method[17] to the quantitative determination of cobalt in the rumen fractions, we have been able to demonstrate that rumen micro-organisms accumulate cobalt from their external environment. Since we find that a large proportion of the cobalt present in the rumen of a sheep is situated in the rumen micro-organisms, it is possible