Cesium Therapy Overview- by Staff of Brewer Science Library

Revised 1/3/2019

The theoretical protocol presented in "High pH Cancer Therapy With Cesium," by A. Keith Brewer, Ph.D., is his last protocol. He wrote this protocol after years of animal research with cesium and rubidium compounds and after receiving reports on the clinical use of cesium chloride by Hans A. Nieper, MD and H. E. Sartori, MD and others. Dr. Brewer died in 1986. In recent years, additions and omissions have been made to Dr. Brewer's protocol by several parties. These protocols need to be evaluated by considering the research or clinical experience which supports them, if any.

When Dr. Brewer had his high pH theory of cancer tested out in an animal model in the late 1970's, the cesium sources used were cesium chloride and cesium carbonate. In the animal research model, the application of cesium carbonate gave superior results, possibly because it is more alkaline.

In Dr. Brewer's original protocol, he wrote that under a physician's supervision, a patient who is taking 3 to 6 grams of cesium chloride might require as much as 2 to 4 grams of potassium chloride to maintain correct blood levels of potassium. Either excessively high or low potassium levels are dangerous and for this reason most physicians monitoring patients on cesium programs are utilizing weekly blood testing to monitor potassium levels. (See "Special Monitoring" on page 3.)

PLEASE NOTE: The amounts of cesium chloride and potassium chloride given by Dr. Brewer in the above mentioned protocol are applicable only for the potency and absorption characteristics of the two compounds specified. There are two important considerations: Different compounds furnish different amounts of potassium. Some compounds are more efficiently absorbed by the body than others.

Dr. Brewer stated in the booklet, "High pH Cancer Therapy With Cesium": "Small doses of Cesium Chloride such as 0.5 grams per day should not be given. These small doses will be sufficient to raise the pH of the cancer cells only into the high mitosis range, and hence may speed up the rate of cancer growth. It is essential that sufficient CsCl must be given to raise the pH into the 7.8 and above range."

CESIUM NOW AVAILABLE IN A LIQUID IONIC FORM:

Recently, new liquid ionic forms of cesium and potassium have become available. The businesses marketing these products must understand the absorption and utilization characteristics of their cesium and potassium products and inform customers about amounts they should take of each mineral product to maintain the body's potassium at an optimum level.

People who choose to use this liquid form of cesium may also find it beneficial to use the potassium in the liquid form, to replace the potassium that is displaced by cesium consumption.

We have received one report of an individual who was taking the liquid (ionic) cesium who tried using a potassium tablet to offset the potassium displacement caused by the cesium. He was only able to stabilize his potassium levels by using the liquid (ionic) potassium with the liquid (ionic) cesium. Some physicians have reported that to overcome the potassium displacement caused by the liquid (ionic) cesium, it is probably best not to mix the liquid (ionized) products with the powdered or tablet forms of potassium due to the variations in absorption and utilization.

High pH Cancer Therapy with Cesium

by A. Keith Brewer, Ph.D.

Published by the A. Keith Brewer International Science Library

Cesium Related Information

Revised 1/3/2019

Information about cesium written by A. Keith Brewer, Ph.D., contained in the booklet *High pH Cancer Therapy With Cesium,* is available **on this website.**

The protocol that Dr. Brewer suggested in his writings included several other vitamins and minerals, which he believed increased the effectiveness of the cesium. Included are significant amounts of vitamin C, vitamin A, zinc, selenium and potassium.

SOME POSSIBLE CESIUM SIDE EFFECTS AND CONTRAINDICATIONS:

1. Stomach upset and nausea are quite common side effects from taking cesium. Eating a full meal, not just a snack, and taking the cesium at the end of the meal, may help to alleviate these problems. Emptying the cesium capsule into a glass of water and taking it this way at the end of the meal may also help alleviate these symptoms. Dr. Nieper mentioned that taking the cesium with the sugar sorbitol and mixing them in a water solution might help in some cases. Eating half a banana before a meal has also been reported to help some people tolerate the cesium chloride better. Ginger capsules or ginger root would possibly combat nausea.

One of the reasons that cesium chloride may cause stomach upset is actually from the increased amount of chloride, not necessarily the cesium. The chloride tends to increase the acidity in the stomach. People who have had a history of ulcers may not be able to handle the increased acidity from the chloride.

2. After taking cesium for several weeks some people experience some numbness in their lips or on the tip of their nose. This can occur even at the dosage of three grams a day. People who are taking larger amounts under a doctor's supervision may experience a greater degree of numbness. Doctors need to monitor this very carefully. Even after discontinuing the cesium it may take several weeks for this numb sensation to disappear.

3. People with heart conditions should not take cesium as it displaces potassium as well as other significant minerals such as magnesium and could lead to heart palpitations or a heart attack.

4. It is essential that the mineral displacement by cesium be adjusted for by increased consumption of minerals, particularly potassium and magnesium. *POTASSIUM* rich foods such as bananas and potatoes can be consumed as well as potassium supplements taken. Some doctors prescribe a high potency *TIME-RELEASE POTASSIUM* supplement for their patients on the cesium protocol. The mineral magnesium is needed in significant amounts. It is involved in over 300 enzymatic reactions in the body. Doctors often suggest that people take up to 800 mg of a magnesium supplement while on the cesium protocol. A brief review of some possible signs of *specific mineral deficiencies* is included.

5. People with kidney disease would not be able to handle the Robert Barefoot protocol that uses high amounts of vitamin D3 and calcium.

ROBERT BAREFOOT'S CESIUM PROTOCOL:

Along with the cesium and other vitamins and minerals that Dr. Brewer suggested, Robert Barefoot suggests that two other special nutrients be added to the protocol.

1. Vitamin D:

He has added high amounts of vitamin D3 to be taken for 30 to 50 days. The vitamin D3 is in 5000 IU capsules and he suggests 6 capsules a day, or 30,000 IU's per day for a month or so. Vitamin D3 has a special function in helping to cause cell differentiation, or the maturation of cells. Cancer cells tend to be immature cells that multiply and divide faster than normal. Vitamin D3 helps them to mature. High amounts of vitamin D3 are contraindicated in people with kidney disease because it causes too much calcium to be absorbed into the bloodstream. Even people

ORIGINS & SERVICES OF THE BREWER SCIENCE LIBRARY:

In 1974 Dr. A. Keith Brewer (1893 - 1986) established this unique library to provide resources and information on topics that were of personal interest to him, as well as being information that is often not readily available. The walk in library closed in 2019 and continues as an online library.

DR. A. KEITH BREWER:

Aubrey Keith Brewer, Ph.D., the founder of the Brewer International Science Library, had a life-long desire to understand the processes going on in the living cell. He was convinced that the tools and methods he used in the laboratory as a physicist could be applied to such phenomena as cancer, the aging process, and mutations. The development of his theory of the High pH Cancer Therapy with Cesium grew out of his understanding of the physics of the cell membrane. The articles contained in this packet are representative of the many articles he has written about the development and utilization of this theory. Dr. Brewer funded some animal research studies undertaken by Dr. Marilyn Tufte of the Department of Biology at the University of Wisconsin at Platteville, which demonstrated confirmation of his theory on the uptake of cesium by cancer cells.

without kidney disease need to have liver and kidney function tests taken to make sure that hypercalcemia does not occur and cause kidney damage.

2. Coral Calcium:

This is a highly absorbable, ionized form of calcium that comes from the coral reefs around Japan. The assimilation rate of this calcium is said to be 98%, whereas other forms of calcium may only be assimilated up to 60% or even less. Calcium is also very alkalizing and this probably helps the body to reach an alkaline pH with the cesium more quickly.

Another ultra-absorbable calcium is AdvaCal™, a calcium complex developed by the Japanese that contains calcium hydroxide, calcium oxide and some seaplant amino acids. Besides providing a highly absorbable form of calcium, this product has been shown to build natural bone density, not just prevent loss as with regular calcium supplements.

SPECIAL MONITORING:

1. Electrolyte Monitoring:

Since high oral intake of cesium tends to drive the electrolytes out of the cells by displacing them, it is prudent to obtain ongoing mineral analysis. Increased oral intake of minerals may maintain the body in a positive mineral status, but only objective testing can reveal that for sure. Nausea and/or diarrhea can also cause electrolyte loss. Electrolyte products available from your pharmacy or the Gatorade beverage may be somewhat helpful.

2. Intracellular Mineral Testing:

Blood tests of potassium and magnesium levels do not accurately reflect the intracellular levels of these important minerals. A unique test called the *ExaTest* is a non-invasive test that measures the levels of several minerals (potassium, magnesium, calcium, phosphorus, chloride and sodium) inside the cells, thus providing an accurate assessment of actual tissue stores of these minerals. The test results are obtained from a quick scraping of cells from under one's tongue, which are affixed to a slide that is sent to *IntraCellular Diagnostics, Inc.* for analysis. (www.exatest.com phone: **1-800-874-4804**

3. Blood Calcium Monitoring for Hypercalcemia:

The high amounts of vitamin D3 taken in Robert Barefoot's protocol can result in too much calcium being absorbed into the bloodstream. If this occurs, vitamin D3 supplementation needs to be discontinued immediately.

4. Liver and Kidney Functions:

It is prudent to monitor these functions during the protocol to assess the reaction of the body to the high dose D3, calcium and cesium intake.

5. Uric Acid Monitoring:

Dr. Brewer suggested that the levels of uric acid would become higher as the tumor was being broken down. Physicians may want to measure uric acid levels at the onset of the treatment and then test uric acid levels frequently if the patient is taking 6 or more grams of cesium. Tumor size and dosage of cesium are believed to have an influence on how soon and how much uric acid levels will increase. A state of wasting may also affect uric acid levels.

SPECIAL NOTES:

1. Cesium Half-life:

The half-life of natural (non-radioactive) cesium in the human body, based on radioisotope studies, is anywhere from 65 to 84 days, so even after cesium is discontinued, it is still assumed to be acting in the body for a considerable period of time.

2. Mineral Supplementation:

The oral intake of extra minerals needs to be continued even after the cesium is discontinued since it is still actively displacing minerals in the body for a considerable period of time.

High pH Cancer Therapy With Cesium

Articles by

A. Keith Brewer, Ph.D

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3. Cesium Chloride versus Cesium Carbonate:

Some of the initial animal research was carried out with both the chloride and carbonate forms of cesium. One of the experiments with mice indicated that cesium carbonate was superior in action to cesium chloride. In fact, in further experiments carried out at the University of Wisconsin, Platteville, only the cesium carbonate form was used. The carbonate form is more alkaline and that may be one of the reasons that it was more effective.

4. Vitamin A Source: The Vitamin A source should not be from fish oil.

5. Networking:

Doctors and patients are encouraged to network and report on their results in using a cesium protocol.

6. Be Vigilant:

Dr. Nieper said that once our bodies have allowed cancer to manifest itself we should never think we are free of it. We must always be vigilant and do whatever we can to support or strengthen our body's defense capabilities.

POSSIBLE MINERAL DEFICIENCY SYMPTOMS:

The following list is not by any means complete. It just identifies some of the more common and most known symptoms of deficiency of these minerals.

1. Potassium:
   - muscle fatigue
   - irregular heartbeat
   - apathy
   - muscle weakness and/or muscle cramps

2. Magnesium:
   - cardiac dysrhythmia
   - high blood pressure
   - muscle spasms
   - eye twitches

SPECIAL PRODUCT SOURCES:

Many supplements, including cesium chloride, vitamin D3, vitamin C, vitamin A, selenium, zinc, potassium and coral calcium are available from Ministry Minerals at 1-888-818-5580 (toll free in Canada, Mexico and USA), or (406)777-0413 (406)777-0414; Fax (406)777-0419

INFORMATION DISCLAIMER

The articles in this packet contain information on some innovative and promising research results obtained from animal studies with cesium chloride. Although this may be considered as compelling evidence to some individuals, it is premature to judge the data and findings as conclusive. These early research results provide the rationale for future basic research and clinical trials. The results obtained by a small study of 50 individuals in the 1980's, should be considered as preliminary and need to be verified and confirmed before any claims about the efficacy of cesium chloride usage can be made.

PROTOCOL DISCLAIMER

The publisher of these articles does not advocate or promote the use of this information except for informational and educational purposes, and makes them available to the public for this purpose. The information in this booklet is not intended to replace the advice and treatment of a qualified physician or health professional. Cancer is a life threatening disease and all matters regarding its treatment require qualified medical supervision. The A. Keith Brewer International Science Library, The A. Keith Brewer Foundation, or any employee or agent thereof assumes no responsibility or liability for the use of any of the information and procedures described in this booklet.

DEVELOPMENT OF THE HIGH pH CANCER THERAPY

by

A. Keith Brewer, Ph.D.

NORMAL CELL TURNS CANCEROUS:

A normal cell will turn into a cancer cell when the supply of oxygen is cut off but the supply of glucose is permitted to continue. In the absence of oxygen the cancer cell completely loses its pH control mechanism. The glucose undergoes fermentation and the pH of the cell drops from the normal value of 7.35 to 7 and then the 6.5 range. In the low pH range the acids attack the DNA, completely destroying its template action. Messenger RNA is then drastically changed, and the control mechanism for the cell is destroyed. The acid medium also induces chromosomal aberrations, thus adding to the loss of cell control. In addition to the above, in the acid medium the enzymes within the cell become very toxic, eventually bringing about the death of the cell as well as of the host. A tumor, therefore, consists of a layer of living cells with uncontrolled growth surrounding the central mass of dead cells.

RESEARCH BASIS FOR THE HIGH pH THERAPY:

The High pH Therapy has its basis in the fact that the strong alkali elements potassium, rubidium and especially cesium are readily taken up by cancer cells when they are in abundance in the adjacent fluids.

The High pH Therapy was arrived at by the author from a detailed series of physical experiments. This study consisted of a series of tests on the isotope effect through membranes of many types, namely synthetic, natural plant and animal membranes, embryonic membranes and cancer membranes of a wide variety of types. This work was followed by a series of tests on the fluorescence and phosphorescence decay patterns of a wide variety of cells.

The isotope results showed that in synthetic cells, embryonic cells and cancer cells, atoms of potassium, rubidium, and cesium are taken up and transported into the cell in proportion to the frequency with which they strike specific areas on the membrane surface. When tests were performed with all other cations in the Electromotive Series, it was found that they were also taken up and transported into the cell in proportion to the frequency with which they strike specific areas on the membrane surface, but this proved true only for embryonic and synthetic cells, not for cancer cells. In contrast, the cancer cell membrane does not attach and transmit cations below potassium in the Electromotive Series such as sodium, calcium and magnesium into the cell. Thus the calcium content of cancer cells is of the order of one percent of that in normal cells. It is the ions such as calcium, magnesium, and sodium that transport oxygen into healthy cells. It is this anaerobic condition, or lack of oxygen in the cell, as pointed out by Warburg as early as 1924, that causes the switch in the cell metabolism to a process of fermentation from glucose. This is the hallmark of the cancerous cell, the fermentation process of metabolism rather than the normal oxygenation process of healthy cells.

HIGH pH THERAPY

by

A. Keith Brewer, Ph.D.

PART I

I. THE HIGH pH CANCER THERAPY HAS ITS BASIS IN THE FOLLOWING:

(1) In cancer cells the pH control mechanism is completely lost.

(2) At a pH below 6.5 and above 7.6 cell mitosis ceases.

(3) At a pH below 6 and above 8 the life of the cell is short.

(4) At a pH above 7.5 cancer cells become palliative, since the acid toxins formed in the cancer cells are neutralized and thus rendered nontoxic.

(5) Cesium, Rubidium and Potassium salts of nontoxic acids are readily taken up by cancer cells in proportion to the frequency with which the atoms strike the membrane surface.

(6) The toxic dose for CsCl is 135 gms; RbCl is 125 gms; KCL is 150 gms. The presence of Vitamins C and A reduce dosage.

(7) Dead alkaline cells are readily absorbed by the system and eliminated in the urine.

II. THE HIGH pH THERAPY: DAILY DOSAGES ADMINISTERED IN DIVIDED DOSES 3 TO 4 TIMES PER DAY:

(1) CsCl	3 to 6 grams (see notes 1,2,3)
(2) KCl	2 to 4 grams
(3) Vitamin C	5,000 to 10,000 milligrams
(4) Vitamin A	50,000 units
(5) Zn gluconate	100 to 200 milligrams
(6) Selenium (organic)	100 to 200 micrograms
(7) Amygdalin	physician directed amounts

NOTE ONE:

Dr. Hellfried E. Sartori of the "Life Science Universal Clinic" used 6 grams per day of CsCl, administered in 3 doses of 2 grams each and taken immediately after eating. He uses this along with a full array of nutritional support substances. He has reported his research results with 50 patients in a published article.

NOTE TWO:

Dr. Hans Nieper has administered 6 grams per day and sometimes more, but only under direct supervision. They are given in 3 to 4 divided doses after eating. He gives the CsCl salt in a sorbitol solution to prevent any nausea. He also uses various forms of amygdalin and other nutritional support substances such as Vitamins C and A.

NOTE THREE:

Small doses of CsCl such as 0.5 grams per day should not be given. These small dosages will be sufficient to raise the pH of the cancer cells only into the high mitosis range, and hence may speed up the rate of cancer growth. It is essential that sufficient CsCl must be given to raise the pH into the 7.8 and above range.

NOTE FOUR:

The KCl and Vitamin E are given to help the normal cells which have been poisoned by the acid toxins that leak out of the cancer cells.

NOTE FIVE:

Direct injection of salts into the tumor mass itself is not recommended. When the mass is punctured the cancer cell toxins may leak out and poison the system. This was observed in mice.

III. MECHANISM OF ACTION AND FUNCTION OF THE VARIOUS INGREDIENTS

(1) CsCl. Cesium and rubidium, along with potassium are powerful alkali electron acceptors. They enter the cancer cells in proportion to the frequency with which they strike the membrane surface. All three elements are effective in raising the cancer cell pH.

(2) Vitamin C. Vitamin C has been shown to drastically increase the Cs, and Rb uptake by cells due to the fact that it is readily absorbed by the cells, and being a weak acid it enhances the negative gradient across the cell membranes.

(3) Vitamin A. Vitamin A behaves the same as vitamin C.

(4) Zinc salts liberate ZnO within the cell which is adsorbed on the cell membrane. ZnO is a moderately strong electron donor, hence it materially enhances the pickup of Cs, Rb, and K ions.

(5) Selenium behaves the same as zinc.

(6) Amygdalin. Amygdalin breaks down in the cancer cells to liberate HCN. The C=N radical is adsorbed on the cancer cell membrane. It acts as a very broad and moderately strong electron donor, which drastically increases the surface capacity to pick up Cs, Rb, and K ions.

(7) Vitamin E. Vitamin E is a strong reducing agent and thus tends to remove attached molecules and atoms from the cell membrane.

IV. ADMINISTRATION:

Cancer patients are prone to nausea. This effect in some cases is enhanced by the administration of Cs, Rb, and K salts. This nausea effect can be reduced and usually eliminated by administration in moderate doses along with food, or preferably soon after taking food. It is therefore advisable to divide the daily dose of 6 to 7 grams of CsCl into 3 parts and administer it throughout the day after food intake. The preferred dose for CsCl is 2 grams taken after eating 3 times per day.

V. COMMENTS: MECHANISM OF CARCINOGENESIS

STEP 1

Carcinogenic type molecules become attached to the P=O radicals which characterize all membrane surfaces. In the energized state these radicals become reactive: Their reactivity depends on two factors: (1) their energy state, and (2) the electron acceptor capacity of the adjacent molecules. In the energized state the P=O radicals become very powerful electron donors. In the presence of attached molecules to the membrane surface the P=O radicals can no longer be raised to high energy quantized states.

STEP 2

In the ground state the P=O radicals can attract Cs, Rb, and K ions and draw them into the potential gradient across the membrane. Cs+ transports 3 molecules of associated water, Rb+ does 5 molecules and K+ 7 molecules of water as well as glucose. Cations below K in the Electromotive Series cannot enter cancer cells. As a result oxygen which is transported by these heavier and more highly associated cations cannot enter cancer cells. In the absence of oxygen the glucose instead of being burned to carbon dioxide and water, undergoes fermentation to lactic acid. The cancer cells then lose their pH control mechanism and go acidic.

STEP 3

In the acid medium of the cancer cells, the positive and negative radical sequence of DNA is completely altered. Amino acids are also changed. As a consequence messenger RNA is changed and the cell loses its control mechanisms.

STEP 4

In the acidic medium the normal cell enzymes such as lysosomal enzymes are changed into powerful toxins, as pointed out by M. Von Ardenne of Dresden, Germany, and also as observed in the mouse experiments. These toxins leak out of the system and poison the host. They can also serve as carcinogens.

COMMENTS:

In the 40 plus human patients treated with cesium therapy (in the 1980's) it was observed that all pains associated with the cancer disappeared within 12 to 24 hours. In a few cases where the patient had been on chemotherapy and was taking heavy doses of morphine as much as 36 hours was required for morphine withdrawal. In every case the cesium corrected the pain problem associated with all the cancers tested. The same also was observed in the mouse tests.

HIGH pH CANCER THERAPY PART II

THERAPY BASIS:

Cancer cells lose their acid-base, pH control mechanism. Cancer cells have a low pH ranging from 7.0 to 6.5 as compared to 7.35 for normal cells. This means that they are moderately to quite acidic as compared to healthy cells.

Due to the acid state the normal enzymes formed within the cell become quite acidic and hence become toxic. Lysosomal enzymes, for example become extremely toxic.

A mass spectrographic analysis of cancer cells showed that the cell membrane readily attached cesium, rubidium and potassium, and transmitted these elements with their associated molecules into the cancer cell. In contrast cancer membranes did not transmit sodium, magnesium, and calcium into the cell: the amount of calcium within a cancer cell is only about 1% of that for normal cells. Potassium transports glucose into the cell. Calcium and magnesium transport oxygen into the cell. As a consequence of the above, oxygen cannot enter cancer cells so the glucose which is normally burned to carbon dioxide and water undergoes fermentation to form lactic acid within the cell. This anaerobic condition was pointed out by Warburg, as early as 1924.

Potassium, and especially rubidium and cesium are the most basic of the elements. When they are taken up by the cancer cells they will thus raise the pH of the cells. Since they are very strong bases as compared to the weak lactic acid it is possible that the pH will be raised to values in the 8.5 to 9 range. In this range the life of the cancer cell is short, being a matter of days at the most. The dead cancer cells are then absorbed by the body fluids and eventually eliminated from the system.

Potassium, rubidium, and cesium salts are very similar in their action to sodium. Their chlorides have about the same toxicity. The toxic dose of cesium chloride, for example, is 135 grams. Too much cesium, however, may have an over stimulating effect, since it enhances action potential of the nerves.

Cesium, rubidium, and potassium salts can be administered orally or injected into the blood stream. They may also be injected directly into the tumor mass, but this possibility requires more research. Tests today on mice and humans have all been confined to an oral intake.

A POTENTIAL CANCER THERAPY:

The objective of this therapy is to increase the cesium, rubidium, or potassium content of the body fluids and hence induce the tumor cells to become alkaline. The dosages given below are for the first week of treatment. After that they may be increased in amount to twice the given values:

Therapy Doses (to be supervised by a physician)
- 2 grams of cesium chloride 3 times per day in water *
- 1 gram of Ascorbic acid, Vitamin C, 5 times per day
- 100 mg. chelated zinc
- Amygdalin as recommended

*See Part I for amount of potassium chloride to include (page 2)

The cesium salt is the curative agent. The Vitamin C enhances the cell's ability to take up alkalis. The selenium and amygdalin enhance the ability of the cancer cell membrane to attach and transmit cesium or rubidium into the cell.

EFFECTS OF THE CESIUM THERAPY:

The immediate effect of the cancer therapy is to lessen the pain and side effects of the tumor. This is a result of the cesium neutralising the effects of toxic enzymes which leak out of the cancer cells. The tumor cells eventually die and are absorbed by the body fluids and eliminated.

It is interesting to note that the areas of the earth where the incidences of cancer are very low all have foods which are high in rubidium and cesium.

Mouse tests showed that a daily rubidium intake drastically reduced the size, and apparently eliminated the side effects of cancer in mice. More recent data obtained at the University of Wisconsin-Platteville and the School of Medicine, Lubbock, Texas shows cesium to be even more effective than rubidium.

HIGH pH CANCER THERAPY PART III

I. BASIS:

The attachment of carcinogens to the cell membrane drastically alters what can and cannot enter the cell. This change causes cancer type cells to completely lose their pH control mechanism.

The cations K+, Rb+ and Cs+ can very readily enter cancer cells. Potassium ions transport glucose into the cells.

Cations below potassium in the Electromotive Series cannot enter cancer calls. It is these heavy cations that transport oxygen and amino acids into the cell. The amount of calcium in a cancer cell is only about 1% of that for normal cells.

The pH in cancer cells drops from the normal value of 7.35 to the 7 or 6 range due to the fermentation of the glucose within the cell in the absence of oxygen. In this acid medium the fluid within cancer cells becomes very toxic, eventually killing the host.

Potassium, rubidium, and cesium cations when present in the adjacent body fluids are readily taken up by cancer cells. Since these are very basic elements, their uptake causes the pH to rise to about 7.5 under normal conditions and to the 8 to 9 range when added to the fluids.

The effect of the High pH Therapy is that (1) the acid toxins are neutralized and thus rendered harmless and (2) at a pH above 8 the life of the cell itself is very short.

II. THE TOXICITY OF CESIUM, RUBIDIUM AND POTASSIUM SALTS

The above cations when associated with nontoxic anions are relatively nontoxic. Adverse effects are noted only in very large amounts.

The Lethal Dose for humans with CsCl is 135 grams
RbCl is 125 grams
KCl is 150 grams

The Lethal Dose for animals in general is: CsCl = 1.5 grams/Kg body weight
RbCl = 1.4 grams/Kg body weight

III. HIGH pH THERAPY (animal tests)

Feed animals 0.01 to 0.1 grams per kilogram of body weight. Use either CsCl or RbCl. Some potassium chloride may be administered along with the cesium should the animals appear to weaken.

The uptake of Cs, Rb, and K can be enhanced by the addition of Vitamins C and A to the diet. Zinc and selenium salts also enhance the uptake.

IV. ADMINISTRATION (test animals)

Tests on mice show an identical effect whether the salts are administered as a solution by forced swallowing, or when injected into the abdomen. Feed daily.

V. RESULTS ON MICE

The data on mice indicate a marked shrinkage in the size of the tumor within a week. Continued administration appears to result in the disappearance of the tumor. No data to date has been obtained on leukemia.

VI. PRECAUTIONS

Do not inject dilute solutions into the tumor proper as it will force the acid toxins out and poison the host. Only concentrated salts should be injected directly into the tumor.

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PHYSICS OF THE CELL MEMBRANE

A. Keith Brewer, Ph.D
Robert L. Neulieb, Ph.D.
Marilyn K. Neulieb, M.S.

A few years ago a student grumbled to one of the authors, "What does physics have to do with biology?" The student left enlightened upon realizing that physics, like biology, deals with the laws of nature by which any living organism is governed. The physics of the cell membrane governs all chemical and biological events. Its application to all body functions is now possible.

Membranes regulate the movement of substances into and out of all living cells. The transport of substances is controlled by a) the electrical properties of chemical bonds on the membrane, b) the electrical gradient across the membrane and c) the electrical attractions between positively charged (+) ions (cations) and polar molecules (those with + and − regions). A failure to understand the physics involved and to use experimental tools of physics has led to much confusion about membrane function.

Cell Membrane Structure

Biological membranes are composed of a lipid bilayer (2,3,6,17) separated by about 70 A. Proteins are incorporated in the membranes. Estimates range from 45-90% (12) lipids to 20-70% protein (13). The physics of the cell membrane is largely based on a chemical bond that is contained in these lipid molecules (2,3,6). The orientation of this bond is critical to membrane function. In most membranes, the lipid molecule includes a phosphate group in the 'head' and two fatty acid tails. These molecules are called phospholipids. See figure 1.

Within the membrane, the heads always point out and the tails point in. The phosphate head is located adjacent to the substances whose transport is being regulated. The arrangement of these atoms is critical for membrane function. The phosphorus (P) atom forms a double bond with oxygen (O), creating the P = O. The oxygen end of the P = O is negatively charged. This negative region must point toward the extracellular fluid on the outer layer and toward the intracellular fluid on the inner layer. It is this P = O that becomes a transport site for those substances on the outside and inside of the cell.

Electrical Properties of Double Bonds

Double and occasionally triple bonds have the pivotal role in enabling and regulating membrane transport. It is the electrical properties of these bonds that are the key to membrane action. When two atoms with significantly different ionization potentials (the strength of the attraction between an atom's nucleus and its electrons) are joined by a double or triple bond, the bonding electrons are located closer to the atom with the greater ionization potentials. Therefore, the structure, such as P = O, has both a negatively charged (−) and a positively charged (+) end, creating what is termed a dipole. The difference in the ionization potentials between P and O is greater than that for any other two atoms common in living tissues. Therefore, P = O forms a strong dipole.

The strength of this dipole can be increased by excitation (energizing) of a bonding electron. As a result, the size of the electron orbit increases. The energy necessary for excitation comes largely from glucose metabolism within the cell.

Even though the double bond spends most of its time in the ground state, its brief time in an excited state is of utmost importance in explaining living processes (4). See figure 2. Energized by the biological processes, an electron of the double bond, such as P = O, leaves the lowest vibration level of the ground state (S_0) for a vibration level of an excited state, such as S_1. Next, there is a radiationless relaxation to the lowest vibration level of S_1. The electron returns to ground state by one of three different routes, emitting electromagnetic radiation in the process. Fluorescence and slow fluorescence are characteristic of living processes while phosphorescence has been used as a laboratory tool. The energy emitted in the return to ground state is immediately absorbed by neighboring atoms.

A detailed investigation by the senior author demonstrated that energizing the double bond did not cause chemical reactions (10,11). Reactions did not occur until energies were high enough to cause ionizations. See table 1. The reactivity of various energy states was measured upon bond excitation. Bond excitation was produced by electron impact and also by the absorption of electromagnetic radiation. No reactivity was found in the metabolic range. With increasing energy levels, reactivity was first observed for ultraviolet radiation, but even then required multiple absorptions of light quanta.

Cation-polar Molecule Associations

Cations are crucial to transport of substances across membranes (3,6,7,8,10,11). Polar molecules associate with cations in a water-based fluid by means of an ion-to-dipole binding. An example is the attraction between the cation potassium (K^+) and the negative (−) region of the polar molecule (H_2O). The nature of cation-polar molecule binding is much different than the bonding of a covalent bond. The degree to which the cations associate with polar molecules is determined by their position in the Hofmeister displacement series (3,6).

$$Cs^+ > Rb^+ > K^+ > Ba^{2+} > Na^+ > Ca^{2+} > Li^+ > Mg^{2+}$$

Cesium and rubidium usually associate with a small number of water molecules. Potassium associates with a few water molecules or a glucose molecule. Calcium and magnesium can associate with a large number of waters, peroxides necessary for oxidation, and larger and more complex molecules, such as amino acids.

Membrane Transport

Transport of substances across the membrane depends upon a cation-polar molecule association being attracted into the electric gradient across the membrane. Double bonds, such as P^5O, are the transport sites. They accept cation-polar molecule associations and bring them into the gradient.

Transport differs markedly whether the double bonds are in the ground or an excited state. In the ground state, the strength of the dipole is only strong enough to accept Cs, Rb and K. Hence, polar molecule transport is largely limited to water and glucose. In excited state transport, all the cations are accepted. See figure 3. In the excited state transport, the

electric gradient is principally provided by excited double bonds on the inside membrane layer. When the bonds return to the ground state, this gradient collapses and many of the cations return to the extracellular fluid without entering the cell. In the process, they do help expel many of the waste products from the cell. Most of the polar molecules which were originally associated with these cations proceed into the cell. In the ground state, the gradient is determined by the number of anions (acid radicals) and cations within the outside the cell.

The senior author tested the degree of association of cations with polar molecules upon passing through membranes (3,6,7). Membranes tested included animal, plant, synthetic and liquid mercury films. For cation-water associations, the degree of association was specific to the cation but independent of the membrane. For example, in every case K^+ was always associated with seven water molecules upon passing through an animal, a plant and a synthetic membrane or a liquid mercury film at body temperature. Some large polar molecules were incompatible with some membranes and therefore the degree of the cation association with these molecules occasionally was dependent upon the membrane type.

These properties of double bonds and cation-polar molecule associations are capable of explaining many biological functions. Among them are the sodium-potassium pump, the cancer process (8-10), nature of carcinogens (7,14) and the role of zinc, selenium, cyanide, vitamin A and vitamin C in carcinogenesis (7,10,16). Other biological phenomena explained are fluorescence and phosphorescent decay from tissues (1,4), nerve action (5), and the properties of transport-promoting hormones, such as insulin (15). Experimental techniques typical of physics are essential for exploring membrane action.

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OUTSIDE
CELL

INSIDE
CELL

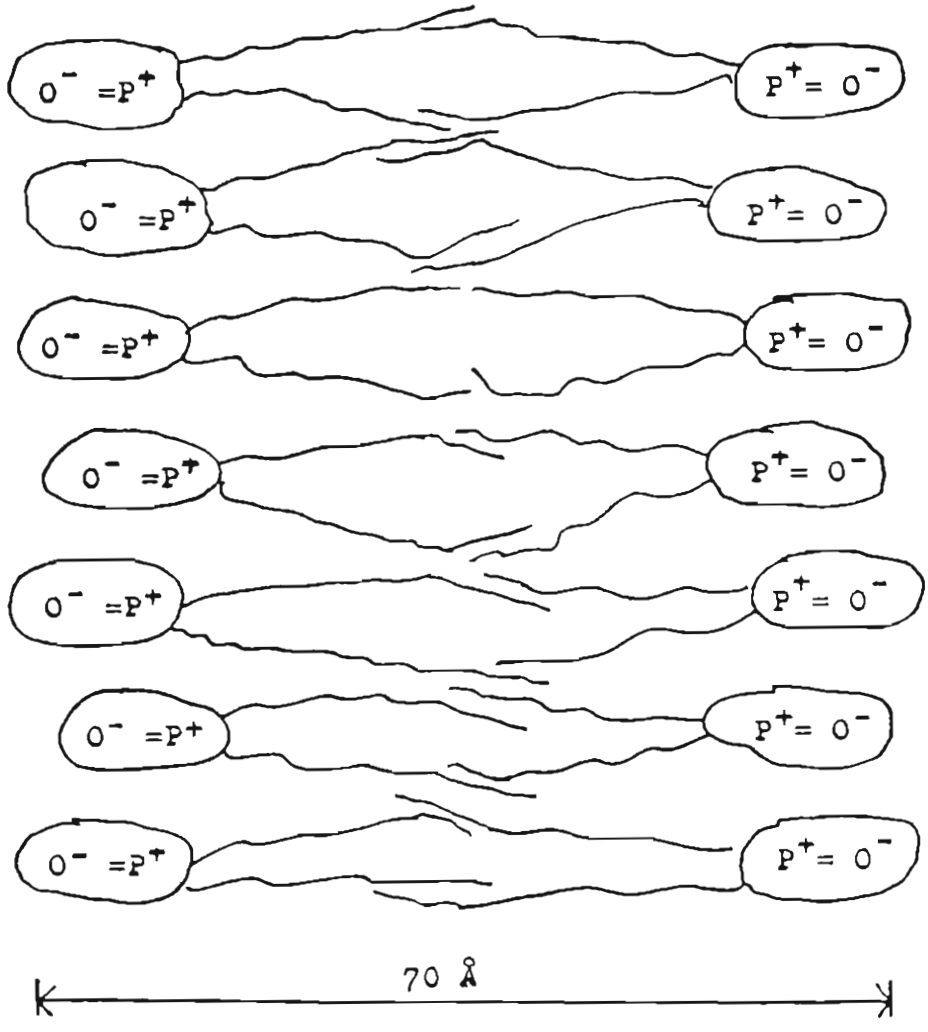

Figure 1. Phospholipids forming lipid bilayer of cell membrane.

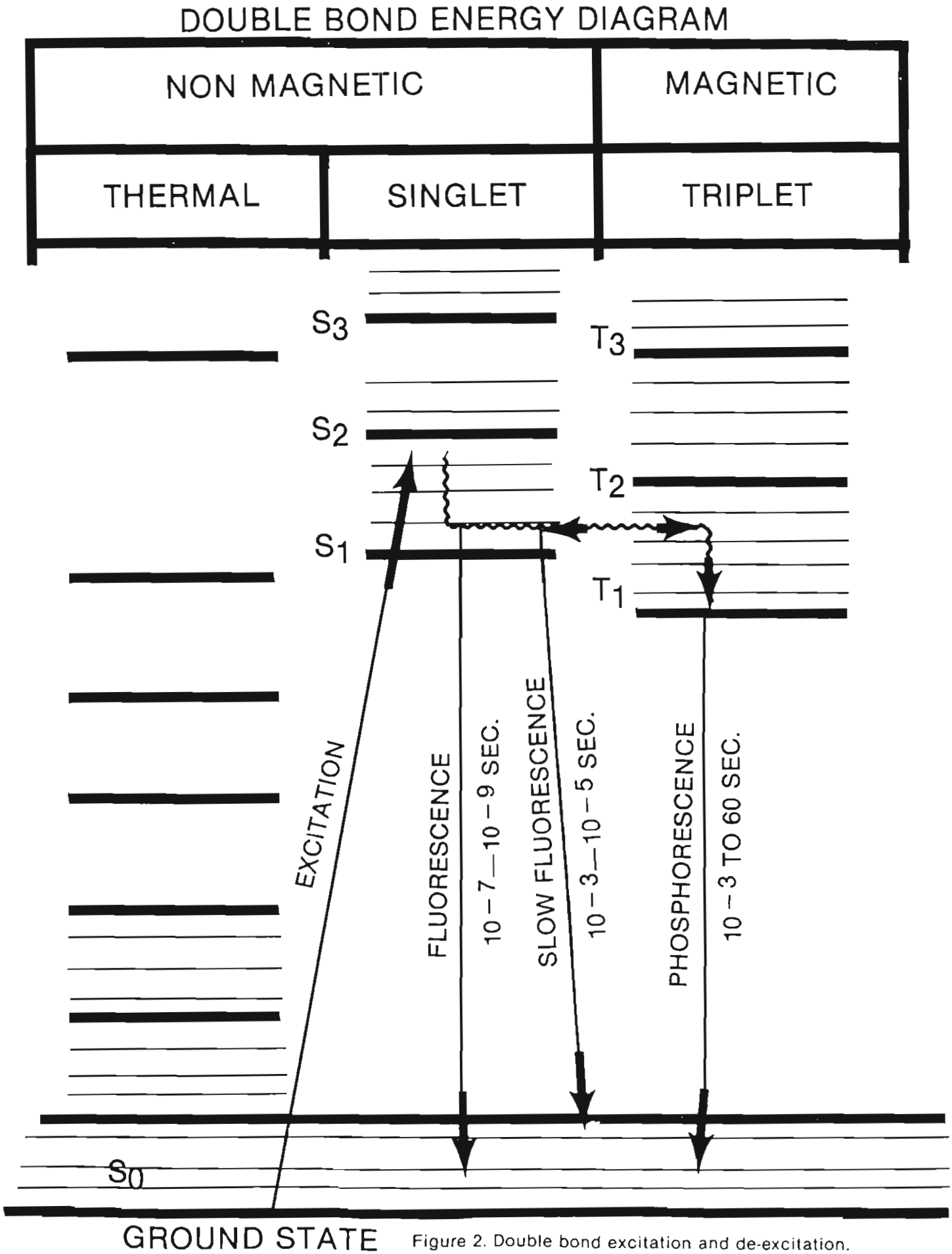

Figure 2. Double bond excitation and de-excitation.

Energy, e-volt	Wavelength, nm (10^{-9}m)	Electromagnetic radiation	Chemical reactivity
10^{-4}	10^{7}	rotation spectra	zero
10^{-3}	10^{6}		
10^{-2}	10^{5} range	infrared	zero
10^{-1}	10^{4}	solar	zero
1	10^{3}	ultraviolet	low
10	10^{2}		
10^{2}	10		
10^{3}	1	X-rays	high
10^{4}	0.1		100%
10^{5}	0.01	gamma	100%
10^{6}	0.001		

Table 1. Chemical reactivity vs. energy states.

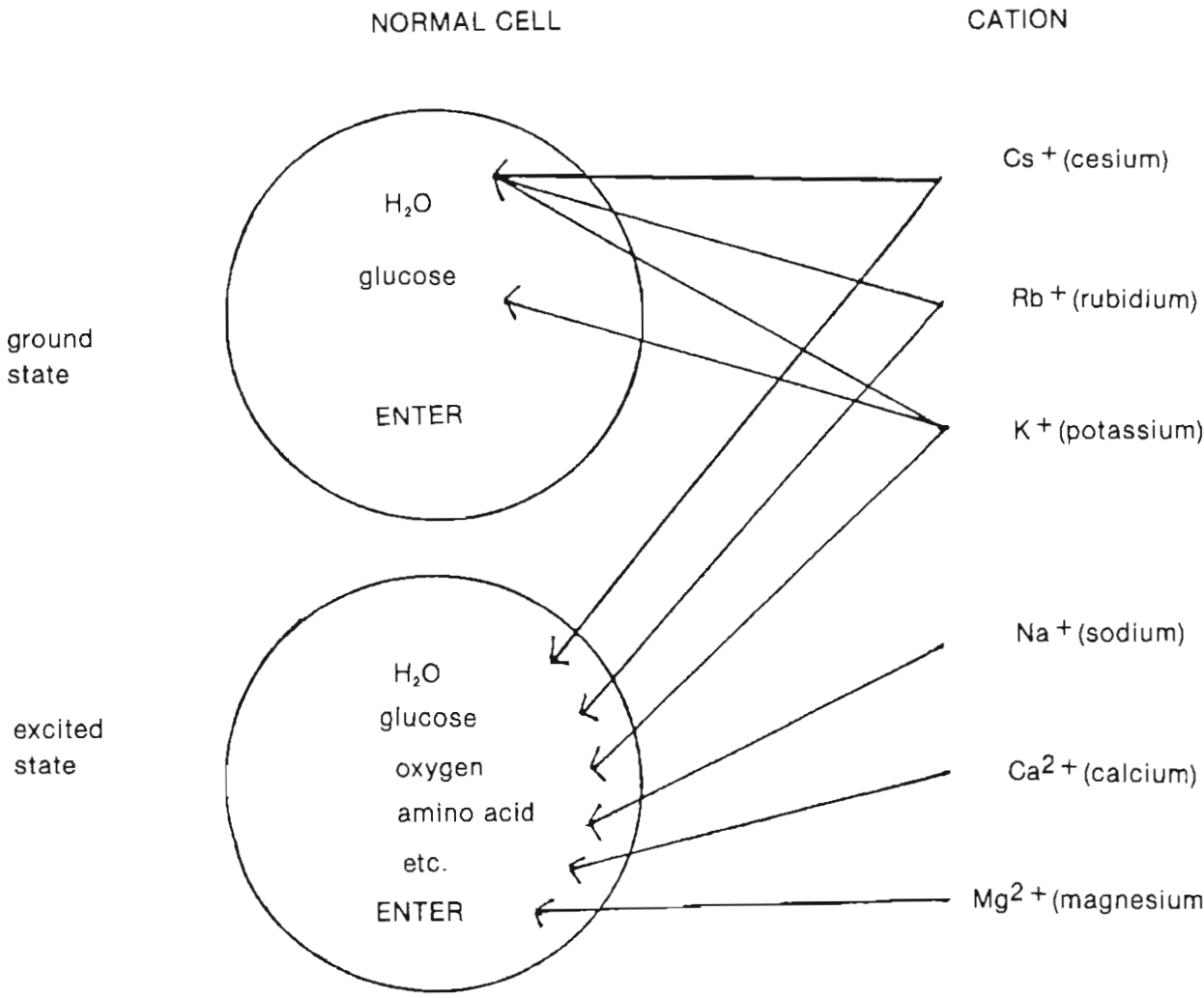

Figure 3. Transport of cation-polar molecule associations depend on whether P = O transport sites undergo ground or excited states.

THE ROLE OF CATION TRANSPORT ON THE INCIDENCE, DISTRIBUTION, AND TREATMENT OF CANCER

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ABSTRACT

The implications of membrane physics in the cancer process are investigated. It is found that high concentrations of Cs+, Rb+ and K+ should be effective in reducing the incidence of cancer. Certain substances which enhance the transport of these ions should also be helpful. It is found that experimental, historic, and geographic evidence strongly support this conclusion. The dominant feature of cancer prevention through nutrition involves the anti-cancinogenic properties of Cs+, Rb+ and K+. The role of carcinogens is secondary.

There are a number of areas in the world where the incidence of cancer is very low. The food intake of these areas has never been investigated to explain these geographic variations in the prevalence of cancer. In June 1978 at the Sixth Annual Marabou Symposium in Stockholm (1) the topic discussed was the relationship between food and cancer. It was concluded that "Food and nutrition have frequently and for many years been associated with cancer but our knowledge of the cause of cancer is incomplete."

The purpose of this paper is to explain the mechanism of carcinogenesis. Topics covered will include how certain foods contribute to cancer formation and how certain elements and compounds found in foods may reduce if not eliminate the incidence of cancer. The food intake in areas with low cancer rates will be outlined.

CARCINOGENESIS

Any cancer theory must be able to explain the experimental results of Warburg (2,3). The fundamental property of the cancer cell that distinguishes it from all normal cells is the anerobic nature of its glucose metabolism. Warburg found that a reduction of 35% in the oxygen partial pressure external to the cell for a period of 48 hours induces a permanent anerobic oxygen supply. Much research has linked the metabolic processes to the intracellular cation concentrations (4-7). In turn, a cell membrane model which explains all of these observations has been developed.

The constituents of cell membranes have been analyzed (8). It was found that proteins comprise 10-50% of the cell membrane. The remainder is comprised of lipids of which 90% are phospholipids. The membrane model presented here differs considerably from some popular ones involving capillary action, fluid membrane with segment rotation and ionopores. However, these are in conflict with the evidence (5,9).

The phospholipids of the membrane are oriented as a double layer separated by about 70 Z (6,10). Each phospholipid has a charged, polar, hydrophilic phosphate 'head' region with two non-polar, hydrophobic fatty acid 'tails.' The lipid bilayer of the membrane is a double surface of phosphate heads with their respective tails positioned inward. The orientation of the phosphorous and oxygen within the lays a major role in establishing both membrane strength and cation transport. On the outer surface, the P-O are oriented such that each oxygen points toward the intracellular fluid. The phosphorous on both the inner and outer layer are positioned toward the intramembranal space. There is probably a staggering of the phosphate heads to maximize structural strength. (6). A schematic is presented in figure 1. This orientation mechanically produces a strong structure as well as electrically enabling cation facilitated transport.

Transport through the phospholipid portions of the membrane is characterized by the electrostatic field which, in turn, is a function of the quantum state of the P=O radical (5,6). Of the double bonds common to living tissues, the difference in the attraction for the four bonding electrons is the greatest for the P=O. The oxygen attracts much more strongly these bonding electrons than does the phosphorous. Hence, the oxygen end of the bond is surrounded by a negative charge while the phosphorous end of the bond is surrounded by an equal positive charge. Upon excitation the displacement of the bonding electron orbitals is even more severe, creating even stronger electrostatic fields. In the ground state, the oxygen end of the P=O radical is a strong electron donor, while in the excited state it is a powerful electron donor.

It is these negative fields which enable and control the transport of cations and their associated masses. The cations must be attracted into the gradient which exists across cell membranes of living tissues in order to be transported across or into the membrane. In the ground state the field generated by the P=O is only strong enough to attract elements down to and including K+ in the Hofmeister displacement series. The series order is Cs^+-Rb^+-K^+-NH^{4+}-Ba^{2+}-Na^+-Ca^{2+}-Li^+-Mg^{2+}.

The masses which associate with the cations are critical to understanding the cancer process. The ionization potential of the cations is generally the inverse of the Hofmeister displacement series. See table 1. In other words, cesium is able to associate with only a few small molecules while magnesium is able to associate with much larger and more varied polar molecules. For instance, Cs^+ can associate with about 3 water molecules, K^+ with about 7 water molecules or a glucose molecule. Na^+ can associate with about 15 water molecules, glucose or heavier polar molecules usch as ATP. Ca^{2+}, Li^+, and Mg^{2+} associate with still more and heavier molecules.

Glucose transport can occur while the P=O is in the ground state because it need only depend on K+ for transport. However, oxygen transport (peroxides) requires that the P=O be in an excited state because its transport cations are less active than potassium. Studies of fluorescent spectra and phosphorescence decay patterns show that excitation of the double bond can be completely depressed by the adsorption of strong polar radicals such as morphine and polycyclic type molecules on the cell membrane surfaces (7,9,11). Miller has identified carcinogens as strong electrophilic reactants which are either induced or form on cell membranes (12-13). Many of these are polycyclic in nature. It would be expected that such reactants should interfere with the excitation of electron donor radicals. Food products, such as smoked fish and meats, charcoal grilled

meats, cooking oils and coffee exposure to polycyclic aromatic hydrocarbons (14). Also radiation can damage the double bond structure (7).

A cell in which the excitation of the membrane double bonds is impaired is deprived of oxygen and, hence, it is forced into anerobic metabolism of glucose. This fermentation process explains the fundamental properties of a cancerous cell as discovered by Warburg. That is, in cancer metabolism, glucose breaks down into lactic acid, not carbon dioxide and water. Without sufficient intracellular oxygen for oxidative metabolism, the cell loses its pH control mechanism.

THE CANCER PROCESS

The carcinogenetic process can be divided into four basic steps:

1. Carcinogenic molecules or radicals attach to the membrane surface. This prevents the P = O radicals on the membrane from entering an excited state. Consequently, $Ca^{2}+$ and other highly associated cations which transport oxygen into the cell can no longer enter. The cell thus enters an anerobic condition and completely loses its pH control mechanism.

2. Glucose which is transported into the cell by K+ ions can still enter. In the absence of sufficient oxygen within the cell, glucose undergoes fermentation to lactic acid. The pH of the cell then drops from 7.35 to 7.0 and even to the 6.5 range. This is the step first observed by Warburg and which has been studied in detail by M. von Ardenne (15).

3. In the acid medium, positive and negative sequence on the DNA is completely lost. Chromosomal aberrations can be expected to occur. The consequence of this DNA change is that the cell processes are changed. In the absence of its control mechanism, the cell undergoes unrestricted multipication. The normal shape and functions of the cell are lost.

4. In the acid medium, the normal cell enzymes are changed to acid toxins. The lysosomal enzymes become very toxic and eventually kill the cell. These acid toxins leak out from the dead cells and eventually poison the host. The toxins themselves are powerful carcinogens and can cause metastasis. In addition, the attachment between cancer cells is very weak. Cancerous cells may break off from the tumor and be carried to various sites where they can multiply.

CELLULAR pH

It has been previously noted that due to 1) lactic acid and other acids involved in the cancer process and 2) complete loss of pH control, the pH of cancerous cells generally falls substantially from normal levels of 7.35. M. von Ardenne of Dresden, East Germany investigated the tolerance of cancerous cells to pH levels either above or below normal levels (15). Both normal and malignant cells undergo mitosis between a pH of 7.5 and 6.5. He found that if the cancer cells with its lack of pH control could be forced from its present range of 6.5-7.0 into a pH range outside that for mitosis, the cancer cell would cease cellular division. He found that cells at pH levels either below 6.5 or above 7.5 enter a dormant state. At a pH of 7.8 and especially above 8 the life of the cell is very short. The same holds for a low pH of 6.5 and below. This limited tolerance of cells to altered pH levels and inability of cancerous cells to control their pH makes two therapeutic approaches possible. See figure 2. One, a low pH therapy developed largely by M. von Ardenne, has little nutritional aspects to its application and no preventative aspects. The other, a high pH therapy theorized by Brewer, explains many of the nutritional observations regarding the cancer process. Fundamentally, this therapy is capable of killing cells which have lost their pH control by increasing the influx of cations until the pH level is elevated into the fatal range (9,16). Due to the nature of the malignant cell membrane, only Cs+, Rb+ and K+ can enter in any significant amount. Unless present in large amounts, K+ may not raise the pH due to its role in glucose transport. When large concentrations of K ions are available, a large proportion will be involved in water transport and hence can raise cellular pH. In this case, glucose transport can even be retarded (12,17-19).

TRANSPORT ENHANCEMENT

The nutritional prevention and treatment of cancer is largely involved in increasing the cation content of malignant cells to the point that the pH level is fatal. Several elements and compounds can increase the transport of the three most active alkaline cations (Cs+, Rb+, K+) into cells. There are two different categories of such substances (7,9). See table 2. One contains compounds which increase the negative gradient across the cell membrane. Normally these are acid radicals which are absorbed into the cell. Examples of these are vitamin A and vitamin C. These have long been the subject of research regarding their tendency to reduce the incidents of cancer (20-22).

The other category consists of substances which contain or form multivalent bonds on cell membranes. These bond structures serve as transport sites and hence increase the number available. Zinc and selenium ions form double bonds with oxygen (9,23,24). The cyanide radical (-C = N) as found in nitriles, contains a triple bond. All of these substances have generated interest with regard to cancer prevention (25).

It must be emphasized that none of these substances is known to possess any primary preventative or curative property with regard to cancerous cells. Their effectiveness is totally dependent on the concentrations of Cs+, Rb+ and glucose-free K+ ions in the body fluids. A recent study by Tufte has confirmed the effectiveness of Vitamin A and zinc in the repression of tumor growth in mice when significant quantities of cesium are administered (9, Tufte unpublished report).

HISTORICAL EVIDENCE

Treatments for cancer which utilized some of the substances discussed have been described even in the early 20th century (26). A common ingredient has been carrot juice which provides large quantities of both K+ and vitamin A. The best documented of these therapies was administered by Dr. Gerson (27). Dr. Gerson administered large quantities of carrot juice daily along with potassium salts. More recently, amygdalin and other nitrites with their -C = N radical, has caused considerable controversy. One significant point was the insistence by some of its advocates that a high potassium diet is mandatory for the therapy to be effective (28-31).

All of the above therapies suffered from a lack of understanding of membrane physics. Consequently none of them were optimized to yield their maximum benefits. As a result considerable controversy was raised regarding the role of individual components of the regime. One serious limitation to all of the therapies was the lack of understanding of the inherent limitation of K+ due to its role in glucose transport. The effectiveness of Cs+ and Rb+ in the repression of tumor growth in mice has been demonstrated recently in a number of studies (9,16,32, Tufte unpublished report).

GEOGRAPHIC EVIDENCE

There are several areas where the incidence of cancer is very low. It may range from 1 in 1000 to essentially zero. Unfortunately, the food intake in these areas has never been analyzed from the standpoint of pH. Still sufficient data is available to show positively that this pH theory of cancer therapy and prevention applies fully.

The incidence of cancer among the Hopi Indians has been reported to be essentially 1 in 1000 as compared to 1 in 4 for the United States as a whole. Fortunately, their food has been analyzed from the standpoint of mineral content (33). It has been found to be higher in mineral content than normal foods. It is very high in potassium and extremely rich in rubidium. The Hopi food is largely blue corn. Instead of baking soda, they use ash of the green chamisa leaves grown in the desert. These leaves are extremely rich in rubidium, and must also be rich in cesium. The Indians also eat a lot fruit including the kernel of the apricot. Actually occurence of some of the minerals is over 35-fold richer in Hopi foods. It must be concluded that their low incidence of cancer is consistent with their high intake of Cs+, Rb+ and K+. This diet would also provide large quantities of substances, including nitriles, which increase the number of transport sites.

In contrast to the Hopi Indians, the Pueblo Indians abandoned their traditional food sources in favor of conventional food. Their incidence of cancer soared from 1 in 1000 to 1 in 4, that is from the rate of the Hopi Indians to that of the United States in general. It is probable that this change in cancer rate has absolutely nothing to do with carcinogens but is entirely a result of their reduced intake of Cs+, Rb+ and the transport enhancement substances.

Cancer is virtually unknown in the Hunza region of North Pakistan (34). lUnfortunately their food content has never been .. analyzed chemically. However, sufficient data was obtained to determine that it is clearly rich in CS+, K+, nitriles and probably. Rb+. The potassium rich mineral biotite is abundant in the mountains of the Hunza region (35). It also contains appreciable quantities of cesium and rubidium (36). The Hunzukuts eat food from their soil and are essentially vegetarian. They eat large amounts of fruit, especially apricots. One professor reported that he observed them eating as many as 40 apricots per day. The apricot kernel is eaten directly, ground into meal or used as a source of potent apricot oil (37). In the latter case, a few drops are added to the homemade wine.

In Hunza, the drinking and irrigation water for farming flows from the melting glacial ice sheets. Clouded by the mineral rich glacial silt, it it reversed as the "milk of the mountains" (38). On the average, a Hunzukut will drink 4 liters a day. A missionary chemist who was there some years ago analyzed this glacial water for cesium and found it to be abundant. The diet of the Hunzukuts appears to be rich in the minerals and transport enhancement nitriles which would be expected to reduce the incidence of cancer in accordance with the high pH theory.

Like Hunza, the Caucasus mountain region in southern U.S.S.R. is famed for its number of healthy elders (39). The mountain peasants also eat food from their soil. Their main (70%) daily caloric intake is from vegetables and fruits, with the balance in meat and milk products. Both Rb+ and Cs+ are found in the rocks (40) and mineral springs of the Caucasus (36). The uptake and concentration of both elements in certain plants have been documented. Bordering the Caucasus region on the west, the Black Sea contains 450/g/1 Rb as compared to 120 /g/1 Rb of the North Altantic Ocean (36). Although the daily life of a mountain peasant mandates rugged physical activity, such longevity has not been witnessed in the Alps or the Carpathian mountains (41). The effect of a Cs+ and Rb+ rich diet is suggested.

There are areas in Central America and in the highlands of Peru and Equador where incidences of cancer are very low. The people of these areas are great fruit eaters and also eat the kernels. Analyses of the fruit from these areas show it to be very rich in Cs+ and Rb+ (Brewer unpublished report). People with cancer have been known to live there for some months with complete remission. A father and son team of surgeons reported to the senior author a case in point. A man with massive tumors in the abdomen was given from 3 to 6 months to live. An examination a year later found him to be cancer free. The patient stated that he went to live with Indians on an island off the shore of Central America. The Indian diet was principally fruit, vegetables and seafood. In a month, the man felt that all his cancer symptoms were gone. He remained on the island for a year before returning to the United States. Fruit was obtained from this island and found to be very rich in rubidium and cesium. The island is volcanic. High concentrations of Cs+ and Rb+ are typical in volcanic soils. The diet met the high pH requirements and transport enhancement aspects of the high pH cancer therapy.

CONCLUSIONS

The nutritional aspects of cancer principally involve the presence of Cs+*m* Rb+, K+ and associated transport enhancers. The role of carcinogens is at most a secondary consideration. Laboratory experiments, historical and geographic evidence support the effectiveness of the high pH therapy and a high pH diet in terms of cancer prevention. The physical nature of the cell membrane is in agreement with these experimental results and geographical observations.

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LEGEND

Figure 1 Phospholipids on normal cell membrane
Figure 2 Cellular response to pH
Table 1 Transport of alkaline cations
Table 2 Transport enhancement of alkaline cations

Figure 1

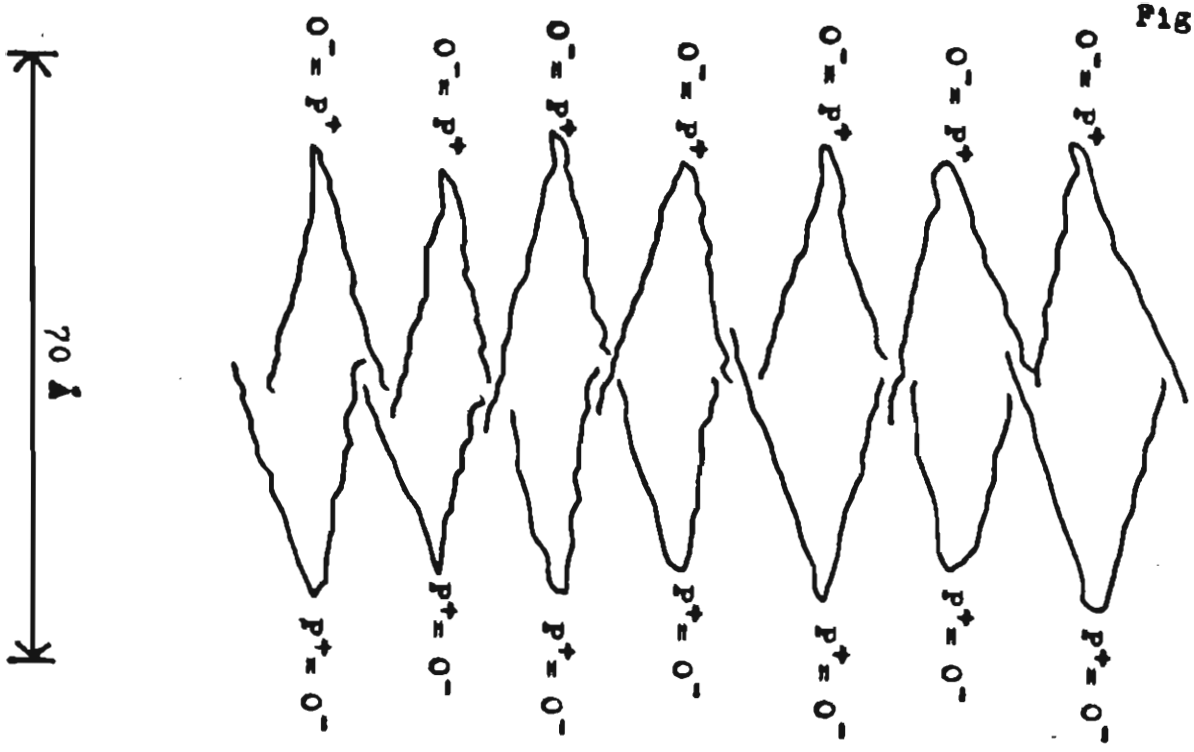

Figure 2

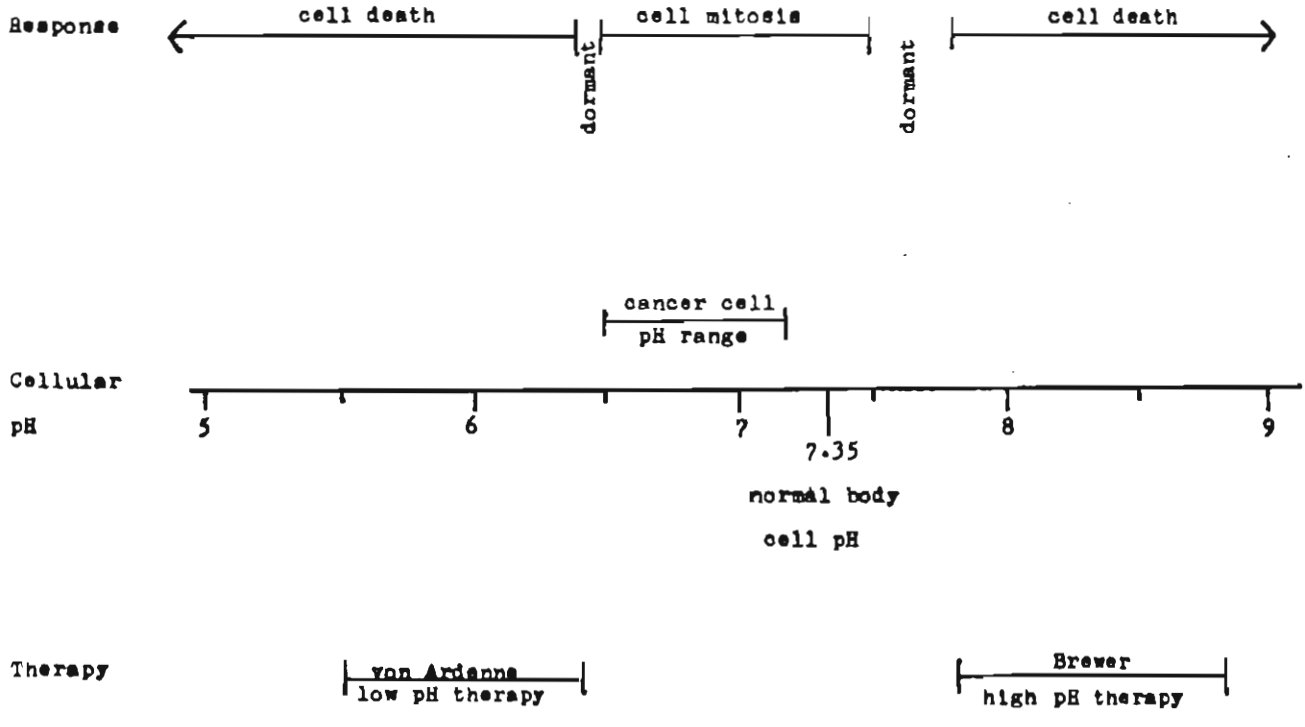

Table 1[a]

Cation	Alkaline strength	Attraction for (-) ions	Minimum potential gradient[b]	Quantum state[c] ground		excited
Cs^+	strongest	weakest	smaller	X	or	X
Rb^+	↓	↑	↑	X	or	X
K^+	↓	↑	↑	X	or	X
Na^+	↓	↑	↑			X
Ca^{2+}	↓	↑	↑			X
Li^+	↓	↑	↑			X
Mg^{2+}	weakest	strongest	larger			X

[a] Table 1 is adapted from references 4-7,11.

[b] Minimum potential gradient of membrane double bond required for attraction into cell membrane.

[c] Quantum state of membrane double bond required for attraction in cell membrane.

Table 2

Transport enhancement property	Example	Action
Acid radical	vitamin A (retinoic acid)	Increases negative gradient across cell membrane
	vitamin C (ascorbic acid)	
Multivalent bonds	Zinc Forms Zn=O	Increases number of transport sites
	Selenium Forms Se=O radical	
	Nitrile Contains -C≡N radical	

The Role of K, Rb and Cs In Low Cancer Rate Areas

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ABSTRACT

A study of the physics of membranes and multivalent bonds has shown that glucose and oxygen are transported through the mechanism of cation facilitated transport which depends upon the electrical state of the multivalent bond on the membrane. Membranes incorporate P = O structures of the phospholipids as the principle multivalent transport sites. Oxygen transport depends upon cations less active than K, while glucose transport depends upon K. In a malignant cell, cations less active than K are blocked by the inability of the multivalent bond to transition from ground to an excited state. This inability is caused by the presence of carcinogens or damage of P = O by radiation. Cs, Rb, and K can still enter the malignant cells. These cells lack pH control due to restricted cation-polar molecule transport and chromosomal damage. It has been shown that all cells have a limited pH tolerance. In the absence of pH control, sufficient quantities of Cs, Rb and glucose-free K can elevate the cancer cells pH into the fatal range.

In this paper, the geology and diet of four areas where the cancer rate is or was very low are analyzed for Cs, Rb and K intake. During the time of the very low cancer rates, these diets were usually rich in these cations and substances which enhance their transport. An historical investigation of dietary therapies for cancer shows that the main ingredients in many were K and transport enhancers. It is concluded that the intake of Cs, Rb, K and transport enhancers is the key to the existence of areas with very low cancer rates.

A study of areas where the incidence of cancer is or recently was very low is instructive in understanding carcinogenesis. It is found that Cs, Rb, K and substances which enhance their transport have the dominant role in cancer prevention. A recently developed theory of membrane transport explains carcinogenesis. The action of the aforementioned substances is in agreement with this theory. Experimental data, data on geographic incidence of cancer and historic evidence strongly support this conclusion. This paper discusses the features of membrane physics that are essential for understanding the nutritional prevention of cancer. The action of nutrients which occur naturally in these low cancer areas accounts for the rates observed.

MEMBRANE PHYSICS

The model of the cell membrane presented here differs markedly from many of the popular models such as capillary action, ionopores and fluid membrane with segment rotation. These other models are totally inadequate for understanding carcinogenesis and are at variance with a whole host of data on membrane and cellular action (15, 16, 20).

The membrane consists of a double layer separated by about 70 A (14-16, 96). Proteins comprise 10-50% of the membrane structures. The remainder are lipids of which 90% are phospholipids (32). Each phospholipid has a polar, hydrophilic phosphate "head" region with two non-polar, hydrophobic fatty acid "tails" (96). See figure 1. The orientation of the P = O in the phosphate head is crucial to the membrane transport properties (15, 16). On the outer surface, the P = O in the phosphate head are oriented such that each O points toward the extracellular fluid. On the inner layer, the oxygen points toward the intracellular fluid. The phosphorous on both the inner and outer layer of the cell membrane positioned toward the intramembranal space. There is probably a staggering of the phosphate head to maximize strength. The P = O is the structure which enables cation facilitated transport. Double bonds, principally P = O, are the transport sites for cations (14-16, 19, 20).

Polar molecules associate with cations and are transported along with the cations. The quantum state of the membrane double bond determines which cations of the Hofmeister displacement series can be transported (15, 16). The Hofmeister displacement series is given by

$Cs^+ \blacktriangleright Rb^+ \blacktriangleright K^+ \blacktriangleright Ba^{2+} \blacktriangleright Na^+ \blacktriangleright Ca^{2+} \blacktriangleright Li^+ \blacktriangleright Mg^{2+}$

In the ground (lowest energy) state, only Cs^+, Rb^+ and K^+ can be transported. The ions less active than K^+ require an excited (energized) double bond for transport. Energy released during cellular metabolism can excite the election orbitals in the double bonds. See figure 2.

The feature of double bonds which enables cation transport is their static electric field strength generated by the distorted orbitals of the bonding electrons. In an excited (energized) state, the orbitals of the bonding electrons are even more elongated and hence, the static electric fields are even stronger than for the ground state. In the P = O, the oxygen atom attracts electrons much more strongly than the phosphorous atom. Therefore, it is the oxygen end with its negative charge which attracts cations into the electric gradient which exists across all living cells (15, 16).

CATION-POLAR MOLECULE ASSOCIATION

As the cations of the Hofmeister displacement series become less active, the size of the association of the polar molecules becomes larger (15-17, 20). Some of the following examples account for transport of H^20 and glucose into the cell.

$Cs(H^2O)^3+$, $Rb(H^2O)^5+$, $K(H^2O)^7+$, $K(glucose)+$, $Ca(H^2O)^{302}+$ Oxygen which is required for aerobic metabolism of glucose is carried in the form of peroxides by cations less active than $K+$, such as Ca^2+. As a result, oxygen transport requires excited double bonds (transport sites) for transport while glucose can be transported with the double bonds in the ground state. Therefore, without double bond excitation, only anaerobic metabolism of glucose is possible. See figure 3.

CARCNOGENESIS

The most fundamental biological property of the cancer process, discovered by Warburg as early as 1924, is the anaerobic nature of glucose metabolism of all cancer cells (94, 95). It has been shown that a deprivation of 35% of the oxygen to a cell for a period of 48 hours will cause a cell to transforms to a state in which metabolism is anaerobic. After this 48 hour period, the anaerobic state can't be reversed by restoring the oxygen levels external to the cell. There has been much speculation regarding the significance of this finding. Many attempts have been made to prevent and treat cancer by increasing oxygen levels in blood supply. All such attempts have been disappointing because the cancer problem is due to an abnormal cell membrane and normally doesn't involve oxygen levels in the blood supply.

The cancer cell has a defective cell membrane which interferes with cation transport (17). The P = O bonds of the cell membrane can't excite because the membrane is coated with carcinogens and/or has bond damage due to radiation. Left with only ground state transport available, only Cs, Rb and K can enter. Consequently, water and glucose are the only polar molecules transported. Without excited state transport, oxygen is blocked from the cell regardless of its extracellular concentration. Anaerobic metabolism prevails in which lactic acid forms. See figures 2 and 3.

The cancer process can be divided into four stages (17, 19, 20).

1. Cell membrane P = O transport sites are either coated with carcinogens and/or damaged by radiation (17). Miller has identified carcinogens as strong electrophilic reactants which are either induced or formed on membranes (66, 67). The P = O on the membrane are prevented from entering an energized state. Consequently, $Ca^{2}+$ and other highly associated cations which transport oxygen into the cell can no longer enter. The cell is forced into anaerobic metabolism of glucose and loses its pH control mechanism.

2. Glucose is still transported into the cell by K ions. Because the supply of oxygen is limited, pyruvic acid from glycolysis is converted to lactic acid. The pH of the cell then drops from 7.35 to the 7.0 range and even to the 6.5 range. This is the step that Warburg observed. M. von Ardenne has studied this step in detail (93).

3. The + and - charge sequence on the DNA is completely lost in the acid medium (17, 19, 20). Chromosomal aberrations occur. The cell processes are altered and control mechanisms are lost. As a result, the cell undergoes unrestricted multiplication with a loss of normal function and shape.

4. Normal cell enzymes are changed to acid toxins in this acid medium. In particular, the lysosomal enzymes become very toxic and eventually kill the cell. The leakage of these toxins from the dead cells poisons the host. These toxins are powerful carcinogens and can cause metastasis. In addition, cancer cells may break off from tumors and be carried to other sites because the attachment between cancer cells is very weak.

CELLULAR pH

M. von Ardenne has studied the response of cells to pH levels both above and below the normal pH 7.35 (93). Normal and malignant cells undergo mitosis between 75 and 6.5. Mitosis rate slows as the pH approaches the extreme of this range until the dormancy state is reached. If a cell can be forced into a pH outside of this range, then cell division ceases. Cells quickly die if the pH is forced above 8 or below.

6. This is limited viable pH range and the inability of cancerous cells to control their pH makes two therapeutic approaches possible. In other words, a cancer cell can be forced into dormancy and then death because it lacks pH control. See figure 4.

LOW pH THERAPY

M. von Ardenne developed a low pH therapy based largely on increasing glucose metabolism (93). Lactic acid production is increased in the cancer cells. Acid enzyme reactants (largely involving lysozymes) are also increased by heat and other therapies. There is little in this therapy which explains variations in the incidence of cancer. Hence the aspects of this therapy will not be discussed further.

HIGH pH THERAPY

In contrast to low pH therapy, aspects of a high pH therapy theorized by A.K. Brewer explains the existence of areas with low cancer rates (19, 20). Fundamentally, this therapy is capable of killing cells which have lost their pH control by increasing the influx of cations until the pH level is elevated into the fatal range. Due to the nature of the malignant cell membrane, only Cs+, Rb+ and K+ can enter in any significant amount. Unless present in large amounts, K+ may not raise the pH due to its role in glucose transport. When large concentrations of K ions are available, a large proportion will be involved in water transport and hence can raise cellular pH (5-7).

Success of high pH therapy requires a sufficient intake of Cs+, Rb+, or glucose-free K to drive the pH of malignant cells into the fatal range (82). Smaller intakes may even accelerate the growth of an established tumor because these doses may raise the pH only slightly to a level for more rapid mitosis. Another requirement, as in any regime, would be maintenance of the electrolyte balance, especially those listed in the Hofmeister displacement series. The transport of large quantities of Cs, Rb, and/or glucose-free K from the body fluids into cells can be facilitated with transport enhancers (see Transport Enhancement). The presence of these enhancers can increase the pH of malignant cells when sufficient supply of Cs+, Rb+, and K+ are available from the body fluids.

TRANSPORT ENHANCEMENT

The nutritional prevention of cancer largely involves increasing the pH of malignant cells into the fatal range through the influx of Cs+, Rb+ and glucose free K+ ions. There are several substances which can enhance the transport of cations across membranes. See table 1. There are two mechanisms of transport enhancement (17, 19, 20). Membrane transport is dependent upon 1) the magnitude of the electric gradient across the membrane and 2) effective area of the membrane (number of sites) available for transport.

The potential gradient is increased when cells absorb weak acids, such as Vitamin A and Vitamin C. A number of transport sites is increased when multivalent bonds are absorbed on the cell membrane. Zinc and selenium form double bonds with oxygen on membranes (19, 20, 59) while the cyanide radical (-C = N), as found in amygdalin, contains a triple bond (19). All of these substances have received much attention with respect to possible roles in the prevention and treatment of cancer (10, 13, 22, 23, 25, 39, 68, 72, 84). Much of the data has been confusing and subject to a great deal of controversy (13). None of these substances has any known primary role in the prevention and treatment of cancer. Since their role is limited to enhancing the effectiveness of extracellular Cs+, Rb+ and glucose-free K+, such controversy is expected. Without adequate supply of Cs+, Rb+ and glucose-free K+ to elevate the cellular pH to the fatal range, these transport enhancement substances (vitamin A, vitamin C, Zn, selenium, and -C = N) are ineffective in cancer prevention and therapy. A recent study by M. Tufte has confirmed the effectiveness of vitamin A and zinc in the repression of tumor growth in mice when significant quantities of caesium are administered (20, Tufte unpublished report).

BIOGEOCHEMISTRY of K, Rb and Cs

The possibility of an influence of the geochemical environment on the incidence of degenerative diseases is well

recognized (29, 61, 75, 85-87). The effect of soil and water on people living close to the land offers insight into diseases. High pH therapy, as described earlier, utilizes glucose-free K+, Rb+, and Cs+ as the active ingredients. In the soil, variations of Rb concentration (1.5-1800 ppm Rb) have been reported (9). In the majority of the samples the Rb content is near the low end of the range. The median value (35 ppm Rb) is only ¼ of the mean value (140 ppm Rb). While Cs concentration in soils is much lower and the data is less extensive (8), similar variations are expected. The limited reports suggest an average Cs content in soil of 3 ppm. Vingradov derived an average soil K:Rb:Cs ration as 5000:50:1 (92).

Exactly how much of K, Rb and Cs become incorporated into the food supply depends on the soil, water and diet. Ion content in the water and replenishment in the soil depends upon the composition and weathering of materials which originated in the molten rock (magma) in the earth. By studying the weathering process, Webber and Jellema found a Rb soil/Rb rock ratio of 1.07 (97). Although K is far more abundant than Rb in the magma and on earth, Rb is still considered abundant by some authors (4). Cs is considered rare.

As the magma cools either through volcanic eruption or solidification within the crust, the cations K+, Rb+, and Cs+ crystallize in various forms (4). Upon differential crystallization, Rb always incorporates with K in the formation of igneous rock. Cs may or may not alloy with K and Rb. The formation of igneous rock leaves a liquid residue, containing Cs and other minor elements which do not readily substitute for the major elements, such as K. The remaining elements, such as Cs, eventually crystallize as a component of minerals in pegmatites and hydrothermal veins. This permits a high concentration of minor elements, such as Cs. Under hydrothermal pegmatitic conditons, Cs forms its own mineral, pollucite (34% Cs) (8). Sometimes pegmatites and hydrothermal veins are found within the already solid igneous rock. In summmary, the magma produces igneous rock, pegmatite and hydrothermal veins.

Three types of geological events can make K, Rb and Cs available for soil and water (4). Volcanic eruptions, such as found in the Andes, can spew the magma onto the surface forming igneous rocks. However, the magma which solidifies in the earth forms igneous rocks, pegmatites and hydrothermal veins. In this case, the K, Rb and Cs in the crust may be exposed by the earth's movements, such as the buckling which formed the Himalayas (77), by erosion or both. Fissures can also be accompanied by a quiet leakage of magma on the surface.

Even though volcanoes are generally a good source of Rb and Cs rich soil (37), there are still wide variations (38, 45). The Rb and Cs content increases with increasing K content and the acidity (SIO^2) of the volcanic rock (37, 38, 45). A survey of Rb in a volcanic rock, andesite, revealed that Fiji andesite had 20 ppm Rb and Ancud, Chile andesite at 120 ppm Rb (37). The Chile sample was the highest among the 12 reported global andesite samples. The 1982 eruption of the El Chico'n volcano In Chiapas, Mexico spewed whole rock pumice and volcanic glass each containing 90 ppm Rb (57). Volcanic rocks from islands generally have less Rb than continental volcanic rock and a higher K/Rb ratio (45). Andesite volcanic rock contains an average of 2.3 ppm Cs (8).

K, Rb and Cs are frequently found together in rock (76). Since K can be replaced in part by Rb and Cs, K-rich rock forming minerals (such as the biotites; feldspars, triphylite, petalite, beryl and lepidolites) show appreciable quantities of Rb and Cs. The micas (such as lepidolite and the biotites) have the highest Cs contents of the igneous minerals and are very high in Rb. Biotite (black mica) found in granite typically contains 900 ppm Rb (2) and over 10 ppm Cs (8). Rb and Cs are also found in K deposits and are dispersed in various rocks (76).

The abundance of Rb and Cs in the soil depends on the composition of the magma, their fate during the crystallization process and degree of exposure on the surface. World averages for very basic to very acid igneous rock range from 2 ppm to 200 ppm Rb respectively, a hundred fold difference (47).

Rb and Cs are found in hot springs, mineral springs, sea and ocean water because their salts readily dissolve in water (35, 76). In general, the concentration of Rb and Cs decreases from springs to sea to the ocean (76). Analyses of mineral springs are expressed in mg/1 while that of the sea and ocean water are expressed in g/1.

Uptake and concentration of Rb and Cs by certain plants and animals have been documented (76). Rb tends to concentrate in both the vegetative and reproductive organs of the plant, as does K (9). For vascular plants and fungi, the biological availablity of Rb, but not of K, increases with soil acidity (89). The difference in Rb uptake may be as great as 10 fold between high and low acidity. THe biomass K/Rb decreases with soil acidity.

Unlike K and Rb, Cs has no naturally occurring radioactive isotope. Cs^{137} is artificially produced and must not be confused with naturally occurring stable Cs^{133}.

GEOGRAPHICAL EVIDENCE

There are small isolated areas of the world which are or were virtually cancer free. Studies of cancer incidence by continent, country, or even province can overlook these areas. The people of "cancer free" areas are relatively isolated and grow their own food on mineral rich soils.

HOPI INDIANS

In the United States the Hopi Indians who lived in the Arizona desert on traditional lands (49) had been reported in 1949 to be 'virtually free from cancer' (69). Hospital records showed a ratio of only 1 malignant case out of 833 admissions for the Navajo-Hopi area in northeast Arizona. At that time the rate for white persons in the United States as a whole was 1 malignant case in 17 admissions. In 1985, a child born in the United States has more 1 in 3 chances of developing invasive cancer (83).

The overall mineral content of the Hopi traditional diet is higher than conventional foods (21). Very high levels of K and Rb are reported. This is due to the soil, groundwater and food preparation. The traditional Hopi food is simple and is grown on their semi-desert land through 'dry farming' (62). In absence of irrigation, blue corn, beans and melons are planted in dry stream beds (30). Dry farming depends on the roots getting enough water from the aquifers of fossil water deep in the ground and from their annual rainfall of 20-38 cm (62). Apricot, peach and apple trees are planted in small hollows which collect thin top soil.

The simple diet is largely based on blue corn which is prepared in many ways (21). Blue corn-ash foods are prepared using the ash of the green chamisa leaves. This highly mineralized ash, used as baking soda in breads, is extremely rich In K (17% by weight) (50) and Rb (189 +/-16 ppm) (21). World average dry weight value for a terrestrial plant on earth is estimated at 20 ppm Rb (12). The Rb content of Hopi chamisa ash (189 +/-16 ppm) exceeded the 21 other indigenous salts tested, all-commercial special salts (9.7 +/-4.5 ppm Rb) and commercial refined salt (no Rb detected) (49). In addition, crude salt collected from a geological deposit is added to the food preparation. One such salt, the Grand Canyon indigenous salt used in the Hopi diet, contains an average of 140 +/-5 ppm Rb. Because the diet is rich in Rb, it is expected to be rich in caesium. The traditional Hopi foods also excelled in iron, zinc and calcium content.

In 1949, an American Medical Association team recommended further study of the low incidence of cancer and its possible relationship to the traditional diet (69). Even though the Hopi custom of adding ash to corn food is also common in traditional diets of the Navajo and other Indians (21), its role in cancer prevention has not been adequately studied. It must be concluded that their low incidence of cancer was consistent with their high intake of K, Rb, and Cs. Their traditional diet also provided large quantities of transport enhancement substances, including vitamin A and nitriles from fruits, vegetables, seeds and kernels (19, 50).

Even though the Hopi are continuing to live on traditional lands, their traditional diet was partially replaced by a federally donated food program (21). In 1955, the Department of the Interior Bureau of Indian Affairs transferred its responsibility for Indian health to the U.S. Public Health Service. In 1958, the question of comparable nutrition between the traditional food and the federally donated food was raised. Today, baking soda and commercial salt frequently replaces the K and Rb-rich plant ash and indigenous salt; milled

cereals replace whole grains, and refined sugar and syrup replace natural cactus syrup. The high mineral diet reinforced with trace elements as Rb and Cs is being replaced with imported foods of lesser mineral content. Kuhnlein found that in 1974-5 less than 25% of the Hopi women and children consumed one indigenous food item per day (50,51). The contemporary diet may be somewhat similar in nutrients to that of other American low-income populations (51), but does not equal the superior mineral content of the traditional high pH diet.

The aforementioned 1949 report predicted increased cancer rate with a diet under the influence of "soda pop, candy bars and spearmint" (69). With time, the absence of adequate malignant cell killers in the diet, namely glucose-free K, Rb and Cs, displayed its malice. The prediction that adoption of more "Western" life-styles would increase cancer risk (74) came true. The Hopi Indians are no longer virtually free from cancer but display a rate less than the U.S.A. as a whole. After only 18 years from the beginning of the transition, significant cancer rates were observed. Based on a moving 3 year average, data of 1973-76 from the Navajo-Hopi area in northeast Arizona indicated a cancer death rate of 57-70/100,000 for a population composed of 65% Hopi and 35% Navajo (91). Similar figures of 55-111/100,000 (non age-adjusted) for Hopi alone can be estimated from cancer data of the New Mexico Tumor Registry (71) and population data provided by the Department of Health and Human Services (46). This encompasses the years 1970-82. For the USA, average annual incidence rate for all cancers during 1973-76 was 324.4/100,000 (90). The best estimate available to the authors for the current age-adjusted cancer rate among the Hopi Indians is about 60% of the U.S. rate (46). It can be concluded that the change in food composition is responsible for the increase in cancer. The lower K, Rb and Cs content of the contemporary Hopi diet provides less protection against malignancies than was present in the traditional diet.

A similar increase in the incidence of cancer occurred with the Pueblo Indians as they gave up traditional foods for the supermarket over 25 years ago (19).

The cancer preventative benefits of areas rich in high pH cations, that is K+, Rb+, and Cs+, can go untapped when peoples replace living off the land for the convenience of imported refined foods.

VILCABAMBA, ECUADOR

The Andes, being heavily volcanic, contains vast quantities of lava (40, 44, 45, 56). Since the source regions of volcanic arcs are enriched with Rb and Cs (37), the authors have focused their attention on the incidence of cancer in Andean people who live off the land.

Close to the Ecuador-Peru border lies the valley of Vilcabamba, Ecuador. Cancer is almost unknown in this mountain valley (27, 28). Civil records demonstrate that death is through accidents and infections (28). Indians in pre-Spanish days called the large Vilcabamba valley of Loja province "the sacred valley." Geologically, Vilcabamba is situated in a basin which is part of a hugh depression in the Andes (56). The great Intercordilleran depression lies between two nearly parallel rows of volcanoes and stretches the length of Ecuador. Its mountain sides dumped vast quantities of andesite volcanic rock and some sedimentary materials in the cavity. In time, Loja basin was partly filled with stream and lake sediments and by abundant volcanics. Vilcabamba valley is shaped as a 5 pointed star and is rich in mineral deposits (28). The village itself is situated on a plain which was a lake bottom. Huge rivers and glaciers carved the five arms and left deposits throughout its path. Most of the soil is black sandy humus from thousands of years of silt enriched with volcanic ash. Due to the nature of the soil-forming process, the authors expect this volcanic soil to be high in Rb. This is supported by the Rb content reported for Chile andesite and El Chico'n whole rock pumice and volcanic glass.

Situated 1500 meters above sea level, Vilcabamba is relatively isolated and unacculterated. Their have-not lifestyle includes rigorous exercise and a frugal mainstay diet of soup made from home grown corn, yuka (a kind of root), beans and potatoes (27, 28). Oranges and bananas supplement the soup in their essentially meatless diet. Their diet, abundant in fruits and vegetables grown on the Andean volcanic soil, is expected to be rich in K, Rb and therefore Cs. The low cancer rate is in accordance with high pH therapy.

Vilcabamba is just one area forming a geographic arc of low cancer rate areas (28). The senior author has obtained fruit from other volcanic areas in the Ecuador-Peru region and Central America identifled as having very low incidence of cancer (19). A mass spectrographic analysis of the fruit from these areas showed a very high Rb content. A study reports that soils from volcanic ash in Central America are rich in K, contain an abundance of K feldspar, and large amounts of volcanic glass (60). Some potash feldspars are reported typically to contain 300 ppm Rb (2). Much of the Central American soil studied was rejuvenated by deposition of fresh ash (60). The high K content in this study implies a high Rb and possibly high Cs content. Properties of soils derived from volcanic ash in Central America were similar to those found for other soils from volcanic ash in South America.

HUNZA VALLEY

Cancer is virtually unknown in the Hunza Valley of north Pakistan (24, 75, 88). Clark, spending over one year in Hunza around 1953, did not observe any cancer among his 5680 patients (24). Sufficient data suggests that the diet of the Hunzukuts is rich in K, Rb, Cs and transport enhancing substances including nitriles, vitamins A and C.

Using crude hand tools, the Hunzukuts terrace the mountain slopes. They change the gravel dumped by glacial streams into black top soil through extensive composting and irrigate the cool desert land with glacial melt water. The silted glacial water, called "milk of the mountains", provides drinking water, irrigation water (24, 65) and a supply of K, Rb and Cs for the soil and food.

Hunza Valley is situated at about 2300 meters elevation in the NW Karakoram mountain range. This area in non-volcanic and was from folding of the earth (34). Highly glaciated (28-50%) as compared to the nearby Himalayas (8-12%), the Karakoram range provides abundant erosion. The towering background of the valley is composed of layered rock (gneisses and schists) of which schists are easily broken along laminations (4), facilitating erosion. In Hunza, high Rb type rocks, those of banded biotite-hornblend granite (granodiorites), are well exposed (34). Studies report that soils on granite contain unusually high Rb and that they contain the highest Cs content tested (92). Granodiorites have a high SiO^2 content which increases the K, Rb and Cs content (37, 38). Hurley reports 122 ppm Rb for a typical granodiorite rock (43). As mentioned earlier, the K-rich biotite found in granite contain typically 900 ppm Rb (2) and over 10 ppm Cs (8). The banding of the granodiority in Hunza is accentuated by acid layers of pegmatitic composition. (34). Pegmatites can highly concentrate rare elements, such as Cs (4, 8).

With this highly eroded geological setting, the Hunzukuts are provided mineral-rich glacial melt being a cloudy (88) to opaque (55) mother-of-pearl gray (41). For survival in the arid environment, a tremendous volume of this glacial water is used for irrigation and ingested with estimates up to 4 liters/day a person. Rainfall which is demineralized occurs only in the winter. A missionary chemist who visited the area had the water analyzed and found it to be very rich in Cs (14). Hoffman analyzed the black top soil and found it to be rich in all minerals (41).

The traditional vegetarian diet of the Hunzukut consists of homegrown fruits, vegetables and grains (24, 41, 53, 88). They eat large amounts of fruit, especially fresh and dried apricots. One professor estimated an intake of up to 40 apricots per day per person. The apricot kernel is eaten, ground up into a meal or used as a source of potent apricot oil. A few drops are added to homemade wine (24), used elsewhere in cooking or as fuel (88). Many garden vegetables and whole grains, such as barley, wheat, millet and buckwheat are consumed. The absence of cancer is consistent with a high pH diet.

For some, the fabled Shangri-la may have lost some of its glimmer. In 1949 Hunzukuts returning from the Pakistani army brought back the taste of candy and tobacco (65). In 1960 a new highway leading to the valley replaced a narrow foot path adhering to a towering escarpment. The new road brought with it flour and margarine, the latter of which

replaced the use of apricot oil. A new hotel now adorns the valley which previously had no lodging facilities or restaurant. The effect, if any, of acculturation on the Hunzukuts' traditionally high pH diet has not been assessed. Their absolute dependence on an abundant supply of silted glacial water for drinking and irrigation may be able to offset a loss of K, Rb and Cs which acculturation might inflict.

CAUCASUS

Like Hunza, areas of the Caucasus mountain region in southern U.S.S.R. are known for the low incidence of cancer (1, 28, 52, 54). The area is a major health resort for U.S.S.R., famed for both hot and cold mineral springs. Rb and Cs enrich the carbonaceous water of the mineral springs (48, 76, 98), the volcanic formations (73) and the mud volcanoes (3). The term mud volcanoes refers to a cone of mud formed by high pressure gas breaking through the ground in a water-bearing strata. The Caucasus area, which forms a border between Europe and Asia, lies between the waters of the Black Sea (450/g/l Rb) on the west and the Caspian Sea (5700/g/l Rb according to preliminary report) on the east (76). The waters of the North Atlantic Ocean test at 120/g/l Rb.

The Georgian, Azerbaijan and Armenian Soviet Socialist Republics of the Caucasus display a diverse terrain including alluvial deposits in lowlands, mountains from folding and volcanic action, vast lava plateaus, extinct eroded volcanoes, mountain vegetation and semi-arid to subtropical vegetation (33, 78-81). The area has complex geology. The northern mountains were formed largely by folding, although extinct volcanics exist. In the southern portion, that mainly of Armenian and Azerbaijan S.S.R., volcanic development becomes more characteristic and the volcanic rock becomes more acidic (70).

Odikadze's work in the Caucasus region indicated the initial magma selectively accumulated Cs (73). (The volcanic rocks by a factor of 5-20.) In contrast to a world mean of 5 ppm Cs for acid rock, mean values of 30 pp, and 42 ppm were obtained for volcanic glass from Armenia and south Georgia, respectively. These samples were taken from a lava plateau area in each republic. The highest Cs contents were found in south Georgia and the Tyrnauz orefield. The latter, located east of Abkhasia province of Georgia, displayed 100 ppm Cs in some samples. An extremely high mean of 1660 ppm was obtained for Transbayhkalia volcanic glasses.

The more than 200 mud volcanoes of Azerbaijan (79) are found mainly on two peninsulas on the Caspian Sea, although some are scattered within the republic. Rb and Cs content of the world's most intensive mud volcanism, located in Azerbaijan S.S.R., was studied by Babyev and Martirosyan (3). Mean values of 151 ppm Rb and 46 ppm Cs were reported for cone breccias. Rocks underlying the mud volcanoes contained 9.9 ppm Cs.

The high Rb and Cs content in the rock of the Caucasus region is the source of the Rb and Cs enriched carbonated water (48, 98). The high chlorine content in the waters react with the rock and enhance mobility of Rb and Cs. The waters have extremely low K/Rb, and Rb/Cs.

In the Caucasus, great efforts are taken to enrich the soil (63). Compost, animal dung, algae from the ponds, wood ashes and mineral-rich materials from the Black Sea are incorporated in the soil. Sand, sea plants and fish leftovers from the Black Sea eventually become soil. Black and Mitchell tested samples of dry ash of brown algae from sea water which contained up to 250 ppm Rb (11). Where available, Cs-rich (73) lava powder is also incorporated in the soil (63). Although enormous lava plateaus lie in each of the three republics, they are situated in the more volcanic southern part of the area (79, 81).

Even though the Cs and Rb enriched area is somewhat industrialized including mining for mineral fertilizer (80), there are agricultural communities where cancer is relatively unknown (28, 52, 54). The inhabitants subsist on home grown unrefined food and maintain traditional peasant ways. Bordering the Black Sea, the Abkhasia province in Soviet Georgia with several Rb and Cs enriched mineral springs (35, 78, 98) is frequently studied. The highland people of Abkhazia are basically free from cancer (28,52,54). Daily cornmeal mush along with fresh fruit, vegetables, many types of seeds (53, 63) and spring water (1) are basic to the diet. The seeds include sunflower, seasame, poppy, caraway, anise, celery and herbal seeds (63). Only 30% of the daily calories is from meat or milk products, such as yogurt and buttermilk (53). The basic fat supplement is oil from the walnut (52), another source of transport enhancing nitriles in addition to seeds. The abundance of fruits and vegetables consumed include green onions, carrots, eggplants, apricots, peaches, tomatoes, squash and citrus fruits. Vegetable juices are ingested as a refreshment similar to the "Western" use of soda pop (28).

The extremely low incidence of cancer is Abkhasia under the influence of a K, Rb and Cs rich diet with transport enhancers conforms to high pH therapy. In the Rb and Cs enriched Caucasus region, the authors anticipate other low cancer incidence areas among communities still subsisting on home grown unrefined food.

HISTORICAL EVIDENCE

High K diets have been recommended as a treatment for cancer throughout this century (42). An ingredient common to many of these dietary treatments is carrot juice which provides large quantities of both K and vitamin A. Dr. M. Gerson's treatment is the best documented (36). He administered large quantities of carrot juice daily along with K salts. More recently amygdalin and other nitriles have been added to these nutritional regimes (58). All of these nutritional theraples suffered from a lack of understanding of membrane physics. None of these were optimized to yield their maximum benefits because membrane physics was not understood. Limitation on the effectiveness of K due to its role in glucose transport was overlooked. Cs and Rb have been proven effective in the repression of tumour growth in mice in a number of recent studies (18, 20, 31, 64).

CONCLUSIONS

The suppression of cancer in the areas cited is due to sufficient intake of Cs, Rb and glucose-free K and substances which enhance their transport. The avoidance of carcinogens is of secondary importance. These results are supported by a study of membrane physics, laboratory evidence and historical attempts to treat cancer.

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Table 1 Transport enhancement of alkaline cations.

Transport enhancement property	Example	Mechanism
Acid radical	**vitamin A (retinoic acid)**	Increases negative gradient across cell membrane
	vitamin C (ascorbic acid)	
Multivalent bonds	Zinc Forms Zn = O	Increases number of transport sites
	selenium Forms Se = O radical	
	nitrile Contains -C = N radical	

Figure 1 Phospholipids on normal cell membrane.

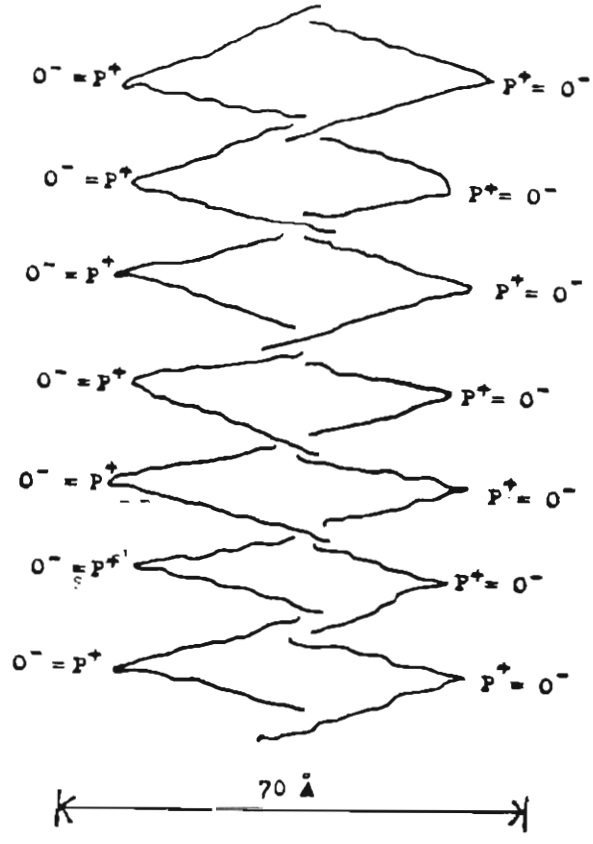
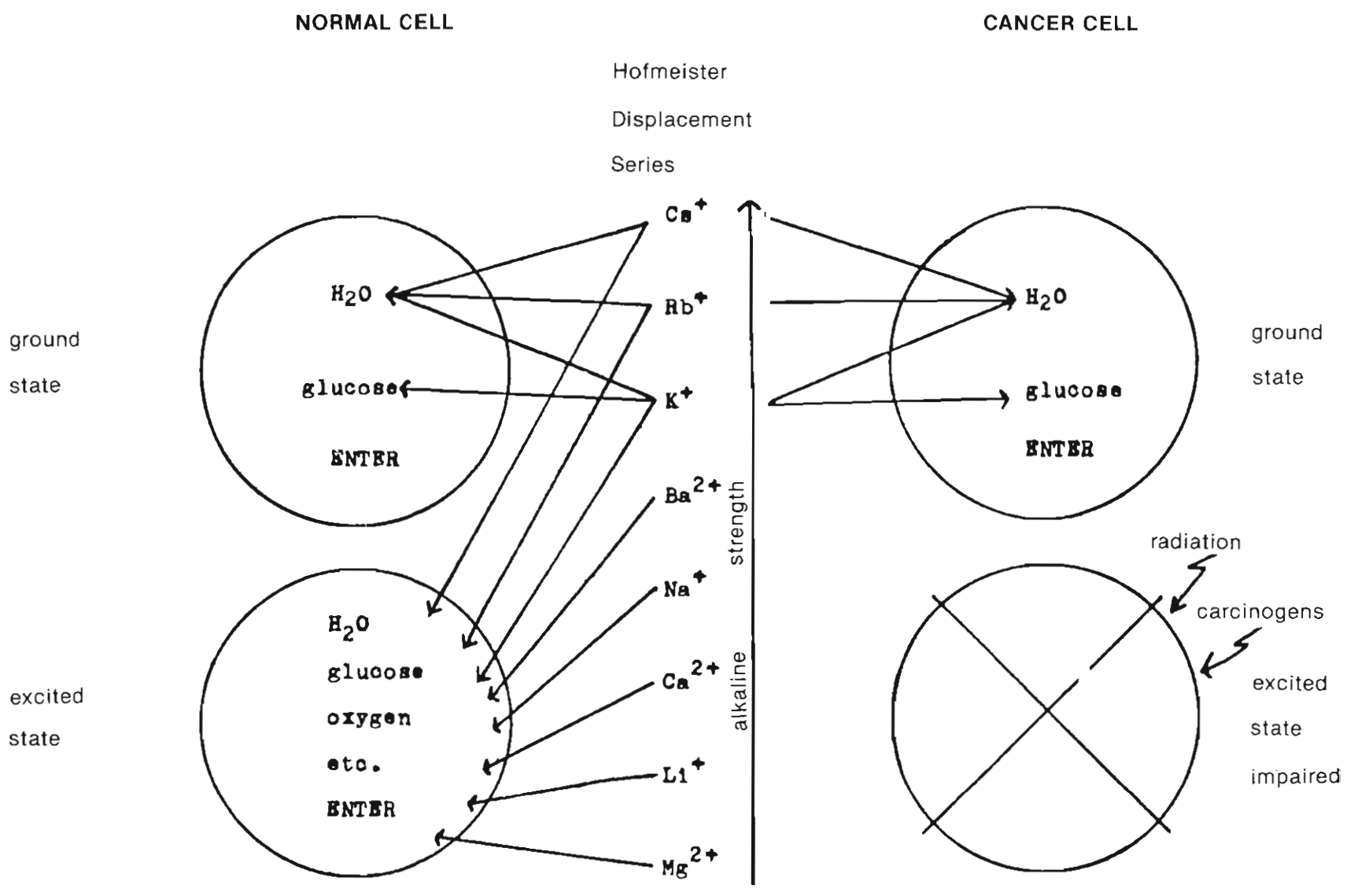


Figure 2 Glucose metabolism explained through cation-polar molecule transport. In absence of excited state transport in cancer cell membrane, oxygen transport is blocked. Transport is limited to the three most active cations, Cs+, Rb+, and K+.



P = O transport sites on membrane undergo ground and excited states.

Radiation and carcinogens can damage membrane P = O transport sites so they cannot excite.

Figure 3 Sustained glucose metabolism in normal and cancer cells.

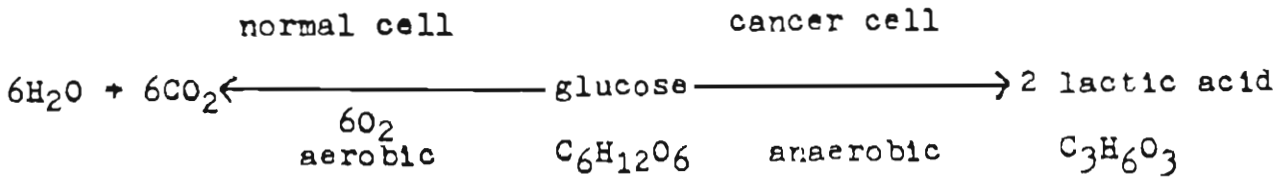
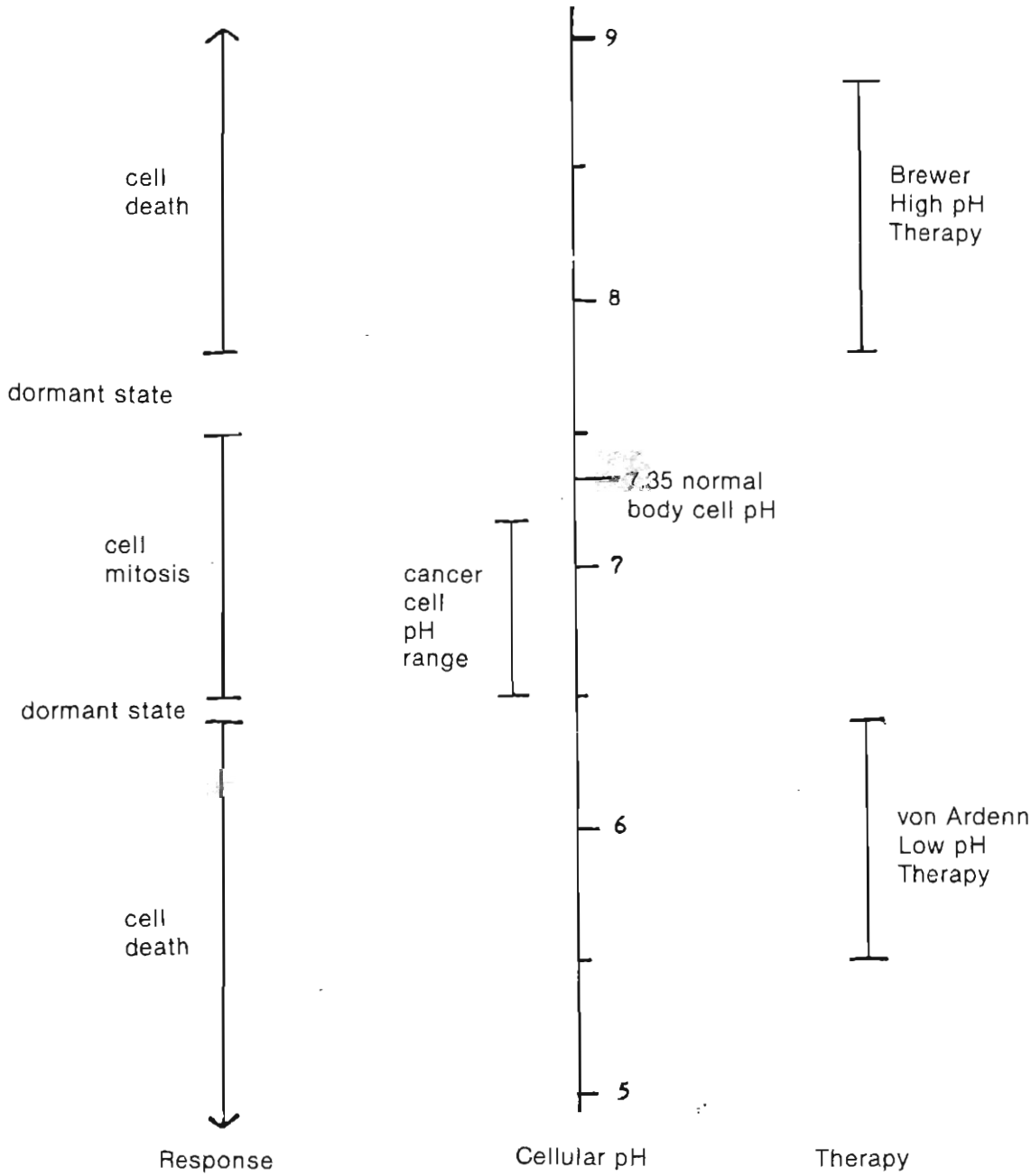


Figure 4 Cellular response to pH.



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The Concept Of Active Transport

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Potassium (K +) and sodium (Na +) - these two minerals are frequent topics in the media today. They are fundamental to the functioning of the cell. In fact, their behavior has puzzled and challenged minds worldwide. Even today their role in cell function is of utmost concern.

For several decades scientists have attempted to unravel how a healthy human cell maintains a high concentration of K inside and a high concentration of Na outside. See figure 1. The K level is about 30-40 times higher inside than outside while the Na level is about 7-12 times higher outside than inside (1,8). There is a concentration gradient, that is, regions of high and low concentrations across the cell membrane for both K and Na. Here are two cations with concentration gradients in opposite directions. The explanation of this phenomenon lies in the physics of the cell membrane, the structure that separates the high concentration areas from the low concentration areas.

In the biological sciences, attempts to explain the movement of substances against concentration or other gradients have led to the concept of active transport (1,11). Transport is considered to be active if it can be shown to be dependent on an energy source. This concept was based on the science of thermodynamics as it relates to the role of force fields on the movement of substances. A force field, such as an electromagnetic field, can influence its surroundings. For example, if there is no force field present, concentrations tend to become uniform in time. Net movement of substances are in directions which tend to produce uniform concentrations. The concentration gradient is zero when the concentration is uniform. In contrast, the presence of a force field, such as the time-dependent electric field at the cell membrane, can produce non-uniform concentrations. This creates a concentration gradient. However, the maintenance of the gradient requires a continuously operating force field. The driving of a dynamic process usually requires an energy input in order to maintain its force fields. This is the rationale of an energy-dependent transport model based on thermodynamics.

The use of the Brewer model of cation facilitated transport clarifies the role of force fields and energy sources in membrane transport (2, 3, 5, 6). The net movement of ions is in response to an electric field at the cell membrane. The movement of ions less active than K, such as Na, is regulated by the energy state of a membrane double bond, P=O. See figure 2.

CLASSIC EXPERIMENT

A study of how the Brewer model of the cell membrane relates to a classic experiment illustrates several properties of ion transport. This and similar experiments (1, 11) were conducted many times from 1941 to present. A lack of understanding of the physics involved in this experiment was largely responsible for the introduction of the concept of active transport. Confusion over the role of glucose in K transport also resulted. See figures 3 and 4.

The basis of the experiments (1, 11) involved freezing normal human erythrocytes (red blood cells) in a saline environment at 0-2° C. The time held at 0-2° C was sufficient to allow ion redistribution by normal diffusion processes. These cells lost K and gained Na until a new intracellular and extracellular equilibrium was reached. The cells were then warmed to 37° C (body temperature) in the presence and absence of extracellular glucose. In the presence of extracellular glucose, the ion concentrations returned to normal. There was a net gain of K and loss of Na in the cell. In the absence of glucose, there was no change in the ion concentration from the cold condition. Normal K and Na ion concentrations were restored by adding glucose to the extracellular fluid.

BREWER MODEL EXPLANATION

In the Brewer model, the P=O located in the 'head' of the membrane phospholipid, serve as transport and transport regulating sites when they are properly oriented (2, 3, 5, 6). See figure 2. The energy states of these sites determine which cations are selectively accepted by the membrane bonds and then drawn into the force field of the membrane. K can be transported in and out when the P=O is in the ground state. Na transport either way requires that bonds be excited or energized through metabolism, frequently glucose metabolism.

In the above experiment, normal ion distribution was observed only when there were both proper phospholipid orientation and extracellular glucose. The reduction of the temperature caused the phospholipids to become crystalline (9). Consequently, the membrane P=O lost their orientation and therefore lost transport control. Due to disorientation of membrane P=O at the cold condition, normal transport was altered. In the absence of transport regulation, distinction between Na and K concentrations was lost. Therefore, inside the cells some of the K was replaced by Na. When the cells were returned to 37° C, the P=O resumed their proper orientation and became operating transport sites which regulate cation movement.

Regulated cation transport requires that the P=O occupy both ground and excited (energized) states. K can pass through the membrane in either direction when the P=O are in the ground state. Ground state transport in mature cells is principally a cation exchange. That is, the number of cations that enter the cell are about equal to the number of cations that leave the cell. This exchange maintains the electric gradient across the membrane because the gradient is dependent upon the total electric charge of the cations within the cell. Isotope studies by A.K. Brewer (5) confirmed the exchange nature of ground state transport in mature cells. K exchange does not depend upon an energy source, such as glucose. However, Na movement across the membrane does depend on glucose because Na is only transported by excited (energized) bonds. The energy for bond excitation is provided by the glucose metabolism within the cells. No exchange of Na is possible in the absence of glucose metabolism or some other energy source.

In the above experiment when the cells were warmed to 37° C in the absence of glucose, there was no change in Na and K concentrations from the cold condition. Na was trapped by the lack of excited state transport sites and therefore K could only exchange with K, involving no net change. Only ground state transport existed.

The presence of glucose in the medium allowed the restoration of normal ion distribution. Since K associates with extracellular glucose and carries it through the membrane, glucose entry occurred during K exchange (2, 3, 5, 6). A net movement of K is not needed for glucose transport into the cell. When the membrane P=O are excited, such as by glucose metabolism, Na transport can occur. Thus, net amount of K entered the cell to replace a net loss of Na. The original ion concentrations were reestablished. These results observed on human erythrocytes are not limited to this one cell type. Similar results have been observed in most animal tissues (11).

As seen in figure 1, K and Na do not have similar high and low concentrations due to the presence of two types of transport, ground and excited state. Excited state transport is energy dependent and happens about 1% as often as ground state. While the transport of the less active cations, such as Na, requires energy, the energy is principally involved in regulating cation movement, not in driving it. The concentrations are the result of a time-dependent membrane electric field which requires little, if any, energy for its

maintenance. It is interesting that many biologists concluded that there was active transport of Na, but not of K (11). Their model could not explain the Na concentrations without the invention of the concept of active transport with its elaborate energy-dependent Na pump situated in the membrane (1, 10, 11). They failed to understand the role of the P = O in membrane transport.

K CARRIES GLUCOSE

In the above experiment, glucose did not enable K transport into the cell. Actually, K transported glucose into the cell through its association with glucose. This is cation-facilitated transport of glucose. The apparent dependence of glucose on K influx was due strictly to the requirement of excited double bonds for Na transport in either direction. The results have frequently been misinterpreted as a dependence of K transport on glucose. On the contrary, it is K that carries glucose!

CYANIDE BLOCKS EXCITATION

Other interesting variations on these experiments have been conducted. See figure 4. Cyanide (-C = N) prevented the redistribution of the cations even when glucose was present (11). This result is predicted by the Brewer model. Brewer has shown that cyanide absorbs on membranes and therefore prevents double bond excitation (4, 7). Even though the energy necessary for bond excitation was provided through normal anaerobic glucose metabolism (glycolysis), this excitation was blocked by the cyanide radical. The action of the substance oubain is believed to be similar to that of cyanide in preventing double bond excitation (6). In these experiments, oubain prevented renormalization of the cation concentrations (1).

The effect of other substances on K-Na redistribution was investigated (1). One class of substances tested was believed to prevent glycolysis. The prevention of glycolysis should produce the same results as obtained in the absence of glucose. However, the authors do not know the exact mechanism involved.

CONCLUSION

The Brewer model provides a complete explanation of these experiments. The high K concentration found inside cells and high Na concentration found outside cells is maintained through ground and excited (energized) state transport which is regulated by the cell membrane. The force field at the cell membrane during ground and excited state conditons are different (6).

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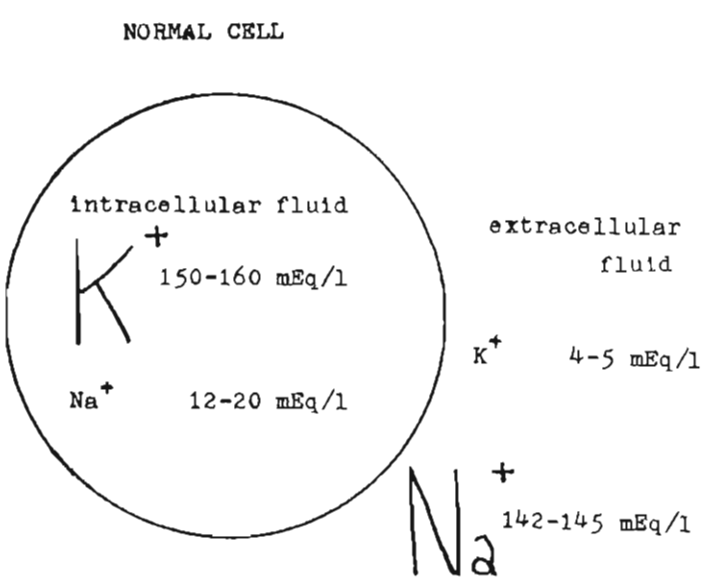
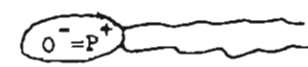
Diagrams for The Concept Of Active Transport



NORMAL CELL

Figure 1. Concentration of potassium (K+) and sodium (Na+) inside and outside the cell, expressed in milliequivalent per liter (mEq/1). Adapted from references 1 and 8.



2a. **PHOSPHOLIPID**

Phospholipid consists of two fatty acid tails and a phosphate head group which provides the P = O.

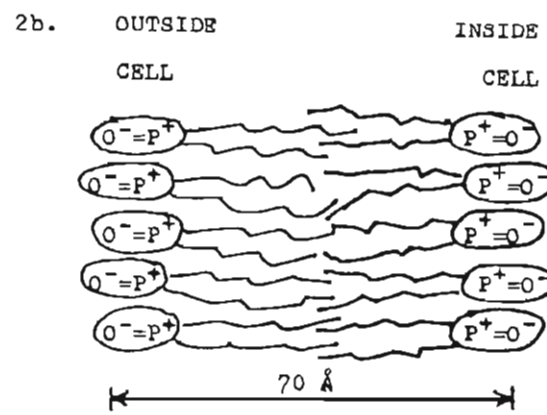


Figure 2. Phospholipids (a) form the lipid bilayer (b) of the cell membrane. The P = O is a regulating transport site.

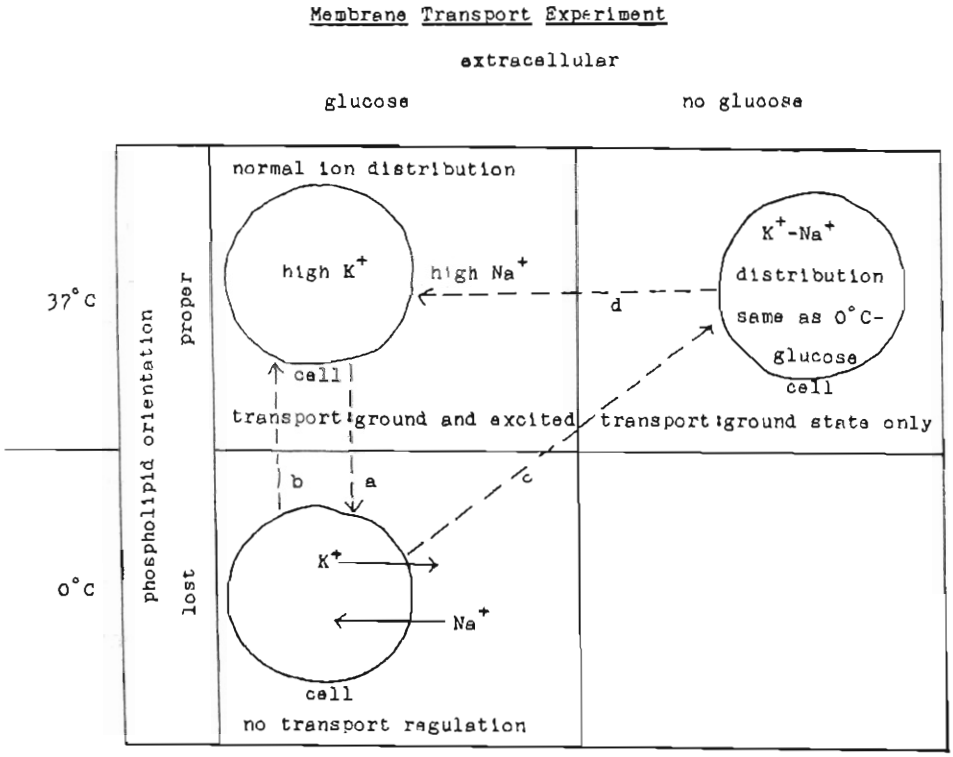


Figure 3. Normal ion distribution in human erythrocytes (red blood cells) in the presence of glucose is observed at 37°C. The cells a) are then cooled to 0°C and b) warmed to 37°C. In the absence of glucose, the cells at 0°C are c) thawed to 37°C and then d) exposed to extracellular glucose. Only at 37°C-glucose condition was normal ion distribution observed. Proper membrane phospholipid orientation occurred at 37°C and the extracellular glucose provided the energy source for excited state transport.

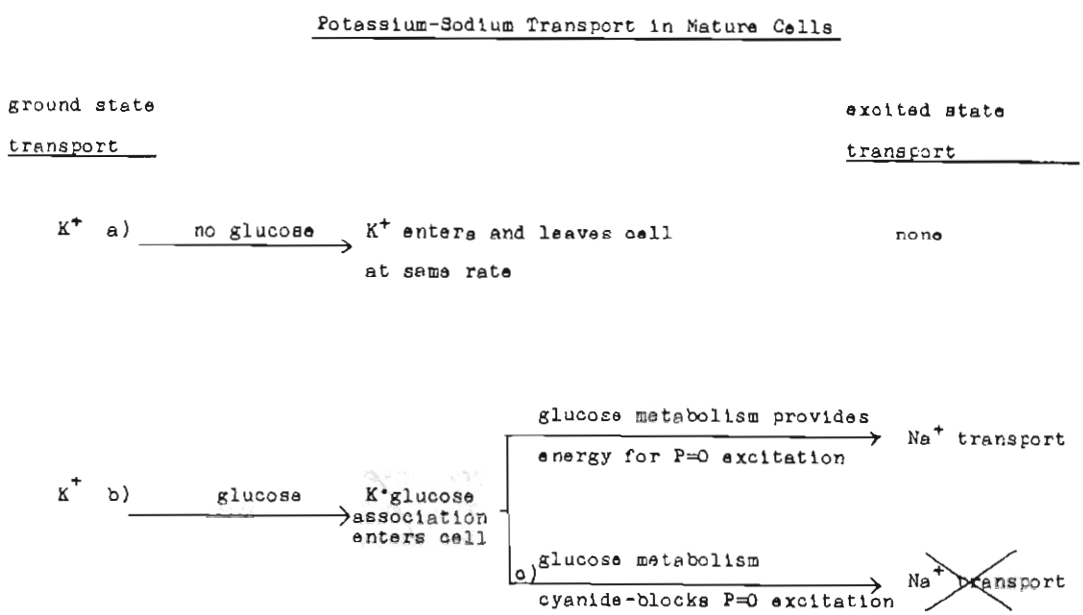


Figure 4. At 37°C a) K+ transport can occur when the membrane P=O are in ground state and in the absence of glucose, b) Na+ transport requires P=O excitation from energy provided by glucose which is supplied through K+ exchange, c) cyanide blocks excited state transport even when the necessary energy is available.

LAETRILE: MECHANISM OF ACTION

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More than 700,000 people in the United States will be told this year that they have cancer. More than 400,000 will die from it. "Cancer," says the American Cancer Society, "is the number two disease killer." For the past thirty years the number of deaths from cancer has increased essentially one percent per year. This year the increase may be several percent.

In virtue of the above, it is not surprising that a large controversy has developed over the use of laetrile as a possible cancer therapy. The primary confusing factor is that the mechanism of action of laetrile within the malignant tumor is not understood. This lack of understanding has resulted in its misapplication and sometimes in its improper application.

The purpose of this paper is to present (1) the mechanism of laetrile action on the cancer cell and (2) a possible cancer therapy involving laetrile. This will be followed by describing the cancer status in countries where laetrile and allied chemicals are found in the standard diet.

Orthodox cancer therapy today consists of surgery, chemotherapy and radiation. Surgery is often effective in removing the primary lesion. Unfortunately, metastasis is very common, especially in the absence of early diagnosis. In cases where metastasis is known or suspected, chemotherapy and radiation are being used. Chemotherapy consists of the administration of chemicals which are sufficiently toxic to kill the weak cancer cells but not the normal cells. Both are quite effective in metastasis provided the cells can be located. The fact the cancer is on the increase and is the No. 2 killer is conclusive proof that a satisfactory therapy has not been found.

Laetrile

Laetrile is found in apricot kernals and in many nuts. Similar type compounds are found in many roots and fibrous materials. The chemical formula is $C^{14}H^{14}N\,NaO^{7}$. In the molecule, the CN (cyanide) radical is attached to the CH group connecting two cyclic groups. Laetrile is often referred to as vitamin B^{17} by its proponents.

The theory that has been advanced for laetrile action is that in the cancer cells fermentations take place with the formation of a number of enzymes among which is betaglycosidase. This enzyme which is lacking in normal cells is capable of causing a breakdown of the laetrile molecules with the liberation of HCN. The HCN thus liberated in the malignant tumor is assumed to bring about cancer cell death since HCN is known to be a very powerful poison.

Some proponents of the laetrile therapy feel that if the HCN liberated within the cancer cells is not sufficient to bring about the immediate death of the cell, it may still counteract the toxic enzymes generated within the cell and thus "restore the host's vigor and appetite and loss of weight. It may also lessen the pain."

HCN Its Mechanism of Action

The biological behavior HCN in the organism makes it one of the most interesting of compounds. It has long been known that HCN is a most deadly poison. The lethal dose for humans is 50 to 60 mg. It is toxic either in the gas phase or as a salt. In an organism, it rapidly induces dyspnea, paralysis, convulsions and heart and respiratory arrest. In contrast, the presence of HCN in tobacco smoke, present to the order of 1100 parts per million, has a most interesting effect. Were it not for its presence, all who smoke would die shortly of cancer since the smoke also contains polycyclic carinogens in the vapor phase. Dr. Alton Ochsner has pointed out that all who smoke have the air passages of the lungs lined with cancer cells. Why these cancer cells remain dormant for years was an unanswered question. It can now be shown that it is the HCN in the tobacco smoke that prevents cell proliferation.

The mechanism of action of HCN on cell membranes is due entirely to the electrodynamics of the triple and double bonds. From 60-90% of the cell membrane is composed of phospholipids in the form of phospholipid bilayer. The phosphate head of the molecule contains a P = O radical. The C = N and P = O can serve as electron donors because they are bonds between atoms with different ionization potentials. In the C = N, the 6 electron orbitals which comprise the triple bond are displaced nearer the N atom than the C atom because of its higher ionization potential. Therefore, the C = N radical is highly polar with the N atom serving as a broad and moderately strong electron donor. For the P = O, the 4 electron orbitals of the double bond are displaced nearer the O atom than the P atom. In the ground (resting) state of the electron orbitals of the P = O, the O atom serves as a moderate to strong electron donor. If one of the electron orbitals is energized (excited), the O serves as a strong powerful electron donor.

Due to the positive and negative fields about the C = N radical, it is readily absorbed between the P = O radicals of the phospholipid bilayer. The consequences of this, as far as membrane behavior is concerned, are many. The HCN molecule is a poison because the presence of the C = N radical, absorbed between the membrane P = O radicals, completely blocks the double bond excitation. In consequence, the absorption of CN on the nerve cell membrane prohibits action potential. It has been shown in previous studies that the P = O excitation accounts for the exact shape and periodicities of the action potential curve. The cyanide radical also will block axon conduction. In consequence, the adsorption of CN prohibits nerve action and thus results in rapid death. In contrast, the HCN in sublethal amounts in tobacco smoke acts only as a depressant on nerve action and thus has a calming action. Unlike an organism, a malignant tumor does not depend on nerve action and therefore can't be poisoned by HCN in this manner. However, HCN can influence malignancies.

It has been shown that carcinogens are compounds that form permanent attachment to the P = O radicals on the cell membrane. They may also be compounds which will remain adsorbed for only a few hours, but under continous exposure act as a permanent layer over the cell membrane. For example, morphine may be carcinogenic under exposure. HCN can be carcinogenic for chain smokers. Since the presence of an adsorbed layer of polar radicals prevent double bond excitation, the attachment and transmission of $Na+$, Ca^{2} and $Mg^{2}+$ into the cell is prevented. It is these ions which transport peroxides into the cell. Since oxygen, therefore, cannot enter the cell, the glucose which is carried into the cell by the K will undergo fermentation. The result is that the pH of the cell will rapidly drop from the normal value of 7.35 to some place in the 6.5 to 6 range. The cell then in this acid medium loses all its control mechanisms and undergoes rapid proliferation; DNA action and RNA are completely altered. The consequence is that the cell is changed from a normal to a cancer type. The calcium content of cancer cells has been shown by mass spectrographic analysis to be reduced to the order of one percent that for normal cells. The same is true for sodium. In contrast, potassium which does not require membrane P = O excitation for its attachment and transmission is drastically increased. Thus it will be seen that, when oxygen is excluded from a cell and the glucose content is increased, the cell will change from normal to cancer.

Since the CN radical is not permanently adsorbed on the

cell membrane, short exposures need not be carcinogenic. Continuous exposure, however, as is the case for heavy smokers, can result in an oxygen depletion to the point where the lung cells turn cancerous.

As Dr. Ochsner has pointed out, the air passages of the lungs of heavy smokers are lined with cancer cells. The interesting point is that these cells may lie dormant for years. In contrast, most cancer cells proliferate rapidly. It has been shown by von Ardenne that the rate of cancer cell growth is an inverse function of the pH. He has also shown that cancer cells with pH near normal and especially above normal are prone to enter a dormant stage. At an alkaline pH of 8.5 to 9 the cells undergo a rapid death; at a pH of 9 the life expectancy of the malignant cell is only a matter of hours. The rise in pH of lung cancer cells is a direct consequence of the HCN content of the tobacco smoke. Thus, while tobacco smoke and HCN can cause cancer, HCN in the smoke can also cause a retardation in the rate of growth. The mechanism involved will be explained in detail.

The presence of C = N radicals as depicted in Figure 1 renders the membrane completely previous to ions through potassium (K +) in the Electromotive Series. Such a membrane would be even more pervious to the powerful alkalis cesium (Cs +) and rubidium (Rb +); these ions should, therefore, be taken up preferentially when they are present in the bloodstream. Enhanced alkali transport in cancer cells can raise their pH to a dormant or lethal level. Many tropical fruits contain appreciable amounts of rubidium; it is not surprising that these foods act as cancer depressants.

Conclusion

The mechanism by which laetrile can act on cancer cells is explained by the action of HCN on the cell membrane as outlined above. To summarize, it was pointed out that laetrile, in the presence of certain enzymes formed in acid cancer cells and found the malignant tumors, is dissociated with the liberation of HCN. Its C = N radical, because of its polar nature, is readily adsorbed on the cell membrane and is capable of rendering it completely pervious to potassium and the elements above potassium in the Electromotive Series. In the case of cancer cells located near a blood supply, the adsorbed CN will result in an increased uptake of potassium ions thus raising the pH to near normal or possibly even alkaline. In this pH state, the toxic lysosomal enzymes are rendered nontoxic; hence, the cancer cells no longer liberate these toxic materials into the blood stream. In consequence, much of the pain associated with cancer is eliminated.

From the above, it will be seen that cancer cells located near an abundant blood supply should be benefited by the administration of laetrile. Lung cancers, therefore, should be depressed. In contrast, a cancer in a rat's tail where the blood supply is limited might receive little help.

In the light of what has been said, laetrile in itself is not a cancer cure. However, based upon the High pH Therapy developed by the senior author, laetrile, among the materials so far tested, is by far the best known aid to a cure. In addition, it can be stated that in areas of the world where the incidences of cancer are very low, a detailed study of the composition of the food intake has shown that the content of cesium, rubidium and potassium in the food is very high. In fact, these foods fully meet the requirements of the High pH Therapy. In addition to the high mineral content of the foods, it has been found that inhabitants are always great nut eaters. They always eat the nut kernals either directly or ground into meal. It is these kernals that are very rich in laetrile. It must be concluded that laetrile as an aid can play a most important role in a cancer therapy.

Figure 1. Transport enhancement by cyanide radical.