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May 2, 1998

Mr. Hugh McDiarmid
Detroit Free Press
321 W. Lafayette
Detroit, Mi. 48226

Dear Hugh:

I would like to thank you for sending me the newspaper clippings on father, Dr. William F. Koch. You may wonder why I am looking into the past for old history on Dr. Koch. Over the years I have collected various forms of information on his life and research. A few months ago I came across an article from the September 7, 1919, Sunday Edition of The Detroit News, on the announcement of my father's research in the cause and treatment of cancer. In the July 1919 issue of the Detroit Medical Journal, Vol. XX, No. 7, Pages 244-248, Dr. Koch published the results of his early research on the treatment of cancer. This research was accomplished through the cooperation of Dr. Carsten, Dr. Judd, Dr. Paterson, Dr. Irvine, Dr. Palmerlee, Dr. Palmer, Dr. Blain, Dr. Watkins, Dr. Hewitt, Dr. Friedlander, Dr. Hackett, Dr. John Burleson, Dr. Ash, Dr. Van Baalen and Dr. Hurst. Dr. Koch had received his B.A. in 1909, M.A. in 1910, and Ph.D. in 1916 from the University of Michigan where he also studied medicine. While in graduate school at the U. of M., Dr. Koch was an instructor in histology. In 1914, he was appointed Professor of Physiology at the Detroit College of Medicine. He completed his medical training there and received his M.D. degree in 1918 while at the same time he was Professor of Physiology and chairman of that department. I was hoping that the Detroit Free Press might have a copy of a similar article on this announcement in its files.

In this September 7th article, Dr. Alexander W. Blain said:

"Dr. Koch is one of the most brilliant physiological chemists in the country....what he has done is this: 'He has made people well who were so far gone with cancer that they had only a few weeks to live. Several patients he treated for me are working hard and enjoying life a year after they should have been dead...I believe—even if he has not discovered an absolute cure for cancer, he has added years to the lives of cancer victims....What he has already done is a boon to human and a great step forward in physiological chemistry'."

Dr. Walter L. Hackett said: "There is no question of Dr. Koch's sincerity and ability....I have enough confidence in his treatment to let him inject his serum into any cancer patient of mine. I had, as a patient, an old woman who was very far gone. At Koch's suggestion, I operated on her and took out such cancerous growths as were apparent. Later, the cancer grew again. Dr. Koch gave her four injections and she is now apparently entirely well. I

have seen some excellent work done with radium, but never anything so remarkable as this. Dr. Koch should be given every opportunity to prove the value of his treatment."

Dr. C. Hollister Judd, president of the medical board, Women's Hospital said: "When we stop to consider that one woman in every seven and one man in every 12 have cancer, the importance of the work Dr. Koch is doing can not be overrated, though it is too early to say that he has a cure for cancer. He has been working under many handicaps. The cases given him have been the 'hopeless' ones, where the surgeons saw the uselessness or impossibility of further operation, and his treatment has shown remarkable results." (Emphasis added)

It should be noted that during the first FDA Trial, on January 29, 1943, Dr. Francis Carter Wood, a government witness and cancer expert stated: "About 95 per cent of all well established cancers prove fatal." It was this same Dr. Wood, when he had learned that Dr. Koch was Europe teaching his research, sent a telegram to Dr. Joseph Maisin, head of a Louvain, Belgium, cancer institute, asking him not to see Dr. Koch. Dr. Wood said: I was trying to protect Maisin." Dr. Wood had attempted to intervene with Professor Joseph Maisin, asking him, to ignore the Koch research during an international conference at the university in 1936. Professor Maisin ignored Dr. Wood's advice. By the time Dr. Wood had learned about Dr. Koch's presents at Louvain University, successful research had already been conducted jointly by Dr. Koch and Professor Maisin. Thus, Dr. Wood was unable to stop this work. In 1935, Dr. Koch and Professor Maisin published the results of their earlier research in C. R. de la Soc. De Biol., Vol. 120, p. 106. In the 1930's, Dr. Koch had gone to Belgium to demonstrate his research at Louvain University. Professor Maisin and his associated continued to carry on research with Dr. Koch's work up to the time of World War II when the Germans occupied Belgium. The results from their research has been published in European scientific journals.

Prior to the publication of the above research paper in the Detroit Medical Journal, Dr. Koch had published four papers: 1) On The Occurrence Of Methyl Guanidine In The Urine Of Parathyroidectomized Animals, Journal Of Biological Chemistry, Vol. XII, No. 3 (1912); 2) Toxic Bases In The Urine Of Parathyroidectomized Dogs, Journal Of Biological Chemistry, Vol. XV, No. 1, July, 1913; 3) The Physiology Of The Parathyroid Glands, The Journal Of Laboratory And Clinical Medicine, Vol. I, No. 5, Aug. 14, 1916; [A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the University of Michigan]; and 4) Tetany And The Parathyroid Glands, Medicine and Surgery, Jan. 1918. It was his second publication that alerted the interest of the editor of the Journal of the American Medical Association that Dr. Koch had come upon a new approach to the understanding of disease and its treatment.

Subsequently to September 1919, Dr. Koch was invited to Chicago to meet some important A.M.A. doctors who were interested in his research. These doctors offered to set him up with a research laboratory if he would turn his research and discoveries over to them to control. Dr. Koch told these doctors that he did not want anything to do with them. He was then advised that if he did not agree, that they would destroyed him and his research. On February 12, 1921 the first national attack came from the Journal of the American Medical Association under the title: *The Propaganda for Reform --THE*

WILLIAM F. KOCH CANCER REMEDY. The next attack came on February 21, 1921, one week later. Over 28 attacks were conducted by the J.A.M.A. against Dr. Koch, and any doctor who supported his work, during the following 30 plus years using their same old smear theme and with variations. The A.M.A. through its State and local associations caused these doctors to lose their memberships in their medical groups, if the individual doctor did not give up using Dr. Koch's treatments. This resulted in denying these doctor's their hospital privileges in A.M.A. approved hospitals.. In some cases, the doctor had had these privileges for over 30 years. This was the same A.M.A. that, for all practical purposes, put "Homeopathic Medicine" out of business in the United States and unfairly attacked "Osteopathy." Because of their own unlawful activities, in 1937 and 1938, the A.M.A. was convicted of violation of the Sherman anti-Trust Law. On January 18, 1943, the United States Supreme Court upheld this conviction against the A.M.A., and its District of Columbia chapter, who had been found guilty of conspiracy to restrain trade in their fight against a local co-operative health association.

In the April 18, 1942 issue of the J.A.M.A., p. 1373, this journal reported: "KOCH'S CANCER TREATMENT MEETS THE LAW" "The Journal has repeatedly called attention to the promotion of products by the Koch Laboratories. Again and again it has urged federal agencies to display an interest in the matter." It should be noted that this was the first criminal action that was brought by the F.D.A. under the new 1938 Federal Food and Drug Act. So we can give the A.M.A. and its Journal credit for this governments action. It was members of the same A.M.A. that try to prevent Dr. Koch from doing research in Europe in the 1930s as they had blocked his research in this country after 1919. The court trials that followed were anything but fair. During the first trial in 1943, while we were involved in World War II, a government rebuttal witness, Edward L. Homes, U.S. Food & Drug inspector, testified: "Dr. Koch told me that Prof. Josef Maisin of Louvain University, Louvain, Belgium, had used his products and studied his methods. He told me, too, that one of Maisin's pupils, a German doctor, had cured Adolf Hitler of cancer of the throat with treatment according to his theory." Federal Judge O'Brien struck the testimony from the record and commented: "I hope the Hitler treatment was not effective, if the story is true." The question is: "Why did the U. S. Government have its rebuttal witness mention Hitler name during this trial?" and "What did bring Hitler's name in to this trial have do with proving the government's case against the defendants?" This was an "unorthodox" and "prejudicial dirty trick" by the government attorney to make Dr. Koch look bad and evil and to make the Government look pure and righteous. The government failed to mention that Dr. Koch explained the chemistry of his products and gave Mr. Holmes, at this inspection, samples of the mother liquids that was used to make Dr. Koch's treatments. Another interesting question is: "Why did the Government substitute malonic acid for Koch's Malonide and substitute glyoxylic acid for Koch's Glyoxylide when they knew: 1) that Malonide is a polymer of carbon sub-oxide ($O=C=C=C=O$) and not malonic acid; and 2) that Glyoxylide is a polymer of ($O=C=C=O$) and not glyoxylic acid? The government claimed it was testing Koch products when they knew this was not true. How can they expect to get curative results when you are not using Dr. Koch's material? Or, did the F.D.A.'s agents want their tests to fail and then blame Dr. Koch for their own failures? If one can not trust the government to properly make and test Glyoxylide and Malonide; than one can not trust the governments alleged production and testing of samples of benzoquinone?

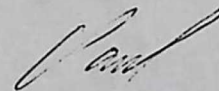
May 2, 1998

The government agents could have check with the U. S. Patent Office and got copies of two of Dr. Koch's patent applications; # 202,469 dated April 16, 1938 (Patented October 7, 1941) and #352,410 dated August 1, 1940 (Patented August 14, 1945) if they really wanted to reproduce his products.

I personally believe that the F.D.A. agents and employees, and it's A.M.A. allies, of the 1930s and 1940s committed a fraud upon the American public at the time the government wrongly prosecuted Dr. Koch in the 1940s. An example, that came to light in 1960, of the conflict of interest that has occurred within the Food & Drug Administration is illustrated by Henry Welch, Ph.D.. He accepted pay for editing two-privately owned journals that were financially dependent on the drug market at the same time that he was employed by the F.D.A. as chief of the antibiotics division of the F.D.A. (see "DRUGMAKERS AND THE GOVT.—WHO MAKES THE DECISIONS?", Saturday Review, July 2, 1960, pp. 37-42) It was this same Dr. Welch who testified as an expert against Dr. Koch in 1943 and 1946. Who was paying him and why? And what about the other government witnesses? I believe that there should be a complete independent investigation of this matter.

I guess I have, I have rambled on too much. Any way you can see where I am coming from. I am seeking the truth and the supporting voluntary statements of local doctors in this matter from the early newspapers; just before the influence of the Chicago A.M.A. doctors and medical politics came into the picture. If you should want any additional supporting information referred to, in his letter, please let me know.

Sincerely yours,



Paul M. Koch

PMK/I

Enclosures:

- 1) The Detroit News. Sunday, September 7, 1919 article on Dr. Wm. F. Koch;
- 2) "A New And Successful Treatment And Diagnosis Of Cancer" by Dr. Wm. F. Koch, from the Detroit Medical Journal, July 1919;
- 3) Dr. Koch's research papers dated July, 2, 1912, July 1913, January 1918 and a copy of the A.M.A. Editorial "Chemical Consequences Of The Removal Of The Parathyroid Glands, 1913;
- 4) 3 articles on A.M.A. convictions;
- 5) 2 articles referring to Hitler dated May 1, 1943;
- 6) Saturday Review article, July 2, 1960: "Drugmakers And The Govt.—Who Makes The Decisions?".

Times 1-27-43

Cancer Expert Rates Dr. Koch Drugs Useless

Angular, 73-year-old Dr. Francis Carter Wood, rated among the world's top cancer authorities, added his testimony today to the government charges that remedies manufactured by the Brothers Koch were worthless.

To a federal court jury of nine women and five men, the venerable scientist told of experimenting with the Koch drugs and finding no response in his cancer patients.

"Isn't it true that Dr. William Koch asked you to send him 10 or 15 stomach cancer cases and allow him to treat them for a year?" demanded William Henry Gallagher, defense counsel.

'DEAD IN A YEAR'

"I don't believe even Doctor Koch would make such an absurd offer," replied Wood. "They'd all be dead in a year."

"You mean they'd be dead under your methods of treatment," snapped the lawyer.

Gallagher endeavored to force from the physician an admission of prejudice against Doctor Koch and his brother, Louis, who are jointly accused of violation of the federal drug act.

He questioned the witness regarding a cablegram sent Dr. Josef Malsin, head of a Louvain, Belgium, cancer institute, in which Malsin was asked not to see Koch.

"I was trying to protect Doctor Malsin," Doctor Wood declared.

"Then, your idea was that any professional man who listened to Koch would endanger his standing?"

DENIES BEING BIASED

"Yes," Doctor Wood answered. "And I was correct."

The famed pathologist, who now holds the title of president emeritus of the Crocker Institute of Cancer Research, denied, however, any bias against the defendants.

"They are a matter of indifference to me," he said.

Prefacing his cross-examination, Doctor Wood went into the types of cancer and possible cure.

"Every cancer case is different," he said. "The peculiarity of each tumor is one of our greatest problems."

Cancer Expert Denies Any Bias Against Kochs

Backs Other Witnesses
Who Called Brothers'
Drug Worthless

With the testimony of 73-year-old Dr. Francis Carter Wood, world renowned cancer savant, the government Saturday was drawing near the close of its case against the brothers Koch.

Doctor Wood echoed the statements of witnesses that the Koch preparations are worthless in the treatment of cancer. He based his contention on experiments on rats, he told the jury of nine women and five men in the court of Federal Judge Ernest A. O'Brien.

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ENCOURAGING PROGRESS

He expressed himself optimistic over eventual conquest of the disease.

"When I consider what progress has been made in my lifetime, we should be far from discouraged," he added.

In a general discussion of the malady, the scientist said skin cancer could almost always be cured; 35 per cent of breast cancer cured; 25 per cent of intestine cancer cured; while death resulted in all but a small percentage of brain, stomach and lung cancers.

"About 95 per cent of all well-established cancers prove fatal," he testified.

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Koch Cancer Medicine No Cure, Says Expert

BY RICHARDS PAULSON

Free Press Staff Writer

One of the world's outstanding authorities on cancer said Friday that ingredients of Dr. William F. Koch's cancer remedies lacked curative powers, highlighting the testimony at the trial of the former University of Michigan professor of chemistry.

The witness, Dr. Francis Carter Wood, seventy-three-year-old di-

rector of the cancer-research laboratory at St. Luke's Hospital, New York City, and former pathologist at Columbia University, said that there is no drug or preparation for the cure of the disease.

JUDGE ORDERS RECESS

The trial of Dr. Koch, charged with violation of the Food, Drug and Cosmetic Act, was recessed until Tuesday morning by Judge Ernest O'Brien in Federal Court.

Defense Attorneys William Henry Gallagher and Richard Steel directed their cross-examination of the eminent cancer authority along the lines of previous charges that the medical world had either ignored or endeavored to minimize the effectiveness of Koch's drugs.

Dr. Wood admitted that he had largely ignored Dr. Koch's theories relative to his sponsored remedies and confessed he had no personal knowledge as to the efficiency of the drugs in the treatment of humans.

"Your idea was," queried Gallagher, "that any doctor who trusted Dr. Koch endangered his standing in the medical profession?"

"Yes, and I was correct," Dr. Wood answered.

REFERS TO BELGIAN

Gallagher also made inferences that Dr. Wood had attempted to intervene with Prof. Josef Maislan, director of the cancer-research department of Louvain University, Belgium, to ignore the Koch products during an international conference at the university in 1936.

Q—Did you not send a cablegram to Prof. Maislan in an attempt to persuade the professor not to grant Dr. Koch any authority at a conference at Louvain University?

A—Yes. I was trying to save Dr. Maislan any embarrassment.

ASKED ABOUT TALK

Q—Do you recall an interview with a Detroit lawyer, intervening for Dr. Koch, asking you to send him from 10 to 15 cases of afflicted persons to Detroit for one year at his expense for treatment to determine the efficiency of his remedies, with you being permitted to examine the patients at the conclusion of that period?

A—I don't believe Dr. Koch would make such an absurd statement. They would be dead in a year.

"You mean under your accepted treatment," Gallagher charged.

"No, but in the natural course of events," replied the witness.

Free Press

1-30-43

Defense counsel indicated that efforts would be made to bring Prof. Maislan to Detroit to testify, but said that he last was heard of in Nazi-occupied Belgium. They also promised to take the unidentified Detroit lawyer before the court to substantiate the line of questioning regarding experimental cases.

Dr. Wood testified earlier Friday that his experiments with Government-furnished drugs as produced by Dr. Koch were unsuccessful on rats.

NO RESULTS, HE SAYS

"No effect was obtained by the injection of this substance," Dr. Wood stated, pointing out that the rats died in all cases.

In lengthy discourse about cancer, Dr. Wood emphasized that the only cures for the disease are radium and surgery. He admitted, however, that he had never employed Dr. Koch's drugs in his treatments, asserting that in view of the ineffectiveness with the preparations with rats no results could be expected with humans.

Earlier, Dr. Cornelius B. Rhoads, director of Memorial Cancer Hospital and professor of pathology at Cornell University, admitted under cross-examination that he had ignored treatment of patients with Dr. Koch's drugs.

TWO OTHERS HEARD

Medical representatives of the Food and Drug Administration, Drs. George Dobbs, of New York City, and Adolph Rostenberg, were heard at the conclusion of Dr. Wood's testimony. They said that no drug had been accepted by medical authorities for the cure of cancer.

Assistant United States District Attorney John Ray said that the Government expected to rest its case next Thursday morning after calling 10 additional witnesses, including more eminent authorities on chemistry and medicine.

condition. Cancer can be cured only through surgery or radiation. Death from cancer is inevitable when cancer patients fail to obtain proper medical treatment because of the lure of a painless cure "without the use of surgery, x-ray, or radium" as claimed by Hoxsey.

Anyone planning to try this treatment should get the facts about it.

For further information, write to:
U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Food and Drug Administration
Washington 25, D. C.

Public warning posters placed in 50,000 U.S. post offices and other public buildings saved thousands from being victimized by the Hoxsey treatment while litigation continued in the courts. Subsequently, in 1962, the law was changed to require the effectiveness of drugs to be determined before they are put on the market.

Official samples of the Koch cancer treatment were labeled as containing 1.32 parts of glyoxylic acid to one trillion parts of water, but analysis could find only water.

Glyoxylic Acid - 1.32 parts
Water - 1 trillion parts
(Equal to a solution of $O=C=O=O$
of dilution 10-12)

1/4/44

Revised

11-2-55

For
Filled and
Compounded by Dr. DONALD WATSON
In Drug Dispensary of HOXSEY CLINIC, 4507 Gaston, Dallas, Texas
Serial No. C-601
Date AUG 30 1952
Not Refillable
except by Dr. DONALD WATSON
at the above address.
Directions: One teaspoonful
meals three times
and at bedtime.
Dr. DONALD WATSON
KEEP COOL

Scientific Basis for the Treatment

1. Malignancy is a constitutional disease comprising several factors:

a. A facultative anaerobic germ, whose favorite habitat is the large intestine, and anaerobic recesses such as occluded tonsular crypts.

b. A toxin produced by this germ which, after absorption and circulation throughout the body for a period of time, injures the body chemistry so as to lower the vital resistance to the activity of this toxin and the germ that produces it. This situation is recognized as the specific factor alluded to by various observers, and enters into the hereditary predisposition.

c. An injured tissue in any part of the body, where the supply and utilization of oxygen are diminished, and a comparative anaerobic state results, permitting the germ and its toxin to carry on their chemistry and infect the injured tissue.

d. A protective effort on the part of the infected cells toward immunity which, instead of attaining adequacy, terminates in a state of symbiosis between the affected cells and the germ, resulting in a reproduction of cells of abnormal chemistry and structure, at a rate dependent upon the activity of the germ in the elaboration of its specific toxin.

II. Toxins are chemical substances of such molecular structure that they represent molecular counterparts to substances existing normally in, and essential to, the structure of the normal body cell. The toxin molecule and the cell structural element are different molecular phases of homologous molecular bodies.

III. Toxins behave as photochemic ferments, and inductively influence the molecular counterpart in the cell to a rearrangement of

its groupings, so that it assumes the toxin type of molecular arrangement. The normal cell chemistry is thus impaired—disease results.

IV. Antitoxins are altered toxins, the toxin phase of structure having been changed to the phase normal to the cell structural counterpart, by cell activity and at the expense of cell energy.

V. Antitoxins also behave as photochemic ferments, and induce change in phase in toxin molecules, causing them to take the phase of molecular arrangement, normal to the cell structural counterpart. Antitoxins, therefore, perpetuate the change started by the cell in the conversion of toxin to antitoxin.

VI. The Koch Synthetic Antitoxin is constructed to possess high inductive capacity, by virtue of which it converts the cancer toxin molecule to the phase of structure, normal to the body cell. It, therefore, successfully accomplishes (what the cancer cell unsuccessfully attempts to do) the conversion of the etiologic toxin to antitoxin, and produces immunity to the germ. The Synthetic Antitoxin has no action on the body and is harmless.

VII. With the destruction of the toxin, the stimulus to cancer cell growth is withdrawn, and the cancer tissue then represents a useless, excessive tissue, and is disposed of by autolytic processes. The cells undergo digestion into the same elements from which they were built up, and are returned to the blood to renourish the body.

VIII. Correct dietary restriction and colonic cleansing are, therefore, important measures in the care of the case under treatment, and will be dealt with in the studies offered in our Bulletins.

History of the Development of the Treatment

1911-1912. Studies on the function of the Parathyroid Glands: isolation of several guanidine poisons from the urines of parathyroidectomized animals in toxic quantities, and their identification as the cause of parathyroid tetany; concluding that the parathyroid glands form a protective mechanism against toxins containing a guanidine grouping.

1913-1918. Studies on the isolation, identification, and synthesis of the toxin that causes

cancer: on the chemical nature of antitoxins, and the synthesis of a cancer antitoxin.

1918-1923. Clinical observations and improvement in the antitoxin treatment.

1923-1926. Period of collaborative observation by physicians in the United States and Canada, demonstrating the practicability, absolute harmlessness, and curative value of the treatment.

February, 1926. Organization and Endowment of the Koch Cancer Foundation to carry on educational and extension work.

GOMBERG, gom'bürg, Moses (1866-1947), Russian-American chemist who isolated the first free radical, triphenylmethyl. Gomberg was born in Yelizavetgrad (now Kirovograd), Ukraine, on Feb. 8, 1866, and went to the United States with his family in 1884. He earned his Ph.D. in 1894 from the University of Michigan.

Gomberg succeeded in synthesizing the compound tetraphenylmethane, in which four benzene rings are bonded to a single carbon atom. In 1900 he attempted to synthesize hexaphenylethane, a compound in which six benzene rings would be bonded to two attached carbon atoms. The product obtained was the free radical triphenylmethyl, which was half the expected compound (three benzene rings attached to a single carbon atom). Gomberg continued his investigations of organic free radicals and produced numerous additional examples of triarylmethyl radicals; he contributed extensively to understanding the relation between the properties and structure of such radicals.

Gomberg was head of the department of chemistry at Michigan from 1927 to 1936. He died in Ann Arbor, Mich., on Feb. 12, 1947.

AARON J. IHDE, *University of Wisconsin*

Gomberg, Moses (b. Feb. 8, 1866, Elisavetgrad, Russia—d. Feb. 12, 1947, Ann Arbor, Mich., U.S.), Russian-born U.S. chemist who initiated the study of free radicals in chemistry when in 1900 he prepared the first authentic one, triphenylmethyl.

At age 18 Gomberg migrated with his family to the U.S. because his father's anti-tsarist activities made them unwelcome in Russia. He overcame poverty and language difficulties to earn his undergraduate degree (1890) and Ph.D. (1894) at the University of Michigan, Ann Arbor. Except for a year of study abroad, he was active in teaching and research at the university and was head of the chemistry department from 1927 to his retirement in 1936.

FREE RADICAL, a highly reactive group of atoms containing an unpaired electron. Free radicals usually consist of atoms of unlike nonmetallic elements. The existence of free radicals is generally highly transitory. Free radical intermediates are formed in a large number of organic reactions.

The unpaired electron structure is responsible for the color, reactivity, and paramagnetic character of free radicals. Because the unpaired electron is loosely bound, free radicals are usually associated with absorption bands in the visible spectrum. Free radicals can be detected and studied by measurement of magnetic susceptibility, magnetic resonance absorption, and electron-spin resonance.

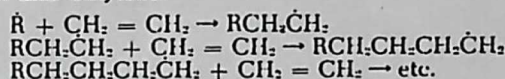
The first free radical to be synthesized was triphenylmethyl, which was prepared by the Russian-American chemist Moses Gomberg in 1900. Gomberg was attempting to synthesize hexaphenylethane, but instead, the product was half the desired compound. In 1929 the Austrian chemist Friedrich A. Paneth and W. Hofeditz showed that free radicals can be formed by the thermal decomposition, or pyrolysis, of molecules of metallic alkyls, such as lead tetramethyl, $Pb(CH_3)_4$. Because the absorption of radiant energy by a molecule leads to bond rupture, photolysis, like pyrolysis, also leads to the formation of free radicals.

Reactions of Free Radicals. In reactions involving free radicals, electrons become paired or unpaired, as in dimerization, addition, formation, and displacement reactions.

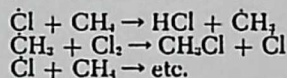
In dimerization reactions two free radicals form a covalent bond by pairing of the unpaired electrons. Thus, two methyl radicals can dimerize to form ethane, H_3C-CH_3 . Most free radicals tend to dimerize rather than remain in the odd-electron state.

The most important reactions involving free radical intermediates in organic chemistry are

addition, or polymerization, reactions, such as the formation of polyethylene from a free radical R and ethylene.



Free radical reactions often lead to chain reactions, which occur so rapidly that they produce explosions. A typical chain reaction occurs when a mixture of methane and chlorine, which is unreactive in the dark, is exposed to light. Absorption of radiant energy results in the formation of Cl radicals from chlorine molecules.



A typical reaction in which a free radical is formed is the production of the triphenylmethyl radical by the splitting of the covalent bond between the central carbon atoms in hexaphenylethane, $(C_6H_5)_2C-C(C_6H_5)_2$.

In free radical displacement reactions, the radical removes an atom from a molecule, thus forming a new free radical in the process. An example of this process is the reaction of the methyl radical with carbon tetrachloride to form methyl chloride, CH_3Cl and the free radical CCl_3 .

HERBERT LIEBESKIND, *The Cooper Union*