Science Questions and Answers

THIS department is conducted for the benefit of readers who have pertinent queries on modern scientific facts. As space is limited, we cannot undertake to answer more than three questions for each letter. The flood of correspondence received makes it impractical, also, to promise an immediate answer in every case. However, questions of general interest will receive careful attention.

EARTHQUAKES

Editor, Science Questions and Answers:
I've always marveled over the fact that scientists watching a machine thousands of miles away from an earthquake can tell where the earthquake occurred and how intense it is. I understand this is determined by means of the seismograph. Can you tell me on what principle this instrument works?

B. E.,
Erie, Pa.

The principle of the seismograph is based on the familiar inertia. Inertia shows itself as a resistance to motion. If a body is at rest, it wants to stay at rest. If a body is in motion, it wants to stay in motion. Thus because of its inertia the seismograph stays still while the ground underneath it moves.

A seismograph is a pendulum with its tip resting on a sheet of paper covered with lampblack. This paper is wound on a drum which is kept revolving by clockwork under the pendulum. With the ground at rest the tip of the pendulum scratches out a white line in the lampblack on the paper as the drum moves continually forward under the pendulum.

If the earth quivered, that is, if an earthquake occurred, the drum, since it is attached to the earth, would also quiver and this quiver would be traced out in the lampblack as a sideways motion due to the sideways motion of the drum under the tip of the pendulum. The pendulum is so suspended that it can move only from side to side in one plane. If two such pendulums be placed, one facing north and south and the other east and west, they will between them pick any quiver from whatever direction it comes.

The motion of such a simple pendulum will, of course, be very slight—particularly if it is some distance from the scene of the quake. To magnify the motion so as to make it more visible, several devices have been introduced. The better instruments use sensitized photographic paper. The pen is a tiny beam of light reflected from a mirror attached to the end of the pendulum—a motion of the mirror causing a motion of the beam of light over the photographic paper.

The most sensitive types of seismographs have a coil attached to the end of the pendulum. Two powerful magnets are set up on either side of the coil and each quiver of the coil in this magnetic field generates a current which moves the mirror of a galvanometer, the mirror in turn reflecting a light spot back and forth across the photographic paper to give us our record of the earth's motion magnified about 2,000 times.

When an earthquake occurs the whole earth quivers and this quivering can be detected by seismographs, utilizing the principle of inertia. But how can we tell from a record of this quivering just where the earth did quake?

When the earth quakes, it sends throughout the earth two distinct kinds of quiver—two distinct kinds of ripples which travel at different rates. One pushes or compresses the earth ahead of it and hence is called a compressional wave, and the other shakes the earth from side to side as it travels and hence is called a transverse wave.

These two earthquake waves travel at different rates—about five and three miles per second, respectively. For every second we can count between the compressional and transverse waves, the quake is a corresponding distance away. For example, in the last Utah quake, the number of seconds counted at Fordham University between the two quake waves was 293, amounting to a distance of 1,940 miles. The seismograph records the arrival of these waves, and the exact second at which each arrives is told by time marks placed automatically on the record by an accurate clock.

Now if we have three stations in communication, the matter of determining the direction is simple. If we describe three circles on a globe with each of the three stations as centers and the distances of the quakes from their respective stations as radii, the three circles can intersect only at one point, and that point is the center of the earthquake. —Ed.

NEON SIGNS

Editor, Science Questions and Answers:
In view of the fact that neon emits a RED light, how do you account for the fact that all gas tube lighting (yellow, green, blue, etc.) is called "neon lighting"? Isn't this inaccurate?

W. M.,
Chicago, Ill.

The term "neon lighting" is somewhat inaccurate as commonly used. Five gases are used in tube lighting. They are argon, krypton, neon, xenon, and helium. These gases are all closely related in their atomic structure, and are all comparatively inert, that is, they do not combine readily with other chemical elements. They are all found in the atmosphere in very minute quantities. Xenon is the heaviest and rarest of these gases. It is found in the atmosphere in one part in twenty million. It is mainly used as a voltage lowering agent for the other gases which produce the colors.

Argon is mixed with krypton in the tubes to give a blue color with mercury vapor acting as a catalyzing agent. Argon, in an amber tube gives off green light.

Neon emits a red light, the most familiar color. Helium, the lightest of this group of gases, gives off a white light, or a golden one if it is contained in a yellow tube.

These gases are obtained from the air by fractional distillation. A part of the atmosphere is cooled by means of a bath of liquid air. Then, by careful temperature control, the liquefied rare gases are distilled or boiled off in turn and collected in gas receivers known as bombs. Each gas has a different temperature at which it becomes liquid.

We are often asked what happens in a neon tube when the current is applied. When an electric current passes through the electrodes in each end of the tube, electrons are thrown off from the gases.

Let us picture a negative electron leaving an electrode and flying through the tube at a speed equivalent to the speed of light, coming in contact with another negative electron attached to an atom. When these two negative particles meet, they repel each other.

We may assume that this intruding electron's speed is so great as to succeed in ejecting the electron from its orbit. Then the atom suffering this condition will become **positive** in its nature. But this lost electron immediately returns to the atom from which it comes, and the atom is thereby restored to its natural electrical condition. When this happens the atom of neon emits light. A tube will go from full brilliancy to total darkness as many as 100,000 times a second. The illusion produced is that of a steady uniform glow.

A neon tube regardless of its length carries only a minute amount of gas in the tube. This amount of gas is being rapidly modulated at prodigious speeds.

The electrodes that are wholly surrounded by the gas in the tube are made of an alloy of secret composition that will not decompose or throw off particles when the tube is placed in operation. The electrodes are further treated by dipping into a special chemical solution that reduces sputtering to a minimum.

When the letters or design of a tube sign have been formed, the short glass tubes holding the electrode assemblies are sealed to the longer tubes of the sign proper. After the tubes are evacuated by means of pumps the desired gas is introduced. They are then connected to a source of current, whereupon, if there are no air leaks, they will glow.—Ed.

EVOLUTION OF MAN

Editor, Science Questions and Answers:

I've read many times that the notion that man is descended from the apes is false. How do you reconcile that with Darwin's theory to that effect?

S. J.,
New York, N. Y.

The widespread notion that man is descended from present-day species of monkeys and apes seems to be the central, if not the only, concept of evolution in the mind of the layman.

It is generally believed that Darwin in his **Descent of Man** claimed that the monkeys and apes, as we know them, evolved earlier than man and that man is a modified offshoot from these apes and monkeys. As a matter of fact, Darwin never held such a view. He realized that the apes and monkeys of today are specialized end products each of its own branch of the ancestral tree, and that not only is man not a descendant of any primate species, but no present monkey or ape is the descendant of any other.

The view held at the present time, as a result of all the evidence available, is that all the present primates have been derived, some earlier and some later, from a generalized ancestral primate stock, which has had one or a few main trends or branches and many minor or less successful trends or branches. The most successful, really the central, evolutionary branch of the primates has from immense antiquity been the man branch.

If there is a genetic relationship between man and the present apes, it would be more nearly in accord with the evidence to say that these various ape stocks have been derived, by processes of specialization of simian and therefore non-human characters, from the central man branch of primate evolution. This at least is more nearly true than is the popular impression; but by this the student of human evolution does not mean to say that apes or monkeys are degenerate men, though this would be better than saying that men are improved apes.

The common ancestors of apes and man are conceived of as possessing the characters that apes and man have in common and as lacking the human and simian specializations that now characterize the present end products of these divergent lines of evolution.—Ed.

THE SEA'S WEALTH

Editor, Science Questions and Answers:

Many scientists have remarked at one time or another that the oceans contain many valuable chemical elements and minerals, such as gold, silver, copper, iron, etc. Have you any more precise data of what one may expect to

find, say in one square mile of the Atlantic Ocean?

**B. S.,
Englewood, N. J.**

One square mile of the Atlantic Ocean seventy-six feet deep carried a treasure of $73,094,600 as it was pumped through the bromine plant of the Ethyl-Dow Chemical Company at Kure Beach, near Wilmington, N. C., during one year.

Only a part of this wealth was recovered in the form of several thousand tons of ethylene dibromide, which is an ingredient of Ethyl fluid, used in gasoline. The potential by-products, comprising 2,491,344.05 tons of minerals and chemicals included 86 pounds of gold valued at $36,300 and equivalent to a ball six inches in diameter. The silver content of the sea water amounted to 1.35 tons, which would make a ball about two feet in diameter, with a value of $25,120.

The seawater also contained 1,831,000 tons of sodium chloride, or common salt, worth $24,500,000 at present market prices. The salt, if compressed into one-foot cubes placed side by side would form a single row from New York to Los Angeles and half way back.

Other minerals occurred as follows:

Magnesium sulfate, or Epsom salts, 464,800 tons, worth $17,660,000, which if distributed among the 130,000,000 people of the United States would give each person more than seven pounds. Calcium chloride, 101,000 tons worth $2,220,000 which would help maintain about 20,000 miles of sand, clay, and gravel roads, or would help cure 7,000 miles of concrete pavement.

Potassium chloride, 52,250 tons worth $4,180,000 which would make about 1,000,000 tons of potash rich fertilizer. Magnesium, 41,900 tons worth $20,950,000, enough to make 200,000 stratosphere gondolas similar to those used in recent flights. Aluminum, 119 tons, worth $45,100, sufficient to furnish pistons for about 50,000 average automobiles.

Copper, 7.9 tons, worth $1,500, enough to make 300 miles of No. 15 telephone wire. Iodine, 2.76 tons, worth $8,280, which would make about 24,000 gallons of tincture of iodine for first aid purposes. Iron, 125 tons, valued at $7,500. Strontium carbonate, 138 tons, worth $82,800.

Besides these main constituents, practically every element and compound is dissolved in the ocean water. In extracting bromine from seawater, chemical science has accomplished the initial conquest of nature's greatest reservoir of minerals. Economic recovery of by-products is still a problem.—Ed.

"ATOM SMASHERS"

Editor, Science Questions and Answers:

Recently a popular weekly pictorial magazine presented some pictures of "atom smashers" in operation. As the text accompanying the feature was quite meager, I wonder if you would say something about the practical use of "atom smashers" in your highly informative and interesting department?

**W. W. M.,
Wichita, Kansas.**

A few years ago when physicists excitedly bombarded various sorts of matter with atomic particles and achieved various sorts of transmutations on a very small scale, the practical chemists working in industry or medicine did not see that it would help them very much.

Now some of the products of these transmutations are becoming valuable tools in the solution of problems that have nothing to do with what happens within the atom.

The artificially produced radioactive elements, created first in 1934, are being used as tags upon various chemical elements. Through their use, investigators can discover facts about the way things happen in industrial processes or in the way the body uses food.

These natural radioelements, such as the relatives of uranium and radium, have been used fruitfully as indicators in chemical and biological research. The artificial and short-lived radioactive substances promise to be even more useful. The circulation of phosphorus in the body has been investigated through the use of artificially radioactive phosphorus made by bombarding sulfur. New light has been thrown on the physiology of the brain by this study. The brain tissue is proved to be constantly regenerated, contrary to general assumption. Radioactive phosphatides were found in the brain after the animal had eaten the radioactive sodium phosphate.

Chemists can trace just how the atoms travel in important chemical reactions. And metallurgists can trace the speed, for instance, of the interchange of metal from one part of a molten mass to another.

These new tools of the scientific detective are not expensive or unduly intricate. A measurer of artificial radioactivity can be made from material in almost any radio shop and artificial radioelements can be manufactured for many purposes using simpler apparatus than the expensive atom smashers. —Ed.

GUIDE TO SCIENCE KNOWLEDGE ANSWERS

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The SCIENCE FICTION LEAGUE

A department conducted for members of the international SCIENCE FICTION LEAGUE in the interest of science fiction and its promotion. We urge members to contribute any items of interest that they believe will be of value to the organization.

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HISTORY-MAKING drama goes forward with incredible speed. 1938 sees the dawning of a new era of scientific appreciation. People are beginning to understand that the true scientist is not just a theorist, far removed in thought and achievement from the lives of people, but is a pioneer who gives increased powers to man.

Scientists are actively aiding movements for the constructive use of those increased powers by man. The true scientist in his search for truth is essentially an idealist, and has a high moral attitude; but his idealism in providing man with power may not be shared by those who use his power. In Alfred Noyes' description of Galileo demonstrating the marvels of his telescope in Venice, the only value which was apparent to the Ventian fathers was, "This glass will give us new powers in time of war!"

Science has pushed back the hunger line for countless millions, and has revealed the possibilities of an abundance of material things, from bread to automobiles, for every human being on Earth. It has solved the problems of production and transportation, and the mechanics of distribution. It has conquered most of the dreaded scourges, except cancer, and stands ready before many years to offer three-score-and-ten as the average span of life.

SCIENCE AND THE FUTURE

But science has one more Herculean task, according to Arthur H. Compton, the noted physicist. Science must meet the last great problem, the civilizing of human relations. It pleads at the bar of the world for a chance to cooperate with the spiritual in bringing peace on Earth. Science must do more than reveal the horror and futility of war. That is negative. It must do more than insist on the qualities of justice, fair play and peace. That is too general. It must definitely have a plan of action.

Human need supplies the motive for scientific action. Scientists are eager to help, through various methods of education. Therefore science looks to the future with anticipation.

SCIENTIFIC CONTEST

If you have an unusual scientific hobby, there is still time to enter our SCIENTIFIC CONTEST. Do you have a home chemical lab? Do you make space ship models? Do you collect meteorites? Do you prepare microscope slides? Do you collect fossils? Are you an amateur astronomer?

Whatever your hobby is, we are certain that you'd like to tell your fellow readers about it. Here's your chance!

The editors of THRILLING WONDER STORIES will award original