A Comparison of Rates of Travel in Age of Speed

(Continued from page one.)
automobile at a rate of 45 miles an hour.

As to the lion, Sir Alfred Pease, celebrated big-game hunter, is quoted in "Life Histories of African Game Animals," by Theodore Roosevelt and Edmund Heller, as follows:

"I estimate a lion covers one hundred yards in his charge in three seconds, perhaps less."

Martin Johnson, noted for his African animal photography, writes in his book, "Lion":

". . . a lion will charge from a distance of over two hundred yards when in open country. He may come at only a trot during the early part of his charge, but he soon breaks into a gallop that outspeeds a fast horse. I am told by men who have taken time that the charging lion can cover the last hundred yards in about three seconds. Roosevelt observed that a horse standing a hundred yards from a lion will be overtaken before it can get into full gallop."

At a hundred yards in three seconds a lion would be traveling at a rate of more than 68 miles an hour. But, though speedy as it is, there is evidence that it is not quite so fast as the cheetah, another member of the cat family. Says the Encyclopedia Americana of the cheetah:

"Its length and slenderness of limb give it a fleetness in running short distances such as is probably attained by no other large mammal."

Roosevelt wrote:

"It kills its game in fair chase, for it is the fastest animal on earth for a quarter of a mile, or perhaps half a mile."

He also wrote that for a short distance a cheetah could move twice as fast as a galloping horse. Figuring a horse as galloping for a short distance at the rate of 35 miles an hour, which would be conservative and approximately correct in consideration of equine speeds given in the next paragraph, the cheetah would be capable of traveling at the rate of 70 miles an hour, or 6,160 feet a minute, as compared with the lion's 6,000 feet a minute.

Speediest of running horses has done a quarter of a mile in 21.25 seconds. That is at the rate of 42 miles an hour. The best time for a horse running a mile on a straightaway course is 1 minute 32.4 seconds. That is at a rate between 38 and 39 miles an hour. Fastest trotting and pacing records, a mile in 1 minute 56.75 seconds and in 1 minute 55 seconds respectively, meant that Peter Manning, the trotter, and Dan Patch, the pacer, were covering ground at the rate of about 31 miles an hour. A rate of 35 miles an hour, therefore, would seem not far wrong for a burst of speed in full gallop on the part of a hunter's horse.

Speeds of birds in flight vary, as do the rates of travel for running animals. Small birds, for instance, fly at rates of from 20 to 37 miles an hour. Crows attain a speed of 45 miles an hour, plovers 40 to 50 miles an hour, swifts and swallows as much as 68 miles an hour, which would be 100 feet a second.

Game birds, such as the quail, prairie chicken, ruffed grouse, snipe, mallard, black duck, spoonbill, pintail, wood duck, and widgeon, fly 60 feet a second, or at the rate of 40 miles an hour. Geese and brant in flight do 70 feet a second, or at the rate of 47 miles an hour. Redhead ducks and bluebills fly 85 feet a second, which is a rate of 57 miles an hour. Canvasback ducks attain a speed of 61 miles an hour in flying 90 feet a second. Blue-winged and green-winged teal are capable of 100 feet a second, a speed of 68 miles an hour.

Rapid as are the rates of flight of the above mentioned birds, they are by no means the greatest for feathered flyers. Speediest of birds are credited with flying as fast as or faster than 100 miles an hour. The duck hawk, for instance, according to apparently authentic records collected by the American Museum of Natural History of New York, does well over 100 miles an hour, or more than 146 feet a second.

The rate of speed of birds on the wing depends a great deal on whether they are flying with or against the wind and on the velocity of the wind at the time. It is recalled that in a famous pigeon race in Europe in 1876 the winning birds flew 270 miles in 3¼ hours, flying at the rate of 83 miles an hour. All conditions were favorable for record speed. In the race of 1877 it took the pigeons 30 hours to fly the same 270 miles. In this connection it should be brought out that the velocity of the wind varies, with a dead calm at one extreme and a rate of 120 miles an hour at the other. Any wind velocity of 70 miles an hour or more is classified as a hurricane.

A man swimming travels at a comparatively slow rate. Johnny Weismuller, in setting a record for the 100 yards of 51 seconds, swam at a rate of little more than four miles an hour. Beside the dolphin, which probably has a speed of 30 to 40 miles an hour for a short distance, the swimming man would seem to be barely moving. Despite stories of sailors to the effect that the dolphin in frisking around a rapidly moving vessel attains a speed of more than a mile a minute, the scientists of the American Museum of Natural History hold that the maximum speed of the creature is 30 or 40 miles an hour. If moving at the last named rate, it would be going 3,520 feet a minute, or a distance of about ten times that of the swimmer.

The walking man is speedier than the swimmer, though he moves at a rate low in the scale for this age of speed. N. Altimani of Italy in walking 8 miles 566 yards in an hour in 1928 was traveling only 732 feet 4 inches, or little more than a city block [eight to a mile], in a minute. A record-breaking skater does an eighth of a mile in 18 seconds, moving at a speed of 25 miles an hour. Man's fastest speed on a bicycle, unaffected by other forces, such as the air suction of a train, is approximately 12 seconds for 200 meters—a rate of speed of between 37 and 38 miles an hour. Eight-oared racing shells rowed by college crews frequently cover a two-mile course in less than 10 minutes. That is at the rate of more than 12 miles an hour. A man-guided bobsled has traveled a mile in 46.16 seconds, sliding at a rate of nearly 80 miles an hour, but in that case it was gravity and the slippery snow and ice that played the important part, the bobsled crew merely sitting tight and depending upon the skill of the steersman.

In attaining his most amazing speeds man has depended upon mechanical contrivances. Sir Malcolm Campbell on Feb. 22, 1933, at Daytona Beach, Fla., drove an automobile at a rate of 272.46 miles an hour. A German-built motorcycle has been driven at a rate of 151 miles an hour and an American stock motorcycle at 104 miles an hour, according to the American Motorcycle association. On June 12, 1905, the Pennsylvania Special [now the Broadway Limited] of the Pennsylvania railroad covered three miles near Ada, O., in 85 seconds, steaming at a rate of 127.2 miles an hour. The Union Pacific's streamlined train M-10001 on Oct. 24 of this year traveled two miles near Sidney, Neb., at a rate of 120 miles an hour. An experimental German streamlined railway coach, driven by an airplane engine, attained the remarkable speed of 143.75 miles an hour in a test in 1931.

In the recent famous London-to-Melbourne air race C. W. A. Scott and Campbell Black drove their plane 11,300 miles in 70 hours 25 minutes, at an average speed in excess of 160 miles an hour. Counting out the time of their stops, however, they averaged 176.5 miles an hour. Capt. Eddie Rickenbacker on Nov. 8 flew across the American continent, a distance of 2,626 miles, at an average speed of 217.4 miles an hour. Lieut. Francesco Agello of Italy on Oct. 23 of this year drove an airplane at the record speed of 440.29 miles an hour.

With marvelous machines on water, man is not so speedy. A boat powered with an outboard motor has made a speed of 58.82 miles an hour. Gar Wood's Miss America X. on Sept. 20, 1932, sped across the water at Algonac, Mich., at a rate of 124.86 miles an hour. The Italian liner Rex in August, 1933, made an Atlantic crossing in 4 days 13 hours 58 minutes, doing a distance of 3,181 miles at an average speed of 28 miles an hour. Modern luxury liners such as the Rex have a maximum speed of approximately 27 knots, or 31 land miles, an hour. The U. S. S. Lexington, an airplane carrier with motors developing 180,000 horsepower, sailed from California to Hawaii in 1928 at an average speed of 30.66 knots, or 35.25 land miles, an hour. Modern battleships have maximum speeds up to about 26.5 miles [land] an hour. Battle cruisers and light cruisers of the latest type are said to have speeds up to 38 miles [land] an hour. Destroyers, swiftest of war craft, are capable of speeds as great as 38 knots, or 43.5 land miles, an hour.

Of possible interest for comparison is the speed of sailing ships. Fastest of the vessels that moved under canvas were the old clipper ships, which frequently sailed at a rate of 17 knots. From the log of the clipper ship James Baines was taken the following entry:

"June 17 [1856], latitude 44 degrees south, longitude 106 degrees east; ship going 21 knots with main skysail set."

Referring to the above, the book "The Clipper Ship Era," by Arthur H. Clark, says:

"This appears to be the highest rate of speed ever made by a sailing vessel of which any reliable record has been preserved."

A speed of 21 knots would mean more than 24 land miles an hour.

Objects propelled through the air by man or by agencies created by man vary considerably in speed with the difference in initial forces behind them. The speed of a baseball as thrown by Walter Johnson in his prime was recorded at 122 feet a second, or at a rate of more than 83 miles an hour. The muzzle velocity of the bullet of the American military rifle is 2,700 feet a second. If it could keep up that rate of speed it could travel 1,840 miles an hour. A certain modern sporting rifle fires a bullet with a muzzle velocity of 3,900 feet a second, which would be at the rate of 2,660 miles an hour. The muzzle velocity of the shells of the German long-range guns that bombarded Paris was 5,260 feet a second, a rate of 3,586 miles an hour.

Falling objects all would drop with the same speed if it were not for air resistance. An air bomb dropped from a plane a mile high reaches earth in 19 seconds, falling at an average rate of 189 miles an hour. A man falling from a plane with his parachute unopened travels at a rate of 118 miles an hour, as learned through dummy tests made at Wright field. Descending with his parachute opened, man moves at a rate of 8 to 9 miles an hour.

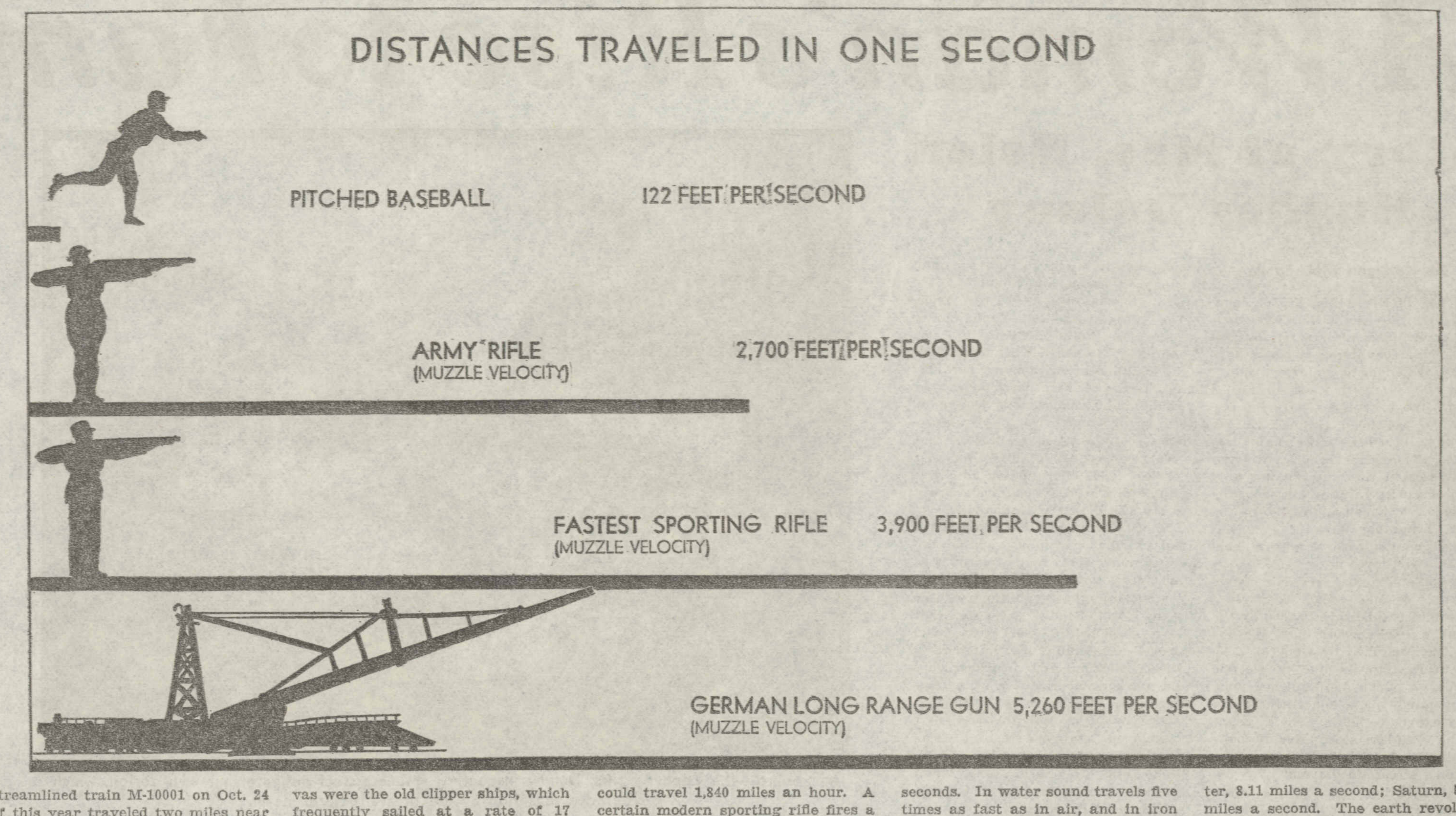
For speeds greater than those already mentioned it is necessary to consider forces controled entirely by natural laws. Light, previously pointed out as traveling at a rate of 186,284 miles a second, is many times faster than sound, which in dry air moves at 399.9 meters a second, or at a rate of a mile in less than five seconds. In water sound travels five times as fast as in air, and in iron or steel fifteen times as fast as in air.

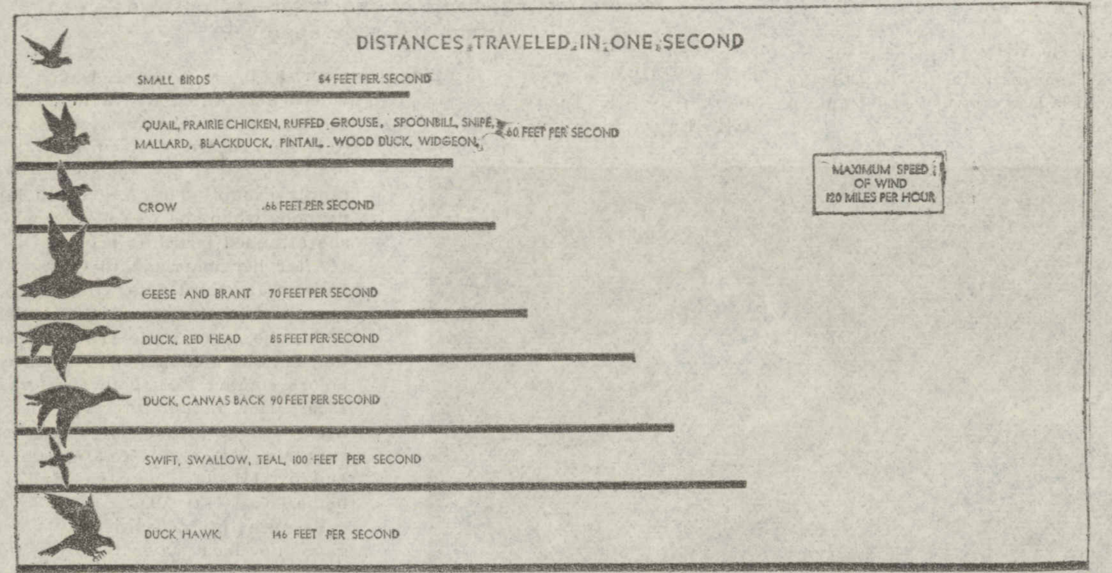
The speed of cosmic rays, mysterious forces the nature of which cannot be gone into here for lack of space, is said to be approximately the same as light. Radio impulses also move with about the same speed as light. Electrons, according to Prof. William D. Harkins of the University of Chicago, travel at speeds as great as 180,000 miles a second, or nearly as fast as light. Speeds of protons vary from 20,000 to 30,000 miles a second. A molecule of hydrogen moves at about a mile a second, other types of molecules at varying speeds. The speed of an atom is about the same as that of a molecule, though the nuclei of atoms attain a movement as great as 30,000 miles a second. A neutron, which is a kind of an atom, can travel at a rate of 35,000 miles a second.

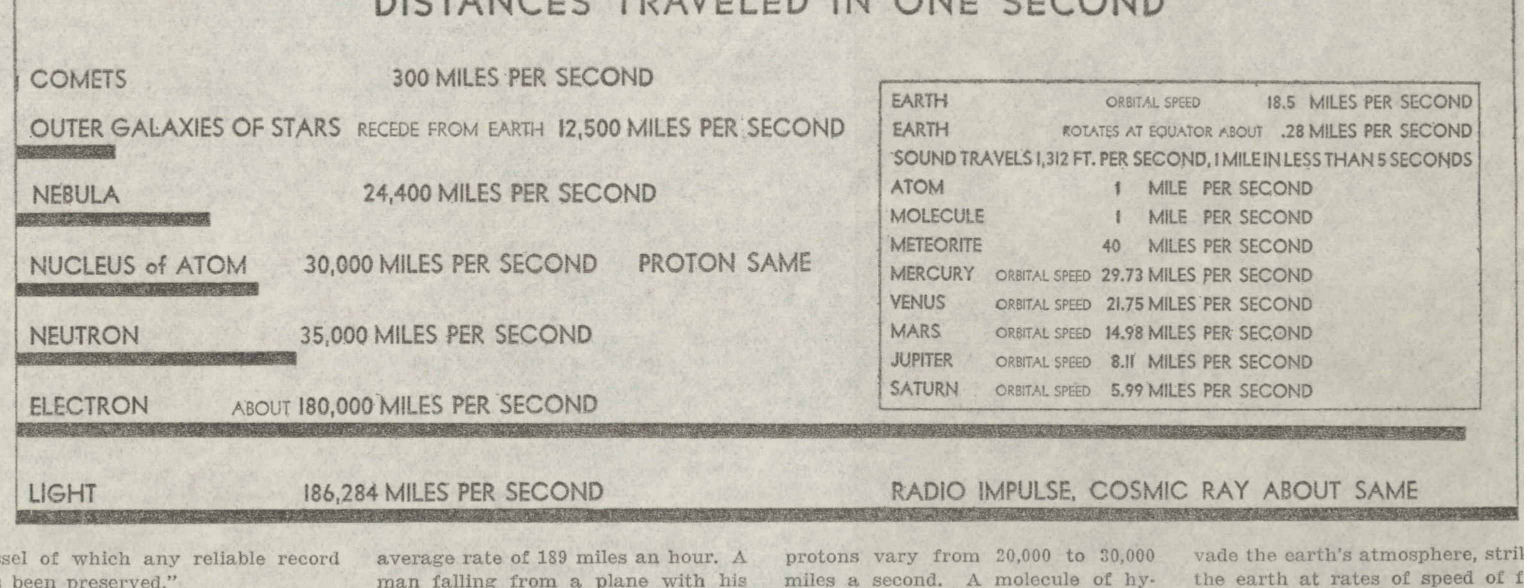
The earth, circling around the sun, moves at a speed of 18.5 miles a second; Mercury, the fastest planet, has an orbital speed of 29.73 miles a second; Venus, 21.75 miles a second; Mars, 14.98 miles a second; Jupiter, 8.11 miles a second; Saturn, 5.99 miles a second. The earth revolves at the equator at a speed of about 1,000 miles an hour, or .28 of a mile a second.

Comets do not have constant rates of travel, speeding up as they near the sun. Those that approach the sun closely attain speeds in that position as high as 300 miles a second, or more than a million miles an hour. meteorites travel at speeds as great as 40 miles a second (144,000 miles an hour), but slow up when they invade the earth's atmosphere, striking the earth at rates of speed of from 400 to 500 feet a second.

Some of the outer galaxies of stars, according to Dr. William D. MacMillan of the University of Chicago, are receding from the earth at the rate of 12,500 miles a second, or 45 million miles an hour. Milton Humason last October at Mount Wilson observatory noted a speed of 24,400 miles a second for a nebula. That would be 87,840,000 miles an hour.







Science Gets More Miles Per Gallon

Are We Running Out of Gas? It's Unlikely

By Thomas M. Beck

THE hardy pioneers who developed the central west had a lot of troubles. Not the least among these was the fact that they needed salt and were a long way from salt water; and a hundred years ago, before the days of railroads, it was almost too expensive to bring in salt from the seaboard. However, it was discovered that in Ohio and western Pennsylvania there were certain underground pools of salt water that could be tapped by wells.

There was considerable exploitation of this gift of nature, but the business had its annoying features. Frequently such a well would yield, instead of salt water, a foul black oil known as petroleum, which was absolutely useless in the manufacture of salt. Such a well represented a total loss, and the well digger would curse the day he had ever entered the business, take down his rig, and go elsewhere to try again.

Of course, occasional attempts were made to find a use for this oil. One enterprising druggist, evidently reasoning from the premise that it had a bad taste and yet was not an instantly fatal poison, put some of it up in small bottles as a cure for most of the ills of man or beast. Although this particular application did not become very extensive, later on, in the 1850's, it was suggested that petroleum, if subjected to proper treatment, might be used as a substitute for the whale oil then used in lamps. The supply of crude oil was at first too small and undependable, however, for such a use. For this reason, in 1859, an adventurous well digger by the name of Drake drilled at Titusville, Pa., the first oil well in America. He was lucky enough to strike a rich pool close to the surface and thereby gained immortality as the founder of what has become one of the world's most important industries.

What is petroleum? Crude petroleum is not a standard product by any means, but varies in appearance and composition, depending upon its source. Most of it can be described, however, as a black oil with a not very pleasant odor. Chemically, it is not the same kind of an oil as those of animal or vegetable origin. The latter are compounds of glycerin and fatty acids, both of which are in turn compounds of carbon, hydrogen, and oxygen. Petroleum consists chiefly of a mixture of hydrocarbons (compounds of carbon and hydrogen alone). Animal and vegetable oils are digestible and can be converted into soap by treatment with lye, while mineral oils possess neither of these properties.

There are quite a number of these hydrocarbons present in petroleum. Most of them belong to a sort of a family having the general formula CnH_2n_2, where n represents any number from one on up. These various constituents differ progressively in their physical properties according to the number of carbon atoms they possess. If n is four or less, the hydrocarbon is a gas. If higher than four, the compound is a liquid, or, for still higher values of n, a solid.

To cite several examples, the chief constituent of natural gas is CH_4. The special fuel gases that can be liquefied in steel tanks are mainly C_4H_{10}. The volatile benzine used by cleaners is chiefly C_6H_{14}. C_8H_{18} resembles gasoline, and $C_{10}H_{22}$ is considerably like kerosene. With increasing numbers of carbon atoms, the hydrocarbons become heavy liquids like lubricating oils, and eventually waxy solids like paraffin. Of course, it should be borne in mind that commercial petroleum products such as gasoline or motor oil are not pure individual hydrocarbons, but mixtures of a number of members of this group of compounds.

The question of the origin of petroleum is a hard one to answer. That of coal is much more obvious, since various coal deposits show all gradations from peat to anthracite, indicating clearly plant origin. But the geologists have not been able to find any intermediate stage of petroleum formation. Consequently, on the basis of very slim evidence, there have arisen three main theories on this subject: namely, that it is of animal, vegetable, or mineral origin.

The refining of petroleum is fundamentally a matter of distillation. Distillation, as everyone knows, is the process of boiling a liquid and then condensing its vapor. Now, distillation is the only cheap method of separating two liquids that dissolve in each other, but it is not a theoretically perfect method.

For example, when a mixture of equal parts of alcohol and water is distilled, the first vapor that comes off is not pure alcohol, but rather a mixture in which the lower boiling constituent, alcohol, predominates. If half of the above mixture were distilled, the distillate that came over would be about two-thirds alcohol and one-third water, while these proportions would be reversed in the undistilled residue. To obtain a complete separation these two fractions would have to be repeatedly redistilled. In the early days of oil refining it was necessary to carry out several distillations on the same batch of crude oil in order to get a fairly decent separation into gasoline, kerosene, and other fractions.

In present-day practice, oil distillation is carried out by means of fractionating columns, which are high steel towers fitted at intervals with perforated plates which force the ascending oil vapor to bubble through layers of condensed oil. The vapor, after passing through such a layer, becomes richer in the lower boiling constituents of petroleum, so that each plate acts as a separate still. Such a column, if properly designed and controled, gives a fairly complete separation of the crude oil into its commercial fractions, with the gasoline condensing at the top and the heavy oils at the bottom. These fractions may be obtained by tapping the column at various points. Usually six of them are obtained, in varying proportions—gasoline, naphtha, kerosene, fuel oil, wax oil, and cylinder stock.

The first four of these are ready for use, although frequently they require a little further chemical treatment with certain substances, usually sulphuric acid or fuller's earth, to remove undesirable color or odor. The wax is cooled to -40 degrees, at which temperature paraffin crystalizes out and is filtered off. The cylinder stock is diluted with gasoline, and vaseline is then frozen out of it in the same manner and the gasoline then distilled off the liquid residue. The liquid portions of the wax oil and of the cylinder stock are used as lubricating oils.

While the fundamental process of oil refining has always been much the same, it is the proud boast of the chemists and engineers that four times as much horsepower is obtained from a barrel of crude oil today as was obtained fifteen years ago. This is due to four factors—better automobile engine design, greater heat efficiency in refinery operations, the development of anti-knock gasoline, and greater yields of gasoline as a result of cracking.

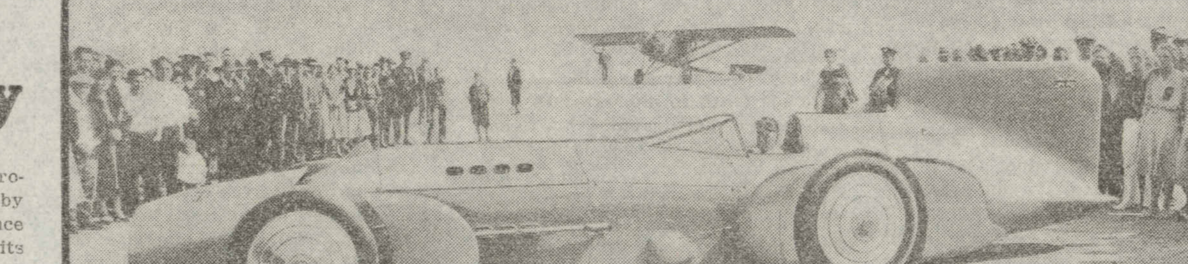
The cracking of oil is said to have been discovered by a refinery workman who day-dreamed on the job and let the still get too hot and build up too much pressure. How this careless person escaped being blasted into the next world is not told by the legend. As a matter of fact, the first successful cracking process was patented by Dr. Burton of Standard Oil about 1912. Cracking consists of heating the heavier fractions of oil under high pressure.

Under these conditions the heavy oil molecules undergo violent internal and external agitation and are shattered into the lighter gasoline molecules. For example, a molecule like $C_{16}H_{34}$ might be broken down into C_8H_{18} or C_8H_{16}. In actual practice it is not quite so simple as this. Much of the oil is broken down into gaseous molecules, or even into carbon and hydrogen. But under carefully controled conditions it is now possible to obtain from a hundred gallons of crude about fifty gallons of gasoline, as compared with fifteen gallons twenty years ago.

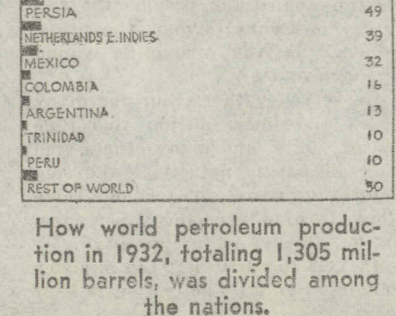
In these days of overproduction of oil such a process would not be worth very much if it were not for the fact that cracked gasoline has valuable anti-knock properties. The knocking of an automobile engine is the result of gasoline exploding too rapidly in the cylinders. This is worse than just a bad noise. It represents a loss in power, since the gas delivers its full amount of power before the piston has time to move very far. The greater efficiency of a relatively slow explosion can be illustrated by the fact that a heavy swinging door can be more readily opened by a steady push than by a hard blow with the fist. No one is able to say at present just why cracked gasoline burns more slowly, but the fact is that it does, and that is why the cracking still supplies about 40 per cent of the country's gasoline today.

But is there any danger of running out of oil? Not in our day, anyway. While it may be foolish optimism to count upon the discovery of new oil fields, yet there is no reason to believe that we have discovered more than a small part of the country's oil resources. After all, the world's richest oil field, that in east Texas, was not discovered until 1930. It was in territory that the experts had long agreed upon as being quite devoid of oil. And even if no more fields are found, it is said that modern drilling methods bring up only 20 per cent of the oil.

Then, when the last possible drop of oil is wrung from the ground, we still have uncalculated amounts of oil-bearing shale to fall back on. And when this is gone there is still the Bergius process of making oil from coal by hydrogenation. So, while there is not much sense in wasting our petroleum resources, it would appear that an oil shortage is much like a bond issue. It is something for posterity to worry about.



The highly developed gasoline of the present day was one of the factors that enabled Sir Malcolm Campbell, the English racer, to drive this car 272 miles an hour.



How world petroleum production in 1932, totaling 1,305 million barrels, was divided among the nations.

Scientific Queries Answered

Mr. Beck will be glad to answer questions of scientific nature. Address Thomas M. Beck, Graphic Section, Chicago Tribune. For personal reply, inclose stamped, addressed envelope.

I have heard that nitroglycerin is one of the most powerful explosives known. If so, why is it not used in cartridges?—N. L. C., Evansville, Ind.

Nitroglycerin is a highly powerful explosive; in fact, too vigorous for the purpose you suggest. It probably would shatter the breech of the gun before the bullet could move out of the barrel. In addition, nitroglycerin is too sensitive to stand ordinary handling, as it is detonated by very slight shocks.