THE TALKING SIREN OF DR. MARAGE.

BY DR. ALFRED GRADENWITZ.

While many early inventors attempted to produce an apparatus which synthesized the elemental sounds used in talking and which imitated the human voice, the invention of the phonograph gave such experiments their quietus.

Despite the success of the phonograph, a French scientist, Dr. Marage, has constructed what may be described as a talking siren, that is, a siren which produces sounds that accurately imitate those of the various vowels both when sung and spoken.

In constructing this device, Dr. Marage intended primarily to design an apparatus for gaging the sharpness of the sense of hearing in different individuals. The "acoumeters" previously constructed for the purpose may be divided into three classes, producing respectively noises, musical vibrations, or the vibrations of spoken words. The first two classes will obviously give only a faint idea of the way in which a given individual may be able to perceive spoken words. In fact, many persons have a rather limited capacity of hearing ordinary speech but are able to hear distinctly either musical vibrations or noises. The reason is to be found in the more complex character of spoken words.

A graphical record of vowels (such as the flames of König) is composed of a certain group of vibrations. French "i" (English "e") and French "ou" (English "oo") are composed, for example, of isolated vibrations, "é" (English "ay") and "o" by groups of two, and French "a" ("ä" as in "father") by groups of three vibrations. In order to reconstitute these vowels, the groups referred to should thus be artificially reproduced. To this effect slots arranged in groups of one, two, and three respectively are cut in a rotatable circular disk. When air is blown through these slots the vowels mentioned will be distinctly heard. In fact, they are not only recognized by the ear but give the same graphical records as natural vowels or the vowels produced by a phonograph. However, they correspond with sung vowels only. In order to obtain spoken vowels the air current is made to pass through special molds (Figs. 1, 2, 3, 4), which accurately imitate the form of the human mouth in pronouncing a given vowel. The graphical records of these sounds are absolutely identical with those of natural spoken vowels. An artificial talker is thus obtained and the apparatus in question may be fitly termed "vowel siren" or "talking siren."

The most valuable property of this apparatus is that the intensity of the sounds given out by it is accurately proportional to the pressure of the air current. It thus affords a means of gaging the intensity of a given sound and producing a sound of any desired strength. This is made use of in determining keenness of hearing.

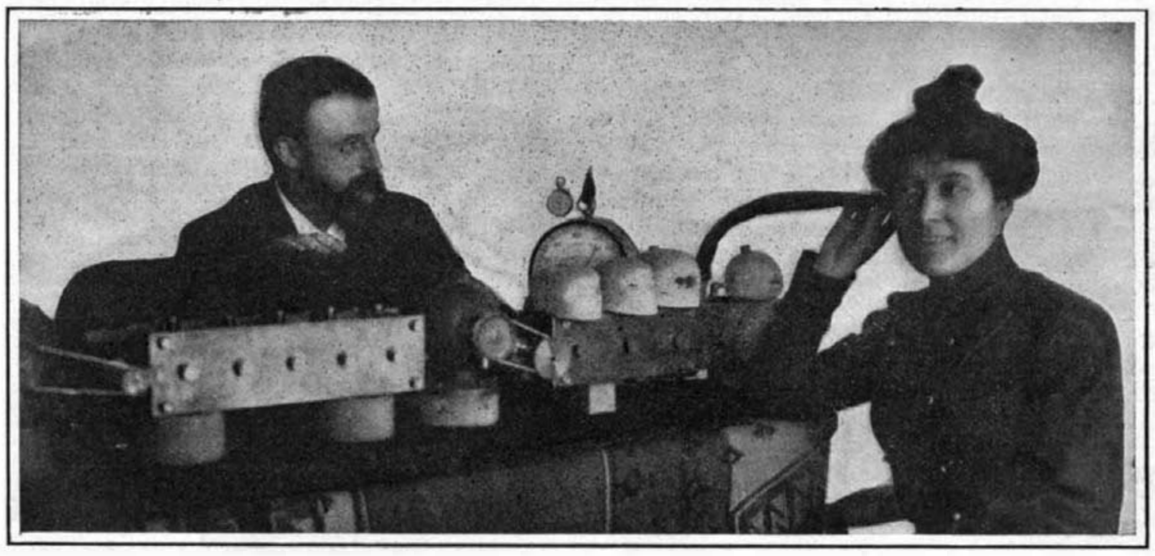


Fig. 5.—An Apparatus for Teaching the Deaf How to Hear and for Massaging the Ear.

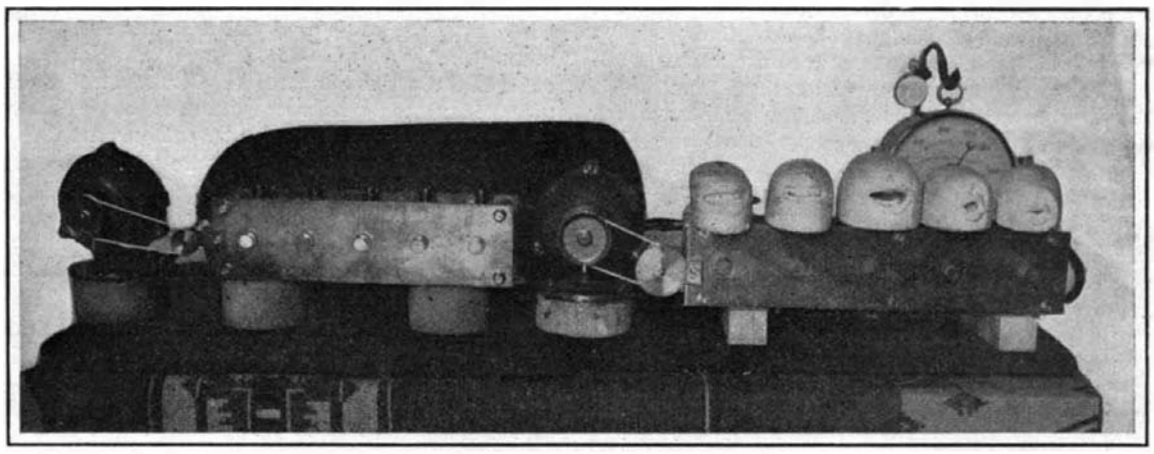


Fig. 6.—Two Sirens, One with a Complete Set of Mouthpieces.

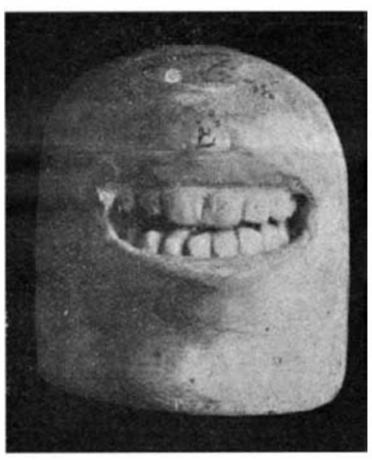


Fig. 1.—Artificial Mouth for Producing the Sound of French "é." (English "a" as in "Make.")

Fig. 2.—Artificial Mouth for Producing the Sound of French "i." (English "e.")

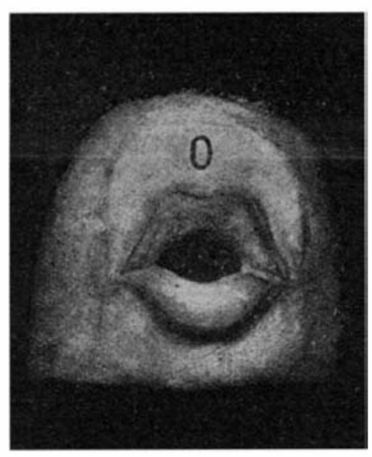


Fig. 3.—Artificial Mouth for Producing the Vowel Sound "o."

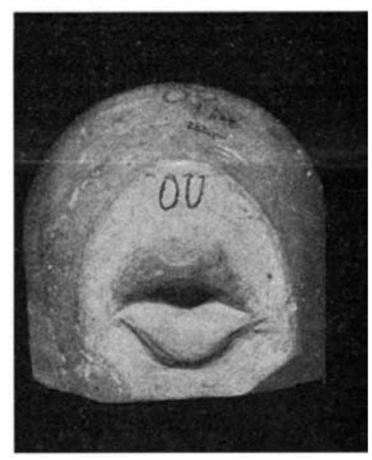


Fig. 4.—Artificial Mouth for Producing the Sound French "ou." (English "oo," as in "Moon.")

The ear to be tested should be placed at a constant distance from the instrument, the sound intensity of which is gradually increased by augmenting the pressure of the air, this pressure being gaged by means of a highly sensitive metallic manometer.

The sound produced by a pressure of 1 millimeter is perfectly well perceived by a normal ear. If the pressure for an ear must be raised to 40 millimeters before the sound can be heard, the acoustic sense of the patient may be said to be 1/40, if to sixty, 1/60, if to two hundred, 1/200, and so on—a simple and efficient scale. The apparatus thus affords an extremely simple measuring instrument, which always remains constant. Its readings may be accurately checked and reproduced whenever desired.

The condition of a given ear is gaged and represented by the following graphical method:

The French vowels "ou," "o," "a," "é," "i" (or their English equivalents) are inscribed on a horizontal line, and below each of them, as shown in the accompanying table, a vertical scale is drawn with graduations corresponding with the pressure read on the manometer at the moment the vowel in question is perceived. If for instance the French vowels "ou," "o," "a," are perceived under a pressure of 8 millimeters, the point 8 on the scales corresponding with each of these vowels is marked; if "é" is heard under a pressure of 21 millimeters, the point 21 is marked on the "é" scale. Finally the point 162 is marked on the scale of the French vowel "i," if the latter is heard under a pressure of 162 millimeters; these five points are then connected by a line and a curve will

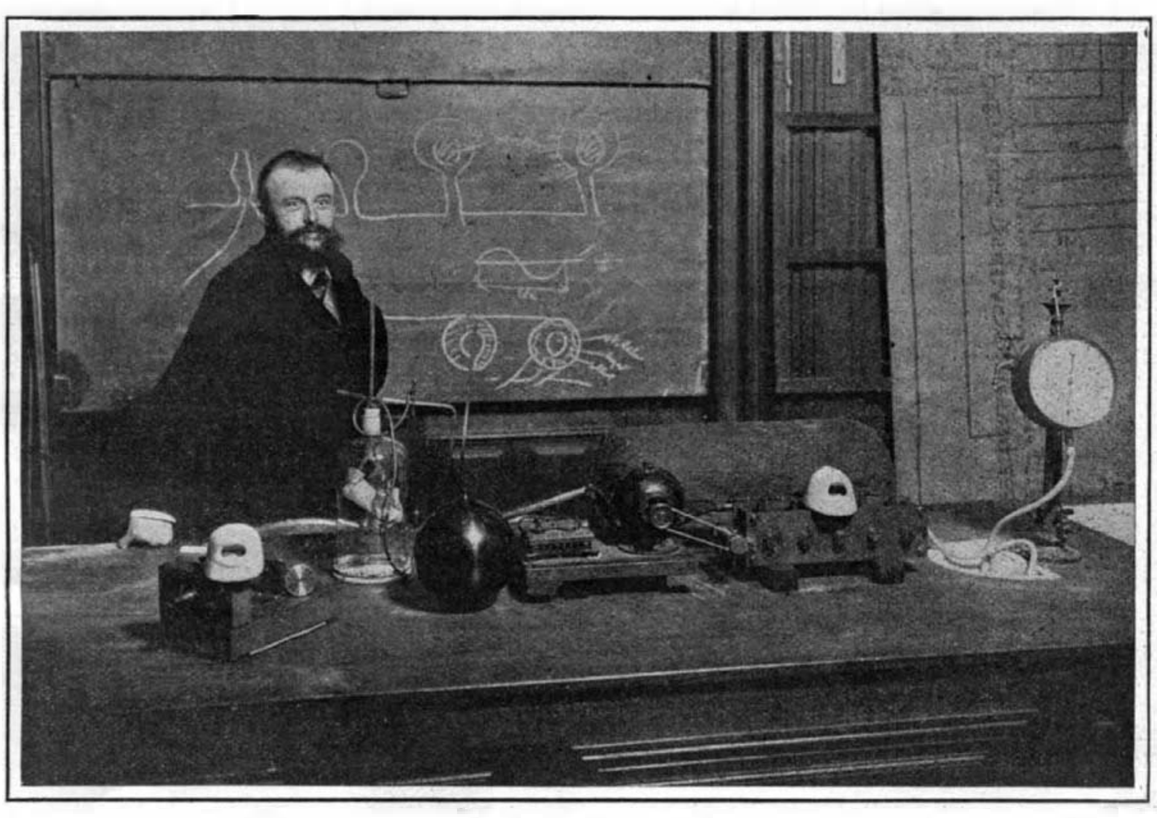


Fig. 7.—Dr. Marage in His Laboratory. On the Table Are a Manometer and Mouthpieces for Uttering Vowel Sounds.

THE TALKING SIREN OF DR. MARAGE.

be obtained. From these curves, varying markedly in shape, the following conclusions can be drawn:

1. If the ticking of a watch, which is normally heard at a distance of 1.5 meters, is heard only when applied to the ear, the acoustic intensity, according to the talking siren, will have become 1/3.

2. If auditive acuteness further decreases, being finally comprised between 1/3 and 1/13, the patient, although he may be able to hear a particular conversation, will lose many words in a general conversation.

3. In the case of an auditive acuteness of less than 1/13, the patient will unconsciously train himself to listen only with the other ear, if this be normal. The deaf ear will perceive only those sounds which are pronounced very distinctly at a short distance.

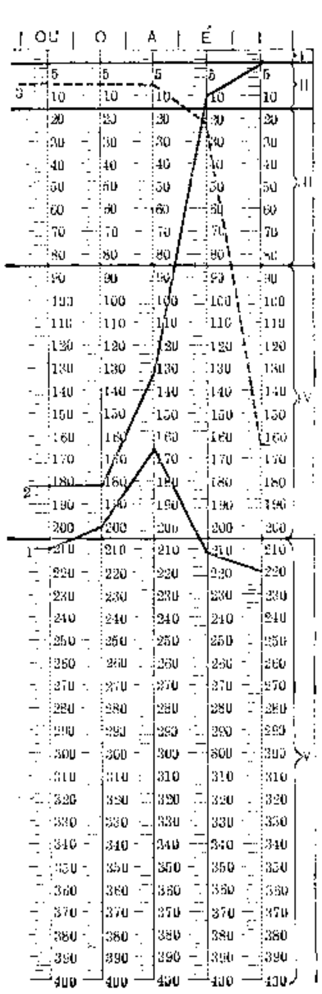
4. Between 1/30 and 1/200 only those words which are spoken in a very loud tone close to the patient will be heard.

5. Beginning from 1/200, spoken words will be heard only by means of a hearing tube.

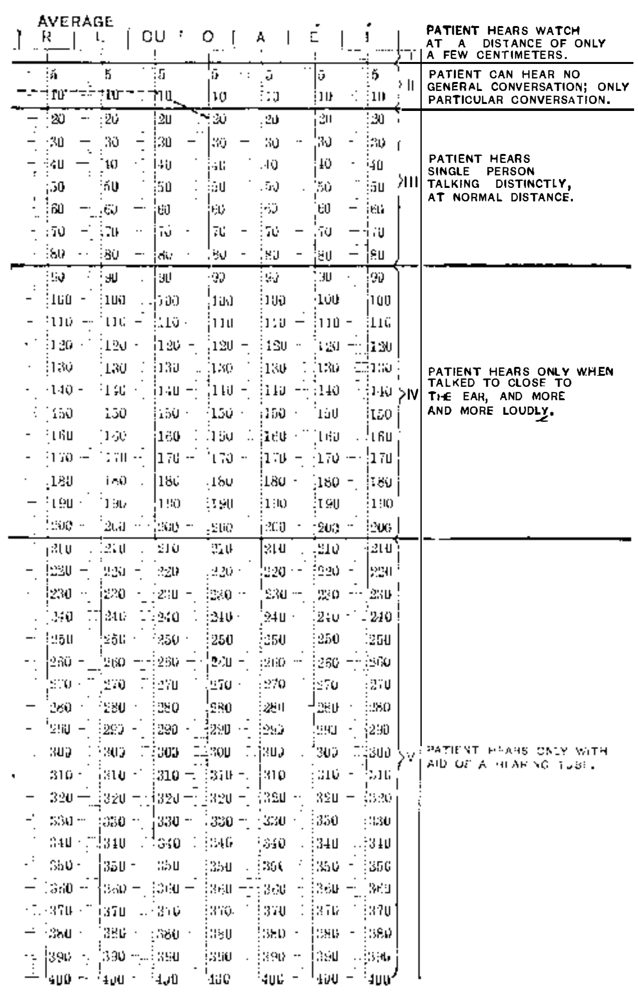
These five zones of deafness are separated in the table by heavy horizontal lines. As long as the hearing remains within a given zone, the patient will not feel any appreciable change and only those talking with the patient may appreciate some variation in the loudness of their words. The siren thus allows the perception of degrees in acoustic intensity which the patient himself or direct observation could not ascertain. After measuring the acoustic intensity and drawing the curve of a patient, the shape of the curve will locate the seat of the trouble. If for instance the curve has the approximate shape of an inverted U, only the middle ear will be affected. Thus each peculiar affliction will have its special characteristic curve.

While the siren can thus be used for diagnostical purposes it will be found useful also in curing the trouble. In fact, a systematic treatment consisting in the repeated production of given sounds before the tympanum of the ear has been found to be a most efficient "massage," which in some cases restores the ear to normal hearing capacity, while nearly always effecting some improvement (Fig. 5). This process has also been used with much success in the treatment of deaf-mutes, many of whom have been taught to hear by its means. In this case the ear is taught according to a method which from the most simple elements of speech, that is the vowels, proceeds to the more complicated, the deaf-mute learning how to hear in exactly the same way as a child is taught how to read by beginning with the alphabet.

In a memoir recently presented to the French Academy of Sciences, Dr. Marage records some interesting experiments made by himself as to the acoustic qualities of some large halls of the city of Paris. He confirms the result found some years ago by Mr. Wallace Sabine, viz., the that the sound of resonance is the principal factor in question. The duration of this sound, as stated by Marage, will vary according to the intensity, pitch, and timbre of the primitive sound, which possibly accounts for the fact that a given hall may be bad for an orchestra and satisfactory for an orator.



Analytic Curve Obtained With Dr. Marage's Apparatus.



Dr. Marage's Table of Auditive Acuteness.

THE TALKING SIREN OF DR. MARAGE.

Official Meteorological Summary, New York, N. Y. April, 1907.

Atmospheric pressure: Highest, 30.38; lowest, 29.16; mean, 29.89. Temperature: Highest, 73; date, 25th; lowest, 26; date, 2nd; mean of warmest day, 61; date, 26th; coolest day, 35; date, 1st; mean of maximum for the month, 52.2; mean of minimum, 37.7; absolute mean, 45; normal, 48.6; deficiency compared with mean of 37 years, —3.6. Warmest mean temperature of April, 54, in 1871. Coldest mean, 41, in 1874. Absolute maximum and minimum of this month for 37 years, 90 and 20. Average daily deficiency since January 1, —1.1. Precipitation, 3.89; greatest in 24 hours, 0.97; date, 9th; average of this month for 37 years, 3.37. Excess, +0.52. Accumulated deficiency since January 1, —1.48. Greatest precipitation, 7.02, in 1874; least, 1.00, in 1881. Snowfall, 6.1. Wind: Prevailing direction, N.W.; total movement, 9,924 miles; average hourly velocity, 13.8; maximum velocity, 52 miles per hour. Weather: Clear days, 8; cloudy, 8; partly cloudy, 14. Fog, 29th, 30th. Thunderstorms, 23rd, 26th. Remarks: Coldest April in 32 years.

Alcohol Engines to Replace Gasoline Engines.

BY JOHN PRESTON.

Although the general use of gasoline engines has developed entirely within the past ten or twenty years, the number of such engines in this country is now high up in the hundreds of thousands, being used as they are for automobiles and as stationary engines for pumping water, running small factories, and for furnishing power for various uses in country residences and on farms.

The law which recently took effect, releasing from the internal revenue tax alcohol so denatured as to render it unfit for drinking, permits, through decrease in price, alcohol to become a possible substitute for gasoline and kerosene as a fuel.

The price at which a gallon of 95 per cent grain alcohol can be manufactured and marketed is now about 40 cents. The government tax raised the market price to about $2.50 per gallon; it is now 37 cents per gallon for the denatured alcohol. In order to avoid paying the revenue tax, the government regulations prescribe that the alcohol must be denatured according to the following rule: To 100 parts of grain alcohol of not less than 90 per cent strength must be added 10 parts of wood alcohol and one-half of one part of benzine. Consequently, the mixture will not only be very poisonous, but will have a strong, disagreeable odor, which will obviate any danger of its being confused with pure alcohol.

Alcohol is an inflammable liquid, and its vapor, when combined with the right proportion of air, forms an explosive mixture suitable for use in engines. Alcohol differs materially in its properties from gasoline. It is less volatile, it gives out less heat per gallon when burned, and its latent heat of vaporization is much greater than that of gasoline.

Although for ten years alcohol has been used to a considerable extent in special alcohol engines on the continent of Europe, such use has been untried in this country.

In Europe alcohol engines have differed from gasoline engines chiefly in the use of a higher compression than is permissible when gasoline is used as a fuel, and in the use of a more or less intricate form of heated carbureter.

Since no alcohol engines are on the American market, all the tests by the United States Department of Agriculture have been made on American engines designed for gasoline or kerosene as fuel.

Every engine tried—ten different kinds in all—was found to work as perfectly on alcohol fuel as on the gasoline or kerosene fuel for which it was made, after sufficient preliminary trial to determine the peculiarities of setting and adjustment necessary for the alcohol. The engines tried included stationary engines up to 20 horse-power, automobile engines up to 40 horse-power, and one marine engine. The engines were of nearly every type—one to four cylinder, horizontal and vertical, four cycle and two-cycle, gasoline and kerosene. Since alcohol is much less volatile than gasoline, it was to be expected that difficulties would arise in its use in a gasoline engine. These difficulties were often very curious, and in some cases seemed for a time quite baffling, but they all yielded to patient study. The proper vaporization of alcohol before its introduction into the engine cylinder is a question which requires for its solution a comprehensive knowledge of the vapor pressure and of the other properties of alcohol as compared with gasoline.

With all the engines it was found that the valve adjustments must be quite different for alcohol from those used for gasoline. Gasoline is so volatile, that it might be almost said to vaporize itself. On the contrary, the vaporization of the alcohol must be carefully attended to. When gasoline is used as a fuel, it is sometimes difficult to start an engine out of doors in the coldest weather. Under like conditions it would be impossible to start an engine using alcohol without the aid of a little gasoline or without first heating the engine in some manner.

There are several important differences between the behavior of an engine when running on gasoline and its action with alcohol. With alcohol fuel there is never any hammering due to pre-ignition. The explosions are slower and consequently less noisy, and there seems to be correspondingly less wear and tear on the machine. The exhaust is never strongly disagreeable in odor, as may be the case with gasoline. With alcohol fuel an engine may be overloaded to an amount considerably in excess of its maximum possible power on gasoline. In other words, an engine rated at 10 horse-power on gasoline might be called a 12 horse-power engine when running on alcohol.

A gasoline engine requires about twice as much alcohol measured in gallons as it does gasoline to develop the same power. This excess in consumption of alcohol would doubtless be reduced in engines specially designed for alcohol.

This increased consumption of alcohol is to some extent offset by its much greater cleanliness when handled and used, the absence of disagreeable noise and odor, and the very great diminution of danger from fire.

On account of the low degree of volatility of alcohol, it is possible to run into the engine an amount greatly in excess of its requirements. This excess will pass through the engine without doing any good. Hence to secure the most economical use of this fuel, perhaps greater care in the valve setting of the engine is required than is the case when gasoline is used.

It has been completely proved that alcohol is perfectly adapted for use as an engine fuel; and, except for its present cost, the advantages of alcohol as a fuel far outweigh those of gasoline. As the use of alcohol engines increases, large quantities of alcohol will be made, and the denatured product will be as easily obtainable anywhere as is kerosene at the present time. The price will doubtless become materially lower than it now is.

If, under the stimulus of demand, inventors and manufacturers will combine to devise, and put on the market, special alcohol engines fitted to secure the highest economy in the consumption of the fuel, we may expect to see, within a few years, alcohol engines as numerous as gasoline engines are to-day.

The best efficiencies of centrifugal pumps are supposed to have been obtained at discharge velocities equaling about 12 feet per second through the discharge aperture of the pump. Recent experiments have shown that from pumps as large as 32 inches 80 per cent efficiency was obtained at 38.68 feet lift, under a discharge velocity of 21.2 feet per second, while some recent tests on very small pumps show gradually increasing efficiencies under heads up to 89 feet and discharge velocities of 40 feet per second.

The pipe line, conveying petroleum from Baku to the Black Sea, has been completed. It is 550 miles long, and is capable of passing 400,000,000 gallons of oil yearly. Another important oil pipe line has been built for transporting Texas and California petroleum across the Isthmus of Panama. It is 8 inches in diameter and 51 miles long.