43. The kind of rays emitted and the HALF LIFE (the time in which half the radioactivity decays) is a constant characteristic of each radioactive isotope of every element, and is used to identify that isotope.

44. In general, the gamma rays are very penerating, the alpha and beta rays less so. Even though the alpha and beta rays are not very penetrating, they have enormous SPEED.

45. The speed with which atom particles travel is the source of atomic energy. ENERGY is capacity to do work. It is work stored up for future use.

46. If you raise a weight to a height above the ground and suspend it there by some device, the WORK you put into raising it can be stored there indefinitely as POTENTIAL ENERGY. It will be there, ready, whenever you decide to release it.

47. The energy which a moving body has because it is in motion is called KINETIC ENERGY. The kinetic energy of any particle depends upon its mass and the square of its velocity. Energy is conserved by the moving particle until it strikes an object, then work is done.

48. All ENERGY is either potential or kinetic. Either one can be converted into the other. These two conversions are continually occurring.

49. Particles of atomic size have kinetic energy arising from several different kinds of MOTION. All atoms are constantly in motion.

50. If the atoms are so dispersed that the material constituting them is a GAS, that gas will exert pressure on all sides of the container that holds it, on account of the motion of the gas molecules.

51. Atoms which compose an element that will combine readily with another element, as hydrogen or carbon will combine with oxygen, have unsymmetrical arrangements of the outer electrons in their systems. These unsymmetrical arrangements tend to set up a sort of strain, which causes CHEMICAL COMBINATION to take place when elements with suitable combining powers are brought together.

52. These unsymmetrical arrangements give rise to FORCES which result in kinetic energy. This energy appears, for example, when carbon and oxygen burn to carbon dioxide, giving off heat, or hydrogen and oxygen explode to form water, again giving off heat.

53. Chemicals combining to form stable compounds give off energy in the process. These are known as EXOTHERMIC REACTIONS. Combinations which absorb energy, forming unstable compounds, are known as ENDOTHERMIC REACTIONS. Explosives, for example, which are highly unstable, are formed by endothermic reactions.

54. Chemical forces, electricity and heat are all forms of energy. Potential and kinetic energy may be distinguished in each case.

55. These energies all arise from motion of the atom as a whole, or motion resulting from attractions and repulsions between the outer PLANETARY ELECTRONS of the atom's structure.

56. Energy resulting from motion of particles deep within the structure of the atom was unknown until the discovery of RADIOACTIVITY.

57. Radioactive elements undergo SPONTANEOUS breaking up of their atoms, giving off alpha and beta particles and gamma rays. Loss of these particles causes the radio-active elements to change into other elements.

58. The energies shown in these TRANSMUTATIONS are thousands of times greater than the kinetic energies which the molecules of a gas have by reason of their motion when heated. They are thousands of times greater than the energy changes per atom in chemical reactions.

59. The property of matter that connects it with motion is INERTIA. Inertia is opposition to change of motion.

60. One conclusion that appeared early in the development of the theory of RELATIVITY is that the mass due to inertia of a moving body increases as its speed is increased.

61. This increase implies an equivalence between an increase in energy of motion of a body (kinetic energy) and an increase in its MASS.

62. It is for this reason that Einstein suggested that studies of radioactivity might show the EQUIVALENCE of mass and energy.

63. Einstein's statement is that the amount of energy, E, equivalent to a mass, m, is given by the equation $E=mc^2$ where c is the VELOCITY OF LIGHT.

64. From this equation, one kilogram (2.2 pounds) of matter, if converted ENTIRELY into energy, would give 25 billion kilowatt hours of energy. This is equal to the energy that would be generated by the total electric power industry in the United States running for approximately two months.

65. Compare this fantastic figure with the 8.5 kilowatt hours of heat energy which may be produced by BURNING an equal amount or coal.

66. Until the atomic power research program, no instance was known of matter being converted into energy without more energy being used to produce the transformation than was released by it.

67. Two axioms of physics state: (1) MATTER can be neither created nor destroyed; (2) ENERGY can be neither created nor destroyed. For all practical purposes they were true and separate principles until about 1940.

68. It is now known that they are, in fact, two phases of a single principle, for we have discovered that energy may sometimes be CONVERTED into matter and matter into energy.

69. Such conversion is observed in the phenomenon of nuclear FISSION, a process in which atomic nuclei split into fragments with the release of an enormous amount of energy.

70. The extreme size of the CONVERSION FACTOR explains why the equivalence of mass and energy is never observed in ordinary chemical combustion.

71. We now believe that the heat given off in such COMBUSTION has mass associated with it, but this mass is so small that it cannot be detected by the most sensitive balances available.

72. Transformation of matter into energy is an entirely different sort of phenomenon than the usual chemical transformations, where the matter is changed into a different form but its MASS persists.

73. From the standpoint of the Laws of the Conservation of Matter and of Energy alone, transformation of matter into energy results in the DESTRUCTION of matter and CREATION of energy.

74. The OPPOSITE transformation, which astronomers believe may be going on in some of the stars, amounts to the destruction of ENERGY and the creation of MATTER.

HIGH-VOLTAGE GAS TESTER—Breakdown limits of new types of gases for possible use in transformers, replacing oil, are determined in this "howitzer" at Westinghouse Research Laboratories. Up to 600,000 volts may be used; when the electrical surge becomes too powerful for the gas, it leaps from one electrode to another. Gas-filled transformers could be lighter and smaller than present types.

ENTOMOLOGY

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➤ MOSQUITO eggs are helped to hatch by some of the same chemicals that stimulate growth in plants. This renders all the more probable the suspicion held by many entomologists, that their eggs are similarly helped in nature by plant substances dissolved in the water on which they are laid.

Influence of synthetic plant growth-

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