should be stated that numerous persons have been interviewed, including zoologists, chemists, physicists, physiologists and psychologists, and he has the first one yet to find who definitely stated having noticed the recurrent irregularities in the flight of the firefly at the time of flashing.

A brief description and discussion follow: The firefly on its twilight excursions flies for the most part in a horizontal direction. Take a windstill evening. A trace of its path viewed horizontally and from the side is shown in Fig. 1. The portions *a, b* and *c* represent

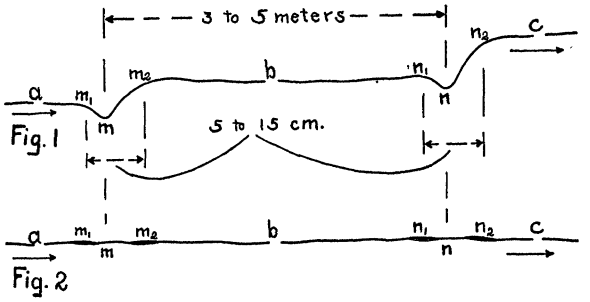

FIG. 1. Side elevation. Two flashes, m_1 m m_2, and n_1 n n_2, are shown. FIG. 2. Top plan, looking down. Wavering shown by thickened line.

the more or less undulating stretches of the flight of the fly, while m_1 *m* m_2 the path during a "flash" and n_1 *n* n_2 the path during the next following flash. As viewed from the side the fly on approaching m_1 slows down appreciably (seeming to waver slightly as though in an effort to stop) but maintains its flying level. The light is then turned on, and simultaneously the firefly drops visibly from its horizontal flight, but acceleration at once ensues, the downward duck is quickly arrested, followed by an upward spurt, as shown by the trace *m* m_2 in the figure. On reaching m_2, at a distance of from 5 to 15 cm from the beginning of the flash, the light is suppressed and simultaneously the flight is again slowed down. The fly seems to waver, as in an effort to regain its equilibrium, before continuing its more or less undulatory flight along *b*, reaching n_1, When the luminous path cycle is repeated.

Looking down from above, Fig. 2, the path discloses no outstanding characteristics. The direction of flight is pretty much straight ahead, but on close observation there may be at times signs of wavering at the points m_1 and m_2 and also at n_1 and n_2, referred to above and shown in Fig. 2 by the thick portions of the line. Observations from above reveal the accelerations in flight, both positive and negative, over the flash period. These observations are not easy to make, as one can well imagine.

Speculating on the evidence revealed by the foregoing, it seems that the system (the firefly) may be thought of as containing stored energy under control of the insect for both maintaining flight and producing flashes of light. The fly now contemplates a flash as it approaches, say, m_1. On turning on the light (drawing energy from the common source) the attendant "overload" causes the mechanism necessary for sustained flight to slow down and the fly drops slightly. Simultaneously extra stores of energy are tapped, the flight mechanism responds, the illumination brightens and the insect speeds upward, in its endeavor to overcome the falling tendency, and reaches the point m_2, having thus described the smooth path m_1 *m* m_2. At m_2 the energy for the production of the light is shut off, and with it, doubtless, some that was needed in maintaining flight. The flight mechanism again slows down, the fly may waver as though to regain its balance (Fig. 2), and then starts off at reduced speed over the routine flight between flashes, while energy for the next flash is generated (chemically or otherwise) en route. That considerable energy is expended in the production of the flash and must be renewed (between flashes) is evidenced by the fact that if the fly is caused to emit light continuously its brightness dims perceptibly with time.

The above are the writer's observations, extending over a long period. Fig. 1 depicts the path quite accurately. Have other observers noticed similar persistent irregularities?

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PATENTS FOR ACTS OF NATURE

Now that Senator Joseph G. O'Mahoney and his colleagues of the Temporary National Economic Committee have apparently concluded their series of snapshot exposures of the iniquities of patent-owners who pool their patents to create wicked monopolies and who exercise "dog in the manger" control of inventions by "pigeonholing" the patents upon them, let them investigate a real abuse of our patent system—patents for true chemical compounds—surely the most preposterous patent monopolies that have ever been foisted upon the public with, alas, the sanctions of some of the courts.

All patent monopolies in this country derive from that provision of the Constitution which reads:

> Congress shall have Power. . . . To Promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

As early as 1790, Congress, pursuant to the grant of this express power, enacted legislation authorizing the granting of patents for arts, manufactures, engines, machines and devices, and improvements upon such subject-matters, but this legislation soon proved to be far from satisfactory. So, three years later, Congress

enacted the superseding Patent Act of 1793, which authorized the granting of patents for arts, machines, manufactures and compositions of matter, and improvements upon such subject-matters, and thereby established those categories of patentable inventions which have persisted unchanged and unreconsidered in our statutory patent laws for the past one hundred and forty-six years. Now while true chemical compounds indubitably are compositions of matter, they constitute a very special kind of compositions of matter, for they are unique molecularly-homogeneous substances of invariant compositions and fixed properties, unalterable by man; but in 1793, not even the most astute chemists (let alone Congressmen) then living could be certain of these facts, because they were not then known, for they were first established experimentally during the years 1801–09 by Proust in his controversy with Berthollet.

By 1841 or earlier, the courts had wisely decided that the word "Discoveries" in the Constitutional provision means merely "inventions"; and hence, only "inventions" are patentable. Now an "invention" is a specifically human affair: it is necessarily a creating or contriving by man—some thing or some action or series of actions performable upon materials that man can, and does, make or perform—in short, a purely human accomplishment: it is, above all, *not* something that nature, and only nature, can create. In other words, the "inventive-content" of any alleged "invention" is, and can never exceed, the contributions, mental and physical, made by man in the sum-total of the phenomena connoted by the alleged "invention"; for, to the "inventor" are likewise applicable those discerning words wherewith Anatole France characterized the "scientist" when he wrote:

> Le savant multiplie les rapports de l'homme avec la nature, mais lui est impossible de modificier rien la caractère essentiel de ces rapports.

The U. S. Supreme Court heavily underscored this conception of "inventions" in 1852 by intimating that "principles of nature", including properties of matter such as the property of plasticity possessed by lead, are definitely unpatentable. Surely there can be no disagreement with these views, inasmuch as it would be most absurd for the Federal government to grant patents for "principles of nature", *i.e.,* phenomena of nature which man had stumbled upon and had not, nor could have, created or contrived, such as the inherent properties of substances. And so consistently have the courts subscribed to this doctrine of the unpatentability of properties of matter that they have refused to sustain patents for the property of ductility possessed by pure tungsten, pure uranium and pure vanadium.

What, then, is most astounding is the fact that the U. S. Patent Office has granted, and certain of the lower Federal courts have sustained, patents for true chemical compounds themselves. Thus, in 1902, the U. S. Circuit Court of Appeals for the Third Federal Circuit sustained U. S. Patent No. 400,086 for acetylphenetidine (phenacetin), and, in 1910, the U. S. Circuit Court of Appeals for the Seventh Federal Circuit sustained U. S. Patent No. 644,077 for acetylsalicylic acid (aspirin). As precedential cases, these two decisions unquestionably and most unfortunately have had the effect of apparently warranting the validities of the enormous number of patents for true chemical compounds, as such, some of the better known of which are:

U. S. Patent No. 782,739 for Veronal
U. S. Patent No. 812,554 for Novocaine
U. S. Patent No. 986,148 for Salvarsan
U. S. Patent No. 1,025,872 for Luminal
U. S. Patent No. 1,280,119 for Tryparsamide
U. S. Patent No. 1,514,573 for Amytal
U. S. Patent No. 1,533,003 for Mercurochrome
U. S. Patent No. 1,649,670 for Hexylresorcinol
U. S. Patent No. 1,825,623 for Nupercaine
U. S. Patent No. 1,921,424 for Benzedrine

But *are* these decisions sound? *Of course not!* If there is one thing on this earth that man can not "invent", it is a true chemical compound, because every true chemical compound, as such, is nothing more or less than an ensemble of unpatentable properties of matter, created and quantitatively embodied in tangible substance solely by nature. You can put together mutually reactive substances, and that "putting together" may well constitute a patentable process, but what you get by, and out of, the interactions of the juxtaposed substances depends wholly upon the volition of nature. Nature, and nature alone, fixes the structure, the composition and the inherent properties of every true chemical compound that is producible by processes devised by man, and neither you or I nor any one else can alter any one of them. Obviously then, no true chemical compound, as such, can be an "invention".

When Germany enacted her statutory patent laws in 1877, just seven years *after* the last not-too-casual overhauling of our statutory patent laws by Congress, she accorded full recognition to the fact that true chemical compounds, as such, can not be "inventions" by extending to them, not intrinsic patent protection, but patent protection merely to the extents that they were products of patentable processes. Hence, in Germany today, owners of patents for non-equivalent processes for producing the same true chemical compound can, each and every one, produce that true chemical compound without let or hindrance by the others. In 1919, England adopted in her statutory patent laws precisely the same attitude toward true chemical compounds. But in this country, under the aforemen-

tioned decisions of the lower Federal courts, the man who first produces a novel true chemical compound can acquire by a patent so absolute a monopoly upon that true chemical compound that for seventeen years he can prevent any one from producing it by any process whatsoever, including all processes which are entirely unlike his own process. Surely nothing could be more irrational than the fact that upon producers of true chemical compounds, including medicinals and pharmaceuticals such as those listed above, were, and are, bestowed the tightest patent monopolies on the face of the earth, founded, mind you, upon subject-matters which can not be "inventions" of man, but which are "inventions" of nature alone! And since such absolute patent monopolies undoubtedly discourage the developments of novel processes for the productions of patented true chemical compounds, they can hardly be said "To Promote the Progress of Science and Useful Arts."

Fortunately, the U. S. Supreme Court has never explicitly affirmed any one of these egregious decisions of the lower Federal courts, nor has it ever categorically declared true chemical compounds, as such, to be patentable, so that a single decision of that tribunal will suffice to dispose of these "earth and a slice of Heaven" patent monopolies. But an amendment of our statutory patent laws, expressly excluding from intrinsic patent protection all true chemical compounds, would accomplish the same result just as effectually and more expeditiously.

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SPACE PERCEPTION BY RADIO

MOST people who have bought an improved radio junk their old one. That is not always wise, as will be shown. First find out whether your old radio amplifies better the low or the high pitches prevailing in music. Then adjust your new radio, which often permits it, so that the other pitches are favored by its amplification. Now, if you have a very large room, put one radio in one corner and the other in the diagonal corner, and seat yourself near the middle. If you have only small rooms, choose two with a connecting door open, place your radios as far apart as possible and seat yourself near the door in the larger of the two rooms. A little experimenting may be called for. You will more or less readily observe a strange effect. Close your eyes or simply forget what you actually see with them. It seems that you have before you the orchestra with the musicians so seated that the highest pitched instruments are on one side of the stage, the lowest pitched on the other side, and the middle instruments ranged between accordingly.

If it is a mixed chorus you are listening to, the female singers seem to be on one side of the stage, the male singers on the other side. Or if it is a duet of a soprano and a basso of the Metropolitan Opera, you seem to be located between the woman and the man. In some cases, though, the peculiar voice quality of the basso singer may diminish the strength of this spatial illusion by "splitting," so to speak, the basso's voice into a lower and an upper component. It goes without saying that you can have the effect only if you have two fairly good ears. If you are deaf or hard of hearing on one of your ears, you will try in vain.

The whole effect would be a very small *esthetic* addition, if any, to what you can get with a single radio, although in any case it would be interesting enough. But there is something else to be mentioned. As soon as you begin to differently *localize* the higher and lower sounds, you notice that the ease with which you *analyze* the compound sound is enhanced, the keeping apart of the components of any chord in your musical apprehension is a matter of less effort to your attention. When the tones say to you, "I am here and I am there" you become more readily aware of their separate existence. Now, whoever knows anything about the psychology of music knows that the ability to analyze, to overcome the fusion to which the simultaneous tones are subject in the untrained listener, is one of the greatest assets for the appreciation of our modern highly complex music. The method above described is therefore a distinct aid for getting the maximum of esthetic appreciation. If you have two good ears, why not utilize fully the possession of both?

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MICROBIOLOGY OF COAL

A STUDY of the biological decomposition of coal has been under investigation in the Departments of Fuel Technology and Bacteriology of the Pennsylvania State College for several months to determine the types of microorganisms that can decompose coal, to study the changes occurring in solutions containing humic acids prepared from bituminous coal and to examine the technical and economic aspects of such changes.

While various investigators have established the presence of microorganisms in coal, an appreciable consumption of coal substance by microbial activity has not previously been recorded in the scientific literature.

For the present experiments coal solutions proved to be an excellent substrate for cultivating bacteria. These solutions were prepared from the alkali-soluble "humic acids" resulting from the oxidation of bituminous coal. The basic substrate for the biological experiments was a 2 per cent. humic acid solution. Microorganisms of the order of true bacteria, fungi and actinomyces were found to grow on liquid and solid