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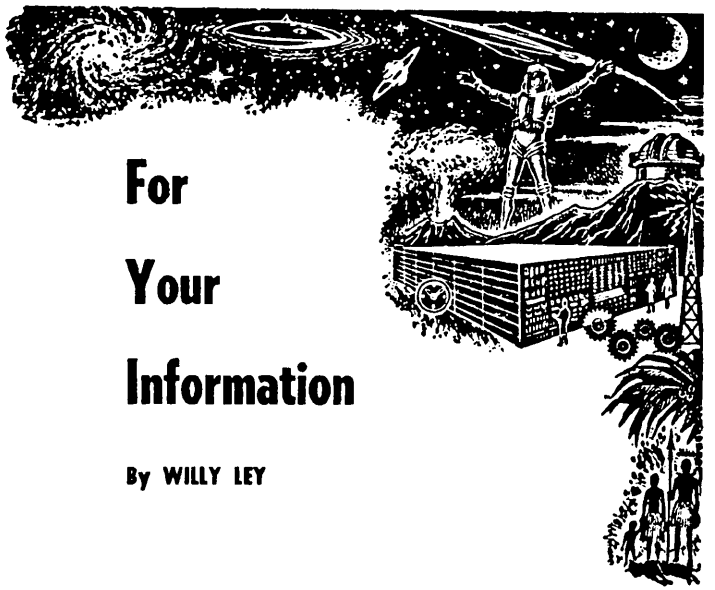

For Your Information

By WILLY LEY

THIS month I am going to devote the main section of this department to a chart of the chemical elements. Well, it won't really be a "chart" because I don't intend to waste space in GALAXY for something that can be looked up in any chemistry textbook. Hence isotopes, whether natural or artificial, will not be mentioned, and not a line will be wasted on melting or boiling points, nor will there be chemical information or

electrical characteristics. All that can be found in textbooks and handbooks. What I am concerned with—and it took a good deal of time to get this information together—will be of no use to chemists or engineers. But it will, I hope, be interesting. I want to write about the names of the elements, what they mean and why their discoverers proposed them.

Element No. 1 is, of course, hydrogen. Nicolas Lémery of France discovered it around 1700 and suspected that water was one of its compounds. The other component of water, oxygen, element No. 16, was discovered by Joseph Priestly of England and Karl Wilhelm Scheele of Sweden some 75 years later and when it was established that elements 1 and 16 made water (at first thought to be HO) the names were tagged on. *Hydor,* a Greek word, means water, hence hydrogen, meaning "water-former." The other component of water seemed to be in every acid, hence the name oxygen, "acid-former."

Now we know that there are acids without oxygen, but none without hydrogen. And since the oxygen atom is much heavier than the hydrogen atom, there is far more oxygen in water than hydrogen, even though the formula is H_2O. In short, element No. 1 *should* be called oxygen and No. 16 *should* be hydrogen. But it's a little late to change them around now.

Element No. 2 is helium, from *Helios,* the Greek sun god, for the reason that it was found in the solar atmosphere first (by Jules Janssen of France in 1868) before Sir William Ramsey discovered it in the Earth's atmosphere (1895). No. 3 was named by its discoverer, Swede Johan A. Arfwedson of Sweden (1817), without noticeable thought or imagination. *Lithos* is Greek for "stone," the ore it came from looked like stone, hence lithium. No. 4 also got its name from the mineral in which it occurs. It happens to be green and in Latin there is a word *beryllinus* which means green-colored, so the element was called beryllium. Similarly, the name of No. 9 was derived from one of its minerals. The mineral was used—and still is—as a flux in metallurgical operations. German miners, consequently, called the mineral *Fluss-spat,* which became fluorspar by adaptation of the Latin word *fluere,* "to flow." Fluorspar is the fluoride of calcium and the element was called fluorine. There happens to be a minor and accidental justification for the name: it "flows out" of almost anything you try to keep it in.

No. 10, neon, means " the new" because it obviously was new

when Sir William Ramsay discovered it in 1898. But No. 11 is less obvious. You may have wondered why the chemical symbol for sodium is Na. The common English name is derived from soda, but the symbol is derived from the word *Natrium,* which was both common and mysterious until somebody found out that that the original is an Arabic word *neter,* meaning "herb-ash," as distinct from *kalyun,* "wood-ash," and accounts for the letter K as the symbol for No. 19.

That K stands for the international name *kalium,* but the English name was derived from pot ash, making it potassium. Both were first isolated in 1808 by Sir Humphry Davy, who isolated No. 12, magnesium, at the same time. That name is from the mineral magnesia, which was named in turn after an ancient city. Similarly aluminum, No. 13, was named after its mineral, alum, while No. 14, silicon, got its name from *silex,* which in this case is not the trade mark of a coffee maker, but the Latin word for flint.

No. 15, phosphorus, has a Greek name which is meaningful and fitting; it translates as "carrier of light." The knowledge of No. 16, sulphur, however, is so old that the meaning of its name is no longer remembered. Since No. 17, chlorine, is a greenish gas, its discoverer, Karl Wilhelm Scheele, just used the Greek word for "green" (*chloros*) to name it. Sir William Ramsay utilized the Greek word for "sluggish" to name No. 18, argon, because it did not want to combine with anything else. No. 20, calcium, one of Sir Humphry Davy's discoveries, derives its name from the Latin *calx,* "burned lime."

When Lars Nilson discovered No. 21 in 1879, he called it scandium, after Scandinavia, but his compatriot Baron Jöns Jakob Berzelius, discoverer, among other things, of No. 22, titanium, had to justify his choice with the excuse that, in Greek mythology, the titans were the "sons of the Earth." No. 23, vanadium, was discovered and named by Nils Sefström of Sweden in 1830. He derived it from the Germanic goddess Vanadis, better known as Freya, for no reason except that he apparently liked the sound.

No. 24, chromium, is from *chromos,* the Greek word for "color" or "dye"; you know what a pronounced color chromium-yellow has. But No. 25, manganese, is a puzzle. Nobody seems to know the derivation of the word, except that one commentator remarked that the mineral from which manganese is derived was wrongly called "black magnesia" for a while. Since *melas*

is Greek for black, I could understand the connection if the element were called melanganese. Maybe it was at one time, but I have yet to find proof.

In the case of No. 26, iron, we have one of the few elements which have been known for so long that their names have no derivation. The chemical symbol FE comes from the Latin *ferrum* and the Greek equivalent *sideros* can be encountered as siderite, indicating an iron meteorite.

Cobalt and nickel, Nos. 27 and 28, are both German, the former meaning gnome (*Kobold*), the latter meaning water sprite. The nasty creatures fooled the brave miners, handing them ores that looked like silver ore, but were completely worthless, since applied metallurgy had not yet progressed to the extraction of the metals. They were discovered, for the record, by two Swedes, cobalt by Georg Brandt in 1735 and nickel by Axel Cronstedt in 1754.

No. 29, copper, although known since antiquity, has a name that is still traceable. The chemical symbol Cu is from the Latin name *cuprum*, and *cuprum* is in all probability derived from the island of Cyprus, which was pronounced "keeprus."

No. 30, zinc, is German again, from the word *Zinke*, which means protrusion because it sublimed in the furnace and condensed in protrusions in the cooler parts. Nos. 31 and 32 are Gallium and Germanium; the two discoverers, Lecoq de Boisbaudran (1875) and Klemens Winkler (1886), honored their respective countries. No. 33 is arsenic, said to have been isolated first by Albertus Magnus. The name, at any event, is Greek; *arsén* means "strong" or "masculine."

Selenium, No. 34, is one of the discoveries of Jöns Jakob Berzelius and is named for the goddess of the Moon, Selene, in the Greek pantheon. I suppose he had a reason.

There is a very apparent reason, though, for the name of No. 35. The Greek word *brómos* means "stench" and the discoverer, the Frenchman Antoine-Jérôme Balard (1825), found out during his experiments that some of the compounds offend the nose. The name of No. 36 is Greek, too, for *krypton* means "hidden" and that's how Sir William Ramsay found it—concealed among the other so-called noble gases.

The names of the next few elements in the table are also simple, once you know what they mean. No. 37 is rubidium because of its ruby-red line in the spectrum; No. 38 is strontium after Strontian in County Argyll, Scotland; No. 39 is yttrium after Ytterby in

Sweden; and No. 40 is zirconium after the name of the gem.

No. 41 was once called columbium in English-speaking countries, where students had to remember that the symbol for columbium was Nb. The origin of the symbol, the international name niobium, has now been officially accepted and columbium will hence be found only in out-of-date textbooks.

No. 42, its discoverer Peter Jakob Hjelm of Sweden thought in 1781, looks rather like lead. Using the Greek name *molybdos*, meaning lead, he called it molybdenum. No. 43 was originally called Masurium, after the landscape of Masuren in East Prussia. But since the two discoverers, Drs. Walter Noddack and Ida Tacke, merely proved its existence while Oak Ridge actually produced it, the original name has been discarded in favor of technecium from the Greek *techné*, "skill."

No. 43, discovered in 1844 by Karl Karlovitch Klaus, was also given a geographical name, ruthenium, from Ruthenia — Russia. The interesting point is that G. W. Osann gave it the same name in 1828, sixteen years prior to actual isolation. Nos. 45 and 46 were both discovered by William Hyde Wollaston in 1803-4; No. 45 was called rhodium from the Greek word *rhodos* for "rose," while No. 46 was called palladium, after the then newly discovered planetoid Pallas.

Silver is No. 47 and known for so long a time that the meaning of the name is lost; the symbol Ag is from the Latin name for it, *argentum*. No. 48, cadmium, is named after the mineral cadmea; No. 49, indium, has nothing directly to do with India, being derived from the indigo-blue line in its spectrum—but the name of that color is derived from the name of the plant, which in turn honors the geographical area. No. 50, tin, is one of the long known elements; the symbol Sn is from the Latin name *stannum*.

The very similar symbol for No. 51, Sb, stands for the Latin name *stibium*, but the English word antimony is Latin, too. Its origin is the first two words *anti monachon*, "against the monks," in an edict of Frances II of France, forbidding its medicinal use by clergy.

No. 52, tellurium, is from the Latin *tellus* for Earth; No. 53, iodine, from the Greek *ioeides* for the color violet; and No. 54, xenon, one of Sir William Ramsey's Greek names, means "stranger." Both No. 55 caesium (from Latin *caesius*, "bluish") and No. 56, barium, (from Greek *barys*, "heavy") seem to make no sense, for caesium looks like silver and

barium is hardly heavier than aluminum. But "bluish" refers to a line in the spectrum and "heavy" refers to the mineral.

The numbers 57 to 71 are the so-called rare earth elements of which a chemist once wrote that they pursue the chemist in his dreams, that they split like amebas and that their chronology looks like a list of "begats" from the Old Testament.

Their names reflect some of the unhappiness they seem to have caused. No. 57, lanthanum, is from the Greek word *lanthano,* which means "to escape notice." No. 58, cerium, was named in 1803 after the recently discovered planetoid Ceres (not after the goddess directly); No. 59, praseodymium, is Greek again, meaning "green twin." No. 60, neodymium, is also Greek: "new twin" (the former didymium had split in two). No. 61, long missing, was first called Illinium (University of Illinois), but Oak Ridge, after definite identification, changed that to promethium, from Prometheus, the mythical giver of fire.

No. 62, samarium, was named by a Frenchman after the Russian mine inspector Samarski. No. 63, europium, was also named by a Frenchman, Demarçay, after the continent, of course. No. 64, gadolinium, was named in honor of the Finnish chemist Gadolin; No. 65, Terbium, after Ytterby in Sweden; No. 66, dysprosium, comes from the Greek word *dysprosopon,* which means "difficult mask." No. 67, Holmium, is derived from Holmia, the Latin name of Stockholm; No. 68, erbium, again after Ytterby; No. 69, thulium, from Thule, the hard-to-identify northern land of Pytheas of Massilia.

No. 70 is ytterbium, *again* Ytterby in Sweden! That place has a total of *four* elements named after it, three of them rare earths, all found in the unusually interesting mine that is located there.

No. 71, lutetium, comes from Lutetia, the Latin name for Paris, and No. 72, the first element after the rare earth group, is hafnium, from Kjöbenhavn, the Danish spelling of Copenhagen. Its discoverer was a Hungarian, Georg von Hevesy, but he commemorated the city in which he made the discovery (in 1923).

There was once, you probably remember, a mythical shade who was punished after death by being made to stand in water up to his neck, but every time he tried to bend down and quench his thirst, the water receded. When Gustaf Ekeberg found (in 1802) a metal which is insoluble in most acids, he thought of this

ancient victim and named the metal after him: tantalum. Tantalus, by the way, had a daughter by the name of Niobe and she provided the name for No. 41.

Tungsten is the Swedish word for "heavy stone" and was once the name of element No. 74. But its chemical symbol was W for Wolfram, which was adopted two years ago by an international congress, so tungsten is no longer correct. No. 75, rhenium, discovered by the same team which announced "masurium," got its name from the Latin *Rhenus*, "Rhine." No. 76 is osmium, actually not a flattering name because *osmé* (Greek) means "bad odor." Its discoverer, the Englishman Smithson Tennant, also discovered No. 77, iridium, which he named because of its iridescent solutions. No. 78 is platinum, a Spanish word meaning "little silver." No. 79 is gold; the Germanic word is essentially a parallel form of the word "yellow" for quite obvious reasons. The symbol Au is from the Latin name *aurum*. No. 80 is mercury (in German still *Quecksilber*), the symbol Hg coming from the old name *hydrargium*. No. 81, thallium, derives from the Greek *thallos*, "green twig."

Lead is No. 82 and the word is probably a variant of "load" (you used it to weigh down things, but lodestone, which is magnetic iron ore, comes from the verb "to lead"). The German name, *Blei*, is derived from that old Germanic word *blâ* which means both "black" and "blue;" to this day, a German soldier will refer to bullets as "blue beans." The symbol Pb is from the Latin *plumbum*, which is also the root of "plumber." No. 83, bismuth, has an originally German name, which in modern rendering would read *Wiesematte* and denotes a "flowering meadow", a name that makes sense if you know the colorful display of a pan of hardening bismuth.

Above bismuth, we get into the realm of the radioactive elements, mostly of recent discovery and with artificial names. No. 84 is polonium, so named by Madame Sklodowska-Curie after her native Poland. No. 85, first called alabamine (after the state) is now known as astatine from the Greek *astasia*, "unsteady". No. 86 is radon, once called "emanation," from the Latin *radius* for "ray;" No. 88, radium, has the same derivation.

No. 87; discovered in 1947 by Mlle. Marguerite Perey, is called franchium, and No. 89 is actinium. Of the radioactive elements, only the more stable ones, No. 90, thorium, and No. 92, uranium, have been known for a considerable time. The former

was discovered by Jöns Jakob Berzelius and named after the Norse god Thor, the latter by Martin Heinrich Klaproth and named after the planet Uranus.

No. 91 is protactinium and above 92 we have the obvious neptunium (No. 93) and plutonium (No. 94); americium ("made in America") as No. 95; curium (after Madame Curie) as No. 96 and, so far the heaviest, Berkelium (Berkeley, Calif.) as No. 97.

As you can see, naming elements is an arbitrary, inaccurate and often sentimental business. Luckily, the origins quickly lose their identities and we are aware only of the properties of these basic substances. And they did, after all, need *some* name and these do as well as any others.

—WILLY LEY

ANY QUESTIONS?

How would the pilot of a ship in space recognize Earth at a glance and could he tell his distance, even roughly, by its brightness?

Earth could be recognized by its color and by the presence of a single large moon. Mars, when seen from space, looks reddish, Venus a pure white, while Earth must be blue-green. Saturn, of course, has its rings as a distinctive feature and Jupiter its stripes and four large moons. If the ship were at the orbit of Venus, Earth can look six times as brilliant as Venus at her brightest appears to us. Even the Moon would be almost as bright as Venus is to us. Seen from the orbit of Mars, Earth would look about as bright as Jupiter does from Earth at greatest proximity. If the ship is at points outside the orbit of Jupiter, the pilot would need instruments to see Earth, which at such distance would be "lost" in the glare of the Sun.

Just what is the velocity of light? 186,000 *miles per second sounds like a rounded-off figure.*

It is, and so is the customary metric equivalent of 300,000 kilometers per second. The *Observer's Handbook* gives the more precise value of 299,774 km. p. sec. Some values obtained in 1949 and 1950 by various investigators read as follows:

Aslakson	**299,792 + 2.4**
Essen	**299,792.5 + 3.0**
Bol	**299,798.3 + 0.4**
Bergstrand	**299,792.7 + 0.25**

In your Conquest of Space *you list the planetoid* Adonis *as the one which comes nearest to the Sun, staying just outside the orbit of Mercury. But since the orbit*

of Mercury is so eccentric, isn't it possible that Adonis *might cross the orbit of Mercury on occasion?*

To the best of our knowledge *Adonis* does not. But we now know a male planetoid that does. It has been appropriately named *Icarus* and it gets much closer to the Sun than the mythical Icarus ever did. Mercury, when closest to the Sun, is 0.31 astronomical units (one astronomical unit, or A.U., is the distance of Earth from the Sun) from the primary, while *Icarus* gets to within 0.20 A.U. or around 19 million miles. Maximum distance of *Icarus* from the sun is 1.97 A.U., roughly twice that of Earth. More precisely, it is 183 million miles. The small planetoid is less than a mile in diameter and probably reaches a temperature of 1000° F. at perihelion.

In the film Destination Moon, *there is a short sentence hinting at the use of titanium for spaceship construction. In what respect would titanium be superior to other metals? I have not seen it used anywhere.*

The reason why titanium is not in use right now to a noticeable extent is simply due to the fact that it became commercially available only two years or so ago. I have seen some small parts made of it. It looks like silver, though less shiny, and has generally the characteristics of stainless steel. It differs from steel in two respects of interest to an engineer—it is non-magnetic, and its specific gravity is only 4.5 while that of steel is 7.8. Heinlein probably picked titanium as a "light-weight steel" for construction purposes.

Why is it that you get ice cubes faster if you put lukewarm water into the trays of your refrigerator rather than ice water?

If I had not been prepared, this question would have surprised me no end. But a few years ago I talked to one of the researchers of the Bureau of Standards in Washington, D. C., who told me that this is a fairly widespread popular superstition and that the Bureau received so many inquiries about it that they finally decided to test it. The answer is astonishingly simple: because of the high latent heat of water, a few degrees more or less do not make a difference which could be noticed without measuring it. Of course, the colder the water, the sooner it will freeze, but the freezing difference between water of 35° F and water of 55° F is about one minute.