HYDRA

book 3 - sea

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HYDRA

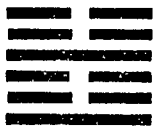
In search of a human hydra, an experiment in the evolutionary development of human society.

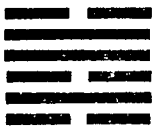
Volume 1
A Trilogy

Compiled by
Bill Morehouse

Attica Institute of Human Resources

HYDRA





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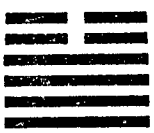

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Book 3 of 3

This book is a reference and resource work to be used in conjunction with its two companion books.

to my countrymen

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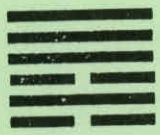

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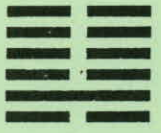

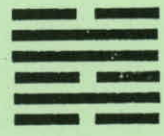

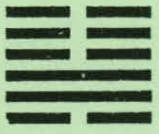

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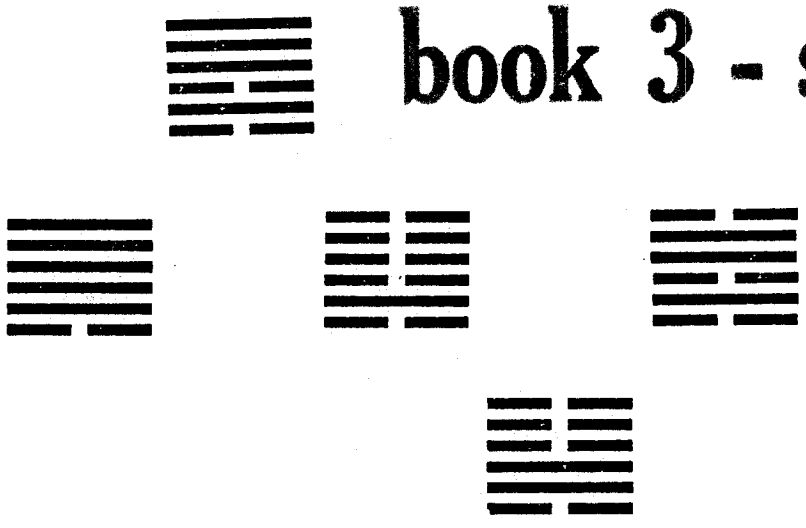

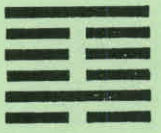

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* THIS IS A LETTER FROM THE PRESIDENTIAL PEN:

The White House,
Washington,
January 17, 1909

Personal

My dear Mr. Grahame,—My mind moves in ruts, as I suppose most minds do, and at first I could not reconcile myself to the change from the ever-delightful Harold and his associates, and so for some time I could not accept the toad, the mole, the water-rat and the badger as substitutes. But after a while Mrs. Roosevelt and two of the boys, Kermit and Ted, all quite independently, got hold of *The Wind Among the Willows* and took such a delight in it that I began to feel that I might have to revise my judgment. Then Mrs. Roosevelt read it aloud to the younger children, and I listened now and then. Now I have read it and reread it, and have come to accept the characters as old friends; and I am almost more fond of it than of your previous books. Indeed, I feel about going to Africa very much as the sea-faring rat did when he almost made the water-rat wish to forsake everything and start wandering!

I felt I must give myself the pleasure of telling you how much we had all enjoyed your book.

With all good wishes,
Sincerely yours,
THEODORE ROOSEVELT

INDEX

And the Lord said, "Behold, they are one people, and they have all one language; and this is only the beginning of what they will do; and nothing that they propose to do will now be impossible for them."

Genesis

word (wûrd), *n.* [ME.; AS.; akin to G. *wort;* IE. base ***wer-*, to say, speak; in the extended form ***wer-bh*, seen also in L. *verbum*, a word (cf. VERB, VERBAL)], 1. a brief expression; remark: as, a *word* of advice. 2. a promise; affirmation; assurance: as, he gave his *word*. 3. news; information; tidings: as, no *word* from home. 4. *a*) a password; signal: as, they gave the *word*. *b*) a command; order. 5. *usually pl. a*) talk; speech. *b*) lyrics; text; libretto. 6. *pl.* a quarrel; dispute. 7. a speech sound or series of them, having meaning and used as a unit of language: words may consist of a single morpheme or of combinations of morphemes. 8. a letter or group of letters, written or printed, representing such a unit of language. 9. [Archaic], a saying; proverb. *v.t.* to express in words; phrase.

at a word, in quick response to a request or command; immediately.
be as good as one's word, to live up to one's promises.
break one's word, to fail to keep one's promise.
by word of mouth, by speech, not by writing; orally.
eat one's words, to retract a statement.
give one's word, to promise.
hang on one's words, to listen to one eagerly.
have a word with, to have a brief conversation with.
have no words for, to be incapable of describing.
have words with, to argue angrily with.
in a word, in short; briefly.
in so many words, precisely; succinctly.
man of his word, a person who keeps his promises.
of few words, untalkative; laconic.
of many words, wordy; talkative; garrulous.
take one at one's word, to take one's words literally or seriously and, often, act accordingly.
take the words out of one's mouth, to say what one was about to say oneself.
the Word, 1. the Logos. 2. the Bible; Scriptures.
(upon) my word, indeed! really!: an exclamation of surprise, irritation, etc.
word for word, in precisely the same words; exactly.

word·age (wûr'dij), *n.* words collectively, or the number of words (*of* a story, novel, etc.).
word-blind (wûrd'blīnd'), *adj.* having word blindness.
word blindness, a cerebral disorder characterized by loss of ability to read; alexia.
word·book (wûrd'book'), *n.* [after G. ***wörterbuch; wörter***, pl. of *wort*, word + *buch*, book], 1. a dictionary or vocabulary. 2. a libretto. 3. a book of song lyrics.
word deafness, a cerebral disorder characterized by loss of ability to understand spoken words; auditory aphasia.
word·i·ly (wûr'də-li), *adv.* in a wordy manner or style.
word·i·ness (wûr'di-nis), *n.* wordy quality or condition.
word·ing (wûr'diŋ), *n.* choice and arrangement of words; phrasing.
word·less (wûrd'lis), *adj.* 1. without words; speechless. 2. unexpressed. 3. inexpressible.
Word of God, the Bible.
word of honor, pledged word; solemn promise.

Webster's

Literacy

The roots of words sink deep into our past.
There is much wisdom in words which can be found
by reading the dictionary as literature.

world (wûrld), *n.* [ME. *werld, world, worlde;* AS. *weoruld, ueorold,* etc., world, lit., age of man < *wer,* a man (cf. WEREWOLF) + base of *old;* basic sense "the age of man"], 1. the earth. 2. the universe. 3. the earth and its inhabitants. 4. *a*) the human race; mankind. *b*) the public: as, the discovery startled the *world.* 5. *a*) [also W-], some part of the earth: as, the Old *World. b*) some period of history, its society, etc.: as, the ancient *world. c*) any sphere or domain: as, the dog *world,* the animal, vegetable, or mineral *world. d*) any sphere of human activity: as, the *world* of music. *e*) any sphere or state of existence. 6. individual experience, outlook, etc.: as, his *world* is narrow. 7. *a*) secular life and interests, as distinguished from the religious or spiritual; social life and its concerns. *b*) people primarily concerned with the affairs and pursuits of the present life. 8. *often pl.* a large amount; great deal: as, the rest did him a *world* (or *worlds*) of good. 9. a star or planet. —*SYN.* see **earth.**

bring into the world, to give birth to.

come into the world, to be born.

for all the world, 1. for any reason or consideration at all. 2. in every respect; exactly.

in the world, 1. on earth or in the universe; anywhere. 2. at all; ever.

on top of the world, [Slang], lifted up with joy, pride, success, etc.; elated; exultant.

out of this (or the) world, [Slang], exceptionally fine; extraordinary; remarkable.

world without end, forever.

World Court, a court (*Permanent Court of International Justice*) set up by the League of Nations to settle disputes between nations.

Webster's

lief (lēf), *adj.* [ME. *lef, leve;* AS. *leof,* beloved, dear; akin to G. *lieb;* IE. base **leubh-*, to be fond of, desire; cf. LIBIDO, LEAVE (permission), LOVE, etc.], [Obs.], 1. valued; dear; beloved. 2. willing. *adv.* [Rare], willingly; gladly: only in *would* (or *had*) *as lief,* etc.

Li·ège (li-āzh′; Fr. lyezh), *n.* 1. a province of eastern Belgium: pop., 964,000 (1947). 2. its capital, on the Meuse River: pop., 156,000 (1947). Flemish name, *Luik.*

liege (lēj), *adj.* [ME. *leyge, liege;* OFr. *liege, lige;* prob. < OHG. *ledig,* free (G. *ledig,* not occupied), but influenced by L. *ligare,* to bind; in a charter of 1253 a MHG. *ledighman* glosses ML. *ligius homo,* liegeman], 1. in *feudal law, a*) entitled to the service and allegiance of his vassals: as, a *liege* lord. *b*) bound to give service and allegiance to the lord: as, *liege* subjects; hence, 2. loyal; faithful. *n.* in *feudal law,* 1. a lord or sovereign. 2. a subject or vassal.

liege lord, a feudal lord.

liege·man (lēj′mən), *n.* [*pl.* LIEGEMEN (-mən)], 1. a vassal; hence, 2. a loyal follower. Also **liege man.**

Lieg·nitz (lēg′nits), *n.* a city in southwestern Poland: formerly in Germany: pop., 24,000 (1946): Polish name, *Legnica.*

li·en (lēn, lē′ən), *n.* [Fr.; L. *ligamen,* a band < *ligare,* to bind, tie], in *law,* a claim on the property of another as security against the payment of a just debt.

li·en·ec·to·my (lī′ən-ek′tə-mi), *n.* [L. *lien,* the spleen; + *-ectomy*], the surgical removal of the spleen: also called *splenectomy.*

li·en·ter·ic (lī′ən-ter′ik), *adj.* of or having lientery.

li·en·ter·y (lī′ən-ter′i), *n.* [Fr. *lienterie;* Mod. L. *lienteria;* Gr. *leienteria* < *leios,* smooth + *entera,* bowels], diarrhea in which incompletely digested food is discharged.

Li·e·pā·ja (lē′e′pä-yä), *n.* Libau: the Lettish name.

li·er (li′ər), *n.* one who lies (reclines).

li·erne (li-ûrn′), *n.* [Fr.; see LIANA], in *architecture,* a short rib used in Gothic vaulting to connect the bosses and intersections of the main ribs.

lieu (lōō, lū), *n.* [ME. *liue* (in *in liue of*); OFr. *lieu* (in *au lieu de*) < L. *locus,* place], place; stead.

in lieu of, instead of; in place of.

Lieut., Lieutenant.

Lieut. Col., Lieutenant Colonel.

Lieut. Comdr., Lieutenant Commander.

lieu·ten·an·cy (lōō-ten′ən-si, lū-ten′ən-si), *n.* [*pl.* LIEUTENANCIES (-siz)], the rank, commission, status, or authority of a lieutenant.

lieu·ten·ant (lōō-ten′ənt, lū-ten′ənt; Brit., *esp. army,* lef-ten′ənt), *n.* [ME. *lutenand, lutenaunt, luftenand;* Late OFr. < *lieu, luef* (see LIEU) + *tenant,* holding, ppr. of *tenir,* to hold < L. *tenere,* to hold], 1. a person who acts for a superior, as during the latter's absence; aide; deputy. 2. a military officer normally commanding a platoon and ranking below a captain: see also **first lieutenant, second lieutenant.** 3. a naval officer ranking below a lieutenant commander and above a lieutenant junior grade. Abbreviated **Lieut., Lt.** (as a title in senses 2 & 3).

lieutenant colonel, a military officer normally commanding a battalion and ranking below a colonel and above a major: abbreviated **Lieut. Col., Lt. Col.** (as a title).

lieutenant commander, a naval officer ranking below a commander and above a lieutenant: abbreviated **Lieut. Comdr., Lt. Comdr., Lt.-Comm.** (as a title).

lieutenant general, a military officer normally commanding a corps and ranking below a general and above a major general: abbreviated **Lieut. Gen., Lt. Gen.** (as a title).

lieutenant governor, 1. an elected official of a State who ranks below and substitutes for the governor in case of the latter's absence or death. 2. in certain countries, an official substituting for the governor general of a province or district. Abbreviated **Lt. Gov., Lieut. Gov.**

lieutenant junior grade, a naval officer ranking below a lieutenant and above an ensign: abbreviated **Lt. (j.g.), Lieut. (j.g.).**

life (līf), *n.* [*pl.* LIVES (līvz)], [ME. & AS. *lif;* akin to G. *leib,* body; sense "body" for all other Gmc. cognates; prob. IE. base **leip-*, to stick, stick to, adhere (seen also in Gr. *leipein,* to leave, remain, Eng. *leave*), whence sense development: what adheres—what remains—body—life], 1. that property of plants and animals which makes it possible for them to take in food, get energy from it, grow, adapt themselves to their surroundings, and reproduce their kind: it is the quality that distinguishes a living animal or plant from inorganic matter or a dead organism. 2. the state of possessing this property: as, we tried to bring the drowned child back to *life.* 3. a living being, especially a human being: as, the cyclone took a heavy toll of *lives.* 4. living things collectively, often of a specified kind: as, plant *life.* 5. the time a person or thing is alive, or a specific portion of such time: as, Shakespeare's *life* in London. 6. one's manner of living: as, his was a *life* of poverty. 7. the activities of a given time or in a given setting, and the people who take part in them: as, military *life.* 8. lives considered together as belonging to a certain class or type: as, low *life.* 9. *a*) an individual's animate existence. *b*) an account of this; biography. 10. the existence of the soul: as, the eternal *life.* 11. something essential to the continued existence of something else: as, freedom of speech is the *life* of democracy. 12. the source of vigor or liveliness: as, she was the *life* of the party. 13. vigor; liveliness; animation; vivacity. 14. the period of flourishing, usefulness, etc.; period during which anything lasts: as, most fashions have a short *life.* 15. in the *fine arts, a*) a lifelike quality or appearance. *b*) representation from living models: as, a class in *life.*

a matter of life and death, 1. something whose outcome determines whether a person lives or dies; hence, 2. an extremely important matter.

as large (or **big**) **as life,** life-size.

bring to life, 1. to bring back to consciousness. 2. to make lively; animate.

come to life, 1. to recover consciousness. 2. to become lively or animated.

for dear life, to, or as if to, save one's life; with a desperate intensity.

for life, 1. for the duration of one's life. 2. in order to save one's life.

for the life of me, [Colloq.], even though my life were at stake on it; by any means: used in negative expressions.

from life, from a living model.

not on your life, [Colloq.], by no means; certainly not.

see life, to have a wide variety of interesting and exciting social experiences.

take life, to kill.

take one's own life, to commit suicide.

to the life, like the living original; exactly.

true to life, corresponding to what happens or exists in real life; true to reality.

life belt, a life preserver in the form of a belt, worn around a person's chest.

life·blood (līf′blud′), *n.* 1. the blood necessary to life. 2. the vital part or animating influence of anything.

life·boat (līf′bōt′), *n.* 1. a strong, seaworthy boat kept in readiness on the shore for use in rescuing people in danger of drowning: it is usually built with air chambers, etc. for more buoyancy. 2. one of the small boats carried by a ship for use in case the ship has to be abandoned.

life buoy, a life preserver (sense 1).

life cycle, the series of changes in form undergone by an organism in development from its earliest stage to the recurrence of the same stage in the next generation.

life expectancy, the average number of years that an individual of a given age may expect to live.

life-giv·er (līf′giv′ər), *n.* a life-giving person or thing.

life-giv·ing (līf′giv′iŋ), *adj.* 1. that gives or can give life. 2. strengthening; refreshing; inspiring.

life·guard (līf′gärd′), *n.* an expert swimmer employed at bathing beaches, pools, etc. to prevent drownings.

Life Guards, [earlier also *lifeguard;* prob. after obs. D. *lijfgarde,* bodyguard; *lijf,* body (cf. LIFE) + *garde* (see GUARD)], two regiments of British cavalry which act as a bodyguard for the king and queen.

life history, 1. the history of the changes undergone by an organism in development from the egg, spore, etc. to its death as an adult. 2. one series of such changes.

life insurance (or **assurance**), insurance in which a stipulated sum is paid to the beneficiary or beneficiaries at the death of the insured, or to the insured when he reaches a specified age.

life interest, interest (in property) that is payable to a person during his lifetime but cannot be passed on by him to another or others at his death.

life·less (līf′lis), *adj.* 1. without life; specifically, *a*) inanimate. *b*) dead. 2. dull; listless. —*SYN.* see **dead.**

life·like (līf′lik′), *adj.* 1. resembling actual life: as, this writer gives a *lifelike* picture of early America. 2. closely resembling a real person or thing: as, a *lifelike* portrait.

life line, 1. a rope shot to a ship in distress near the shore in order that connection may be established between it and the shore. 2. any rope fastened where it may be clutched by persons in danger of being swept away and drowned. 3. the rope by means of which a diver is raised and lowered, used by him for signaling. 4. a line in the palm of the hand, curving about the base of the thumb, supposed (in palmistry) to reveal facts about the person's life. 5. a commercial, especially maritime, route of great importance: the route from England to India via the Suez Canal is often called the *life line* of the British Empire. 6. a route that is the only one over which supplies can be transported to a certain place.

life·long (līf′lôŋ′), *adj.* lasting, or remaining as such, for all one's life: as, a *lifelong* defender of liberty.

THE PRINCETON GALAXY

Four Princeton scientists fire a starburst of ideas about ends, beginnings, transformations and reincarnations: "cycle after cycle, not only of man but of the universe itself"

Robert H. Dicke: Big-bang radiation

Jeremiah P. Ostriker: Deaths of stars

Remo J. Ruffini: Evidence of black holes

John A. Wheeler: The moment of collapse

Interviews by Florence Helitzer

The language of modern physics is alluring. Such words as "birth," "death" and "rebirth" and phrases like "cycles of creation and destruction" constantly recur. These words have been encountered before in other contexts: in myth and fairy tale, in oriental religion and in the Bible, in literature and in philosophy. The past overflows with them.

In an attempt to find a bridge between past culture and current physics, now reaching into an immense universe, questions drawn from religion, mysticism and philosophy were put to four eminent cosmologists who teach and do research at Princeton University. Since modern physics was our point of departure, it became necessary during the course of the interviews to elucidate some of its concepts.

The four scientists, who were interviewed separately, are:

Dr. Robert H. Dicke, *Cyrus Fogg Brackett Professor of Physics. In 1965 Dr. Dicke and his research group revived the hypothesis of Gamow and Alpher that the universe was born in the explosion of a primordial fireball. Dr. Dicke suggested that radiation from this "big bang" should be detectable as radio waves in space. At about the same time, a Bell Telephone Laboratories team detected such radiation but couldn't explain it until learning of the Dicke theory. Another of Dr. Dicke's interests is gravitation physics. He suggests the existence of a "scalar" gravitational field to account for part of the gravitational attraction, thus questioning Einstein's general theory of relativity.*

Dr. Jeremiah P. Ostriker, *Professor of Astrophysical Sciences. Dr. Ostriker's theme could be described as the deaths of stars. Last year he won the American Astronomical Society's Warner Prize for his contributions to the theory of rotating stars, in particular for investigations of the internal structures of rotating white-dwarf stars and for a theory of pulsars.*

Dr. Remo J. Ruffini, *Assistant Professor of Physics. Dr. Ruffini, who works in close collaboration with Dr. John A. Wheeler, recently reported having found persuasive evidence for the existence of black holes in space, bizarre dense objects that may be the remains of stars that have undergone gravitational collapse. The gravitational field of a black hole is so strong that nothing can ever escape from it. Such an object is invisible because it emits nothing— not even a light ray.*

Dr. John A. Wheeler, *Joseph Henry Professor of Physics. Dr. Wheeler, one of the first American scientists to concentrate on nuclear fission, worked with Niels Bohr in 1934 and again at Princeton in 1939. His research has ranged from elementary particles to gravitation and the cosmos. Dr. Wheeler has worked out a detailed description of the black hole, including what happens at the*

moment of collapse. He views the black hole as an omen for the future gravitational collapse or death of the universe [see ID, December 1972].

Each scientist consented to the interview for similar reasons. For example:

Ostriker: There are a lot of similarities between the mystic's view of the world and Einstein's [see "The Quotation Game: How Can You Tell a Physicist from a Mystic?" ID, February 1972]. I don't know whether it's coincidental that currently the best cosmology is a "big bang" cosmology and that the best potential rival is a cyclic one, which is more like the Eastern view. I am intrigued. I suspect that I could learn a lot just from thinking and talking about it.

Wheeler: Through the very process of talking about such issues, one tends to understand them better. It's like the little old lady who said, "How do I know what I think until I hear what I say." But then there is the other side of it—that one has to be very humble in the face of people who have dealt with these eternal issues over so many generations.

We began by trying to focus on the nature of the observer rather than on what is observed. Specifically, we tried to pinpoint a mysterious and elusive human process: intuition. There was an assumption that past religious cosmologies had evolved intuitively. There was also a corollary that the mystic's view of the cosmos is largely intuitive and often ineffable . . .

Q: Is it possible to have knowledge without adequate language or the precise and defined way of communicating that science offers?

Ostriker: I don't think people know what produces ideas. They may know where they start and where they finish. The mystics' experiences might be analyzable if we knew enough about the series of steps. You may know that if you fill your tank with gasoline and then press the accelerator, the car will go. You might not know what goes on inside, but you can predict the result. There are many things we can't see. You think about a problem, and you wake up in the morning with a solution to it. It's possible that it was some divine leak. We simply can't say.

Q: What has been your experience with intuition?

Ruffini: You seem to hit something that is true in nature. You study and work for a long time, and once in a while you feel that something is true. You cannot justify it at the moment, because the experiment to test and verify your theory has not yet been performed. Still, you have this feeling that your intuition is really in correspondence with nature. To keep knowledge moving, we need a lot of work and a great many challenges. And nothing is more challenging than this feeling of finding something new.

Q: Is there any way of analyzing human intuition?

Dicke: Intuition is very interesting. It plays a powerful role in the origin of theory, and I don't think we know very well what it is except that an element of trial seems to be very important.

Q: Can we try to define it a little bit better? From your previous description, a prerequisite would be education or experience with the problem.

Dicke: That's right. I think you must have some background knowledge, or else an intuitive solution, an intuitive seizing on an idea, would be ridiculous.

Q: Can intuition be prophetic? Can it tell you things you have no real way of knowing from experience?

Dicke: I would think intuition comes out of past experience. In a sense you knew but perhaps didn't realize that you knew.

Q: Why do so few people seem to have intuition?

Dicke: That is both true and interesting. Intuition has an aspect of creativity too, doesn't it? For example, there could be an extremely capable mathematician who knew almost everything that's ever been discovered about mathematics and could reproduce it. But he might not be able to create new mathematics. This kind of encyclopedic knowledge is without creativity. Yet someone whose knowledge is not so widespread may be more creative. I think a strong element in intuition and creativity involves quickly examining a number of possibilities and throwing out the obviously ridiculous ones.

Q: Does anything else happen?

Dicke: I suspect that images play an important role in creative thinking. Even when I'm dealing with a very abstract idea, such as the multidimensional space in which one pictures the state of an atom, I have a rough mental image of that space. It's strange that we can form an image of such an abstraction as space.

Q: Will you then proceed from image to analogy?

Dicke: Yes, modeling. The theoretical structure of physics is a mathematical model. That's what is so beautiful about it. There isn't quite a one-to-one relationship, but theory provides a reasonable model of the world that can be manipulated in mathematical symbols. The process of carrying out a theoretical investigation is something like an experiment. And that's a really lovely concept—an experiment carried out without apparatus. The theoretical experiment is performed sitting in your armchair: you decide from the theoretical structure what would happen if a real experiment were performed. Then you actually perform the experiment to see whether or not it behaves the way the conceptual one did.

For ID in Princeton and New York City, photographed by Susan Lombardo

"Intuition comes out of past experience. In a sense you knew but perhaps didn't realize that you knew." — Dicke

Q: Does the intuitive process, then, rely more on modeling or symbolism than it does on language?

Ostriker: Very often there is a discovery in physics, and then someone else rediscovers the same thing using different language. Only after considerable work do they realize that they have

both discovered the same thing. So, in a sense, the fact was there and the language disguised it. The means of discovery may involve a symbolism that is not linguistic. For example, Einstein thought geometrically. Most physicists seem to think in mechanical images, perhaps because of their education in Newtonian physics. So they learn to make models in their heads. Or they think in geometrical images because of their background in mathematics.

"This is a world of pure mathematics, and when we penetrate to the bottom of it, that's all it will be"—Wheeler

Mathematics and the Physical World

Q: Mathematics has often been compared to a chess game, which, though valid and often exciting, doesn't tell us anything about what might be happening even one inch away from the chessboard. So why and how does mathematics work for the physical world?

Dicke: There's a structure to mathematics that has no obvious inherent relation to the structure of the physical world. But, interestingly enough, several branches of mathematics have developed that have been useful in describing the physical world. It's not clear that there should be any connection at all. It's true that when you look at the structure of mathematics you find a game, like chess, played with rules, a formal structure. Yet, you reason and think about the external world in relation to the mathematical structure of physical theory. Like moves on the chessboard, you play with the formal mathematical structure of the physical theory and gain some understanding of the physical world itself, with no direct observation. (Of course, the theory originated in a host of observational results.) Later you make an observation to see whether you're off the track or not. This observation is the essential part—without this there can be no science.

Ruffini: How a mathematical structure can correspond to nature is a mystery. One way out is just to say that the language in which nature speaks is the language of mathematics. This begs the question. Often we are both shocked and surprised by the correspondence between mathematics and nature, especially when the experiment confirms that our mathematical model describes nature perfectly.

This surprise and shock automatically pose a different question, which some people choose to answer in a religious manner and others refuse even to ask. At this point the decision involves recognizing the presence of a god who has arranged it all. To some people the question does not make sense. Still, common to both these attitudes is the feeling of surprise and happiness in discovery, which generates a deeper respect for nature. Nature appears to us simpler and more and more beautiful. This serenity and happiness is, I think, exactly the feeling that in the past was called the religious feeling.

Wheeler: As one looks around at the trees and flowers and birds, this wealth seems to be about as far as possible from anything mathematical. It's only when we look into nature in more detail that we realize that it's made out of these cells and those genes and these molecules and those atoms and these particles. And the simplicity is there—it's inescapable! But what makes us think that as we go on we're going to come closer to the world of mathematics? I suppose that there's nothing more comforting than that this is the way it has been. Eugene Wigner [Nobel Laureate in physics and a colleague] puts it in a marvelous phrase of his, "the unreasonable power of pure mathematics."

The fact is, it works and we tend to use what works. But why should mathematics work? Other people have put it in language far more vivid than I can hope to do—the idea that this is a world of pure mathematics and when we penetrate to the bottom of it, that's all it will be. We don't have to go to the people in the world of logic and mathematics to hear that all existence is a dream and we are the stage managers of this dream. But it's healthy and helpful, in this connection, to refer back to [the seventeenth-century philosopher and mathematician, Gottfried von] Leibniz because he says, whether it's a dream or not, it's a world in which reason offers a way to make progress and helps us along every step of the way.

Faith in the Power of Science

Q: There are two imponderables here: the dream and the "unreasonable power of mathematics." I don't see how scientists, aware of these dilemmas, can have such faith in their observations, reasonings, mathematical constructs, theories.

Ruffini: I can only answer with an example. After pulsars [stars that have undergone partial gravitational collapse and are emitting light in sharply defined pulses—also called neutron stars] were discovered, I spoke with Emilio Segre, who was awarded the Nobel Prize for his discovery of the antiproton. I told him we were finally convinced that we had found neutron stars. And Segre, speaking in elegant, old-fashioned Italian, said, "Perhaps God is so powerful that He could find a different way of making a pulsar than with a neutron star. How can you be so definite in saying you have found a neutron star?" He was alluding, I think, to the problem of the theoretician, which is not just to find *a* correspondence between his theoretical framework and the physical world but to find the *unique* correspondence.

Q: How *can* you be so definite?

Ruffini: Physics is an expanding frontier. As more data are accumulated, new theories and predictions arise to fit the data; but these in turn demand more experiments and observations. There is a constant feedback between experiment or observation and theory, with the experiments either confirming the theory or altering it.

In the case of the black holes, which emit neither radiation nor light, evidence for their existence has to be indirect. The reasoning was that if a black hole exists as part of a binary star system, it will be detectable through its influence on its luminous companion. In

sucking material from the normal living star, the black hole will overheat the falling material. The overheated material will emit an enormous amount of X rays, equal to some 10,000 times the luminous energy of our own sun.

Q: And you found such X-ray sources?

Ruffini: Yes. The American Uhuru satellite has recently discovered such X-ray sources. Their features are so unusual that we see no other way to explain them except through neutron stars and black holes.

The data on these X-ray binary stars, collected every day from the Uhuru satellite and from radio and optical telescopes around the world, fit our theoretical predictions marvelously well. Nevertheless, we consider most seriously any alternative explanation. Much of the excitement comes from proving or disproving, on the basis of the experimental results, alternative explanations of the same phenomena. In this light there has been much speculation recently on the uniqueness of the final configuration of gravitational collapse. Our group has been examining how many different kinds of black holes we could have and devising experimental checks to pin down the differences among them.

Some scientists have even speculated on the possible existence in nature of "naked singularities"—what we could perhaps call black holes without horizons: regions of space in which the density of the material becomes so high and extreme that the entire formalism of theoretical physics, as known today, will break down, and totally new phenomena could occur. Though fascinating and extremely challenging from a theoretical point of view, these "naked singularities" do not seem to me to be very realistic. No experimental evidence exists today of any major breakdown in our theoretical framework.

Q: Why do you have so much faith in science—especially in cosmology, where so little is actually observed?

Dicke: Surprisingly, the amount of information is increasing rapidly. Astronomical observations show an expanding universe, and from the rate of expansion, we can project back to a beginning. These conclusions are indirect, based on observations of stars, galaxies, microwaves and radioisotopes. And there is an involved analysis of stellar evolution that permits us to decide how old some of the oldest stars in our galaxy are. This age is found to be the same as that for the expansion of the universe as a whole, so we believe that these stars must have formed near the beginning of the expansion.

Q: I am puzzled about the relationship between theory and experiment. Which represents the act of faith?

Ruffini: As far back as 1630, Galileo introduced the dogma that the final judge for scientific theory is the experiment. The experiment is our way of posing the right question to nature. The answer or solution that emerges from it is assumed to be unchanging in time and space. If performed under the same conditions, the experiment will always produce identical results. Our faith in the reproducibility of the experiment is indeed a dogma. And dogmas can appear to some to be unreasonable and rigid. But the most compelling reason for our faith is the extraordinary amount of knowledge we have acquired in natural science through our acquiescence to Galileo's dogma.

"Some scientists have even speculated on the existence of 'naked singularities'—what we could call black holes without horizons" – Ruffini

Q: Will the next step be toward more and more complex observational instruments and experimental apparatus?

Wheeler: I suspect that the next step will be determined more by pure thought than by experiment. The worst possible thing would be to say that by pure thought we can understand how the world is put together, because if there's anything we've learned from the history of the past, it's all the surprises that are in store for us. Nothing has been more effective in driving us to these surprises than experiment itself. And yet we've also learned that out of the imagination of man, the feeling for symmetry, the instinct for what is beautiful and right and simple, we can make enormous progress. While we must make our way in this world by experiment, our guides, I think, must still be in large measure the philosophers and thinkers of the past.

Time and Space

Q: The religious believer claims that it is possible to transcend these dimensions. I don't know that the space-time concept, like mathematics, is anything more than a way of defining existence and the world. Is it conceivable in physics for something to exist or an event to take place outside space and time?

Wheeler: Einstein speaks somewhere of Leibniz as one of the very few men who preserved his skepticism toward the Newtonian view of space and time. This is a healthy thing to realize, be-

cause it's taken for granted that spacetime is what physics tells us it is, a framework for all that goes on. It's astonishing to be reminded that this is really a mental construct we ourselves build up out of our experience.

Q: Can time exist in a void?

Dicke: Time is not something one can measure, like water. I think the nicest way of describing time is to relate it to space. If two bodies collide, their collision can be characterized as happening at a certain place and a certain time. If two other bodies collide, the event might happen at a different place and a different time. But when you try to define the distance and time difference between the events, you find that complicated concepts are involved.

Q: If there were no events?

Dicke: If there were no events, you would be speaking of a universe, if you could conceive of it, that was static. Time would then have no meaning.

Q: Is time always a continuum?

Dicke: This raises an interesting question in relation to order—whether one thing comes after another or before, whether one thing causes another but not vice versa. The question of order is very interesting, because the laws of physics are reversible under time reversal. You would think that under these conditions there would be no way of saying whether something happened before or after because you could measure time in either direction. The only thing we've been able to come up with as a way of distinguishing future from past is the phenomenon of order and disorder. The universe tends in the direction of more disorder, of increasing entropy, so the direction of increasing disorder is the direction of time flow.

Transformations

Q: This word "transformations" has current usage in depth psychology, so we're hearing it a lot. But it comes from the past; all mythologies and religions deal with transformations or a transformation. By this is meant various things: that things or beings change their shape or form in time and space; that one thing becomes another; that everything will someday be different, as after Judgment Day. Physics deals a lot with transformations because physicists agree that the world is in a state of becoming, that things change in space and time. Has this idea led you to further speculation?

Ostriker: Many of the transformations that we know about depend on the orientation of the observer. One observer looking at a given world will see it differently from another observer even though the world is the same. They can quite honestly see different things. The physical laws are invariant systems, but if you are at different coordinates, you see different things.

Q: But some transformations are not at all obvious. Would one dream, for example, that not only can matter be transformed into energy, but that the transformation is reversible?

Ostriker: You're right. Very often in physics two things are thought to be different, each one preserved as a conserved quantity. Then afterward you discover that they are different manifestations of the same thing and that the sum of these two things is the conserved quantity. So one thing changes into another. It's unexpected when it's discovered. You say, gee whiz, there are fewer things in the universe than we thought.

Q: May we talk about aspects or manifestations, about things that seem different but are really not or are other than they appear to be? Are particles really particles, or are they bits of energy?

Dicke: These are different words being used to describe the same thing. We can only describe the way things behave. Our views of the nature of physical particles have changed. There was a time, not too long ago, when people thought of the proton and neutron and electron as definite particles created at the beginning of the world. One could change into another, but each had a definite separate existence. A more common view now is that a particle is a continually changing form, that it has a complex structure. A neutron, for example, can be thought of as being a neutron part of the time and a proton, electron and neutrino part of the time. It's a very complicated picture with particles forming and reforming, dissolving into one another.

Q: Is there a situation in which things become each other and can no longer be properly individuated or defined?

Dicke: It's not inconceivable that someday we will have a theory that will view all the elementary particles as different states of the same entity, which would then take various forms. We've seen many attempts in the last decades to create a so-called master formula, an all-encompassing theory. These attempts have not been very successful.

Q: What kind of reality do the particles have?

Ruffini: The particles, as they manifest themselves here and now, are absolutely necessary for our view of the universe. The size of the particle appears to us to be related to the size of the universe, to the dimension of the stars and even to our own existence. It seems like a circle: we exist because of the universe, the stars, the sun; and, ultimately, everything exists because of the particles. Yet, we do not think that the particle is the final structure of nature.

Wheeler: The particle is a concentration of energy endowed with all kinds of special properties that set it off from other particles and from energy in the raw. And if there is any mystery that's greater than any other in present-day physics, it's why particles should have this set of unique and characteristic properties. And if that's the greatest mystery in physics today, then it's really an enormous encouragement to think we may someday make progress in understanding this mystery. That is, we may realize that the identity of the particles gets washed out or transcended when these particles fall into a black hole. There's absolutely no way to keep track—by any measurement made from outside the black hole—of what went into it. In this way the black hole symbolically marks the threshold between the world of the individuated and the world of the abstract.

Q: I do not understand the relationship of the particles—the very, very small—to the universe—the very, very large. Why should the same laws work for both?

Wheeler: In the past five years one of the greatest developments in elementary particle physics has been so-called conformal invariance, the discovery that the equations of elementary particle physics possess a property that in effect is this: changing the scale in which you examine the phenomenon does not change the nature of the phenomenon. For decades this so-called conformal invariance has been known to be a property of electromagnetism. The conformal feature of gravitation physics has been known for a lesser time. But the conformal features of elementary particle physics are a discovery of the past five years. This strange feature of nature that permits us to subsume the very large and the very small under the same kind of equation is something we don't yet understand, but it raises in one's mind the perpetual question: Can it be true that what we think of as the very

small and what we think of as the very large are really not so different?

Unity or Oneness

Q: The quest for a unifying principal is as old as recorded history. Why do scientists feel that nature is unified?

Ruffini: Again it's a belief. And the belief holds that there is only one nature, which is completely self-consistent. It is also true that we perceive more and more unity in nature. In this connection the philosophy of Leibniz has been important to our thinking. His theory of monads, for example. It is possible to remove one monad from the Leibnizian universe and from its analysis understand the structure of the universe.

Q: Are you saying that this quest for unity has been as consistent in physics as it has been in philosophy and religion?

Ruffini: Yes, but we have also had tremendous success in our unifying. When Galileo described the motion of a particle, he used a great many brilliant geometrical tricks to make it fit circumstances. Newton's world view was mathematically more sophisticated, and his equations explained in complete generality all possible motions of a system in a space given a priori for any instant of time. General relativity presents us a totally new view of the key ideas of space and time, so it is both more complex and more unifying at the same time. Paradoxically, however, once one understands the new theory, nature appears to be very much simpler.

Q: In experiencing the world, we experience its multiplicity. How then do we get multiplicity out of oneness? Is the oneness manifesting itself in a multiplicity of different ways, among them the very large and the very small?

Wheeler: It really comes back to your question about the power of mathematics. To me one of the most remarkable things is the multiplicity that came out of the Schrödinger equation [the basic equation in modern physics, replacing Newtonian mechanics in the description of atomic phenomena]. It was far beyond anyone's power of thought, Schrödinger's or anyone's, to anticipate the wealth in that one equation. Similarly, I believe that when we discover the equation behind the universe, for a long time we won't realize the multiplicity that's hidden in it. We won't realize how we ourselves fit into it.

I suspect that at present there's nothing hindering us more from getting this equation, the equation behind the universe, than the multiplicity we see about us and the gargantuan possibilities that exist for our interacting with these multiplicities. By comparison, it's preposterous to think that one equation, particularly a simple equation, could have everything hidden in it.

"How did Mendeleev get to the one, the unity? Unity emerged from the search for unity!"— Wheeler

Q: I have just read an article in which you use Miës van der Rohe's architectural edict, "Less is more!" and, by analogy, you create a new analogy, "Much into little!"—your description of what happens to matter in black holes. You mentioned Dmitri Mendeleev, the inventor of the periodic table of the elements, and his quest for unity.

Wheeler: How did Mendeleev get to the one, the unity? The poor man was giving lectures in chemistry, and he so wanted his students to get the feel for chemistry. He thought it would help to arrange the elements in some natural tabulation. He searched for ways that would make it easy for his students to understand, and in the process he himself understood. Unity emerged from the search for unity!

Birth, Death, Rebirth or Beginnings

Q: Can you conceive of there being no beginning and no end?

Dicke: I have trouble with no beginning and no end. If our laws of physics permit us to say what happened yesterday, you would think that they would permit us to say what happened the day before. We ought to be able to continue indefinitely. We ought not to come to the day when we could not say what happened before that. In other words, there should be no real beginning.

Q: You incline toward the "big bang" theory of creation. Where did the big bang come from?

Dicke: Our observations today are not complete enough to give us a certain picture of what happened billions of years ago. The further back you go, the more difficult it becomes to speculate. But despite this difficulty, we have a measure of confidence in talking about what happened only a few seconds after the big bang. This confidence comes from a variety of sources, including the helium content of the sun and stars.

Q: Could there have been a different universe prior to the big bang?

Dicke: I would like to believe so, but we can't find any support for that idea in the theoretical structure.

Q: Could it have happened out of nothing if there had been no particles?

Dicke: This is a real problem because the theoretical structure we have develops a singularity as you go back in time, and our ideas are limited by this theoretical structure. We cannot go back in time beyond a certain point. We have a philosophical reason to believe that you can go back further, but in terms of the formal structure of physics, you can't find a way to do it.

Q: I think that two phenomena are now taken for granted: a continuous complication of matter from the lighter and simpler toward the heavier and more complex elements and a constant interchange of matter so that new stars are perpetually forming from the ashes of stars already dead. Would you say something about this constant death and renewal in the universe?

Dicke: As we see it, the very early universe was so hot that the heavy elements couldn't exist. They would have evaporated into electrons, protons and neutrons. Then as the universe began to expand, it cooled and the hydrogen (the first element that would be formed) reacted with neutrons to form helium. So there was the helium and hydrogen and not much else—a little lithium, a little beryllium. Everything heavier was

"Atoms in your body have been through several stars—they were ejected many times as gas from exploding stars"—Ostriker

formed later in the stars.

Q: Will you explain cosmic deaths?

Ostriker: Deaths of stars—that's something I work on all the time. Certainly we know that a lot of the matter in a star is reprocessed at its death. When a star dies, some of the matter collapses with it, but a lot of it is ejected. This matter will be included in the next generation of stars and so on ad infinitum. It's been estimated that atoms in your body have been through several stars—that they were ejected many times as gas from exploding stars.

Q: What transformation has matter undergone in the collapsed part of the star? Would we recognize it as matter?

Ostriker: We know at least three different ways in which stars can die. One way is to form white dwarfs. These are about the mass of the sun and the size of the earth. They're very dense, but they are made up—so far as we know—of ordinary elements. If you could take a cubic inch out and put it in the laboratory, it would be recognizable—the same elements that we have on earth but in different proportions. In neutron stars the surface layers are also recognizable, but the interiors would be quite unlike any state of matter on earth. In these stars the density is almost unimaginably large: a cube 1/16th of an inch on each side would have a mass of 100,000 tons.

Q: And in black holes?

Ostriker: Speak to John Wheeler about that. At very high densities there are probably particles that we've never seen on earth. It's very bizarre. If you made a bit of a black hole, there would be nothing you could hold it in. It would be tiny, and it would just fall through the earth picking up matter. A one-centimeter black hole would weigh 10^{28} grams, or the mass of the earth, I think.

Q: So in the process of dying, the star liberates energy, or is this too bizarre a way to describe it?

Ostriker: We might have a bit of fun in forming an analogy on that. There have been arguments that evolution is directly influenced by cosmic rays. I think they're interesting speculation. Cosmic rays, according to current theory, come from deaths of stars, exploding stars or supernovae. Thus there might be a direct connection between what is given out at the death of a star and the evolution of life on earth. That blue light in the Crab nebula is unlike any other kind of light. It's produced by very high-energy particles, cosmic rays in the expanding nebula.

Q: What's making the cosmic rays?

Ostriker: The present theories have it that the pulsar is a little, rapidly spinning star ejecting particles at extraordinarily high energy.

Q: Is this a star that's dying or dead?

Ostriker: Dying, but not quite dead. Unlike a black hole, which is totally dead, this is still giving out enough energy to keep the whole nebula shining.

Q: What happens to the particles after they have fallen into a black hole?

Wheeler: The particle had mass before it entered the black hole. After the black hole has absorbed the particle, its mass has been augmented, and in this respect something remains. The electric charge also remains and a third property as well, angular momentum. But not one other property remains.

Q: So the properties are mass, charge and angular momentum. What precisely are they?

Wheeler: They are in some respect the most primitive features you could have. Andrey Sakharov, the father of the Soviet H-bomb, who is now working in gravitation physics, says in effect that such things as mass and charge—in other words, such things as gravitation—are really about the lowest degree of penetration that one could ever think of having in the structure of nature, rather than the highest. He says that there's a very close analogy between these features of matter and such an everyday feature of matter as elasticity. You throw almost anything together and melt it, then let it cool down and solidify, and you'll find that the structure, complicated as it is, is endowed with elasticity. If you stretch it with a certain force, it will yield a certain amount; how much it yields is a measure of its elasticity. This elasticity is one number that summarizes in itself a wealth of internal complications of the material—whether it's made of tar or diamonds, glue or beeswax. Sakharov says that although the world is a complicated mixture of particles, their properties all add up to a single number, which he calls the metric elasticity of space. It's his name for what gravity is. This grossly oversimplified single number has hidden inside it all the contributions from a wealth of internal structures that we are still so far from understanding.

Q: But wouldn't an attribute such as

elasticity be very primitive?

Wheeler: In 1953 I first began to take seriously Einstein's vision that everything is made out of curved empty space, that particles are constructs out of this magic dough, which is geometry. Sakharov says in effect that it's as crazy to think of particles as made out of geometry or out of curved empty space as it would be to think of atoms as made out of elasticity.

We learned from Mendeleev's periodic table that to think of sulfur and chlorine or carbon and hydrogen in terms of their particularities—as requiring their own separate laws, structures, valences—was the wrong way to understand matter. We learned that all these particularities of nature went back to one simple, more primitive view of electrons held together by electric forces and moving in accordance with the quantum principle. If we try to guide ourselves by this analogy, we would say it's exactly wrong to think of the particles as a primitive world. There must be something far simpler out of which they themselves derive their structure, and that something far simpler—call it pregeometry or what you will—is the thing to which we are at present directing our attention.

Q: So pregeometry, or whatever it will be called, might be the magic dough or building material of this world. The end of the world is anticipated by the existence of the black hole, a star having undergone gravitational collapse. This phenomenon is an invisible omen of our future, you've said, because gravitational collapse is the ultimate destiny of the universe. But you have also suggested that this end will become a new beginning—that something else, something new and different, will be reborn from the ashes.

Wheeler: I am thinking of the oriental concepts of reincarnation and of cycle after cycle, not only of man, but of the universe itself. I would be the last person to know how to analyze this kind of idea in a sensible way. I do, however, feel that in this game of the collapse of the universe, we're very far from having a cycle that leaves room for any individuality to remain. In fact, we have come to the point where the very ideas of "before" and "after" are inappropriate. The very idea of time is an approximation. Of all places it goes wrong, it goes most wrong at the moment of actual collapse. Although we don't know how to deal with the physics of that collapse, we've had experience with other kinds of physics that have many points of analogy with it.

By the predictions of the old classical physics, when an electron collides with an atomic nucleus we would arrive at a catastrophic infinite energy at a physically finite time. But we know today from our experiments that the electron is scattered rather than annihilated. So we can think of the universe itself as starting a new cycle, or we can think of different histories of the universe, each with its own number of particles, length of time, maximum contraction, possibilities for life or nonlife.

Q: Can you construct a more ordinary analogy?

Wheeler: Yes, I can believe that any given cycle of the universe is put together out of elements—Lord knows what they are—much the way a broom is put together out of bits of hay. Then we follow these bits of hay up to where they meet at the handle of the broom. So, you could think of following the phases of the universe down to the point of minimum dimension, until everything collapses. But then instead of thinking that a new form must begin at this point, it could be that at this point of maximum contraction something quite disorganized happens. Bits of hay blow about in the wind, lacking any organization whatsoever. The options must be fantastically varied.

Human Beings

Q: At the beginning of these conversations we spoke about human intuition and man-made mathematics in order to find the door through which we enter the universe and its particles. But we, the observers of the universe, are also constructed out of its particles. What role do human beings play in this strange enactment of nature?

Wheeler: No theory of physics that deals only with physics will ever explain physics. I believe that as we go on trying to understand the universe, we are at the same time trying to understand man. Today I think we are beginning to suspect that man is not a tiny cog that doesn't really make much difference to the running of the huge machine but rather that there is a much more intimate tie between man and the universe than we heretofore suspected. Only as we recognize that tie will we be able to make headway into some of the most difficult issues that confront us. Nobody thinking about it from this point of view can fail to ask himself whether the particles and their properties are not somehow related to making man possible. Man, the start of the analysis, man, the end of the analysis—because the physical world is in some deep sense tied to the human being.

The framework for this loop, the thing that gives it structure, is pure mathematics. Or the framework for this loop is pregeometry. Give it whatever name you will, it provides a channel, a structure, a tie by which we progress deeper and deeper into the analysis of nature from elastic bodies to atoms, from atoms to nuclei, from nuclei to elementary particles—and as we press further on, we'll come back, in some strange way, to man himself.

Q: Can you characterize our relationship to the physical world at this moment in time?

Wheeler: Insofar as we've learned to understand the quantum principle, it's the small tip of an iceberg that tells us that the momentum and the position of an electron are not qualities that exist independently of us but depend upon our consciously making a decision to measure the position and the momentum in order to bring these features into evidence. I think that through our own act of consciously choosing and posing questions about the universe we bring about in some measure what we see taking place before us.

Therefore, I think the word "observing" is inadequate. A better word is "participation." We are going to come to appreciate that the universe itself in some strange way depends on our being here for its properties. "Depends" is perhaps not the right word, because it implies that the universe is dependent upon us, when there is a mutuality of relationship that needs to be stated.

There's one term I love to give the universe just as a temporary symbol because every day one needs a new flag to run up on the mast to guide one's work. The flag that I like to run up just now is called "Our Participatory Universe."

and the astronauts were warned to be on the lookout for bad odors when they began sampling Skylab's delicacies, which include such items as roast beef, lobster Newburg and Conrad's favorite butterscotch pudding. The space agency was also worried about the buildup of potentially lethal fumes from the decomposition of the heat-sensitive polyurethane foam used to insulate the interior walls of the ship. As an added precaution, the astronauts planned to don gas masks before entering the ship.

By far, the greatest attention was devoted to developing the various sunshades. That effort required the skills and ingenuity of a wide assortment of specialists, ranging from pipefitters and seamstresses to space physicists and polymer chemists (who were needed to evaluate the effect of solar radiation on the thin, aluminized Mylar and nylon sheet used to construct the canopies). Because plastics are notoriously vulnerable to the sun's ultraviolet radiation, technicians taped a thin, gold-colored protective material on the outside of one of the shades. But they quickly discovered that the coating made the canopy too bulky to fold and pack. So they pulled the coating off.

Two different kinds of canopies were tested underwater in the big tank at Huntsville, where conditions of weightlessness can be simulated; the astronauts found that it was possible to deploy the devices. But NASA gave top priority to a third, untested device: the so-called "parasol" canopy. One reason: the astronauts would not have to leave Skylab to put it in place. Resembling a beach umbrella, the canopy is made up of a 22-by-24-ft. sheet of aluminized Mylar and nylon attached to a long pole consisting of seven 4-ft. sections. An astronaut could extend the pole and sheet out of a small airlock in the middle of the Orbital Workshop's exposed area. Springs in the umbrella's "spokes" would automatically snap the covering into a rigid rectangle that could be positioned close to the skin of the shieldless spacecraft. Major drawback of the parasol: the airlock mechanism would prevent the astronauts from seeing how the operation was proceeding outside the spacecraft.

As their second option, the astronauts also carried into space a canopy rigged to a makeshift A-frame. But its deployment would require a more difficult space walk from the exit in Skylab's airlock module. As a third option, the Apollo command module carried the "Spinnaker Shade," which had been the original first choice of space officials. They had second thoughts about the sail-like canopy, because they feared that the light jet plumes from the command module's thrusters might fog the still functioning solar wings on the telescope mount. As he hung out of the open hatch of the command module, an astronaut would have to fasten the canopy in place while the ship hovered at Skylab's side. The final decision about which technique was to be used was left to the astronauts—the first time that so important a responsibility had been given to a crew in space.

Successful deployment of the canopy would not immediately solve all of Skylab's problems. At best, space officials expected some three or four days to elapse before the shading effect of the shield would reduce the temperatures inside Skylab to a near normal 70°. Meanwhile, the crew would have to wait out the time in the cramped confines of their command ship, making occasional forays into the stifling heat of the orbital workshop only to bring out food and perhaps scientific equipment. If all went well, and the workshop cooled, the astronauts were to begin their scientific chores, hoping to complete a good part of their originally planned 28-day mission.

Comet of the Century

Even now it is hurtling closer, racing toward a year-end rendezvous with the sun. By December it will be the brightest object in the predawn sky, providing early risers with an unusual celestial display. The newly discovered comet may eventually be 50 times as brilliant as Halley's comet, which last dazzled the world in 1910; its tail could arc across some 30°—or one-sixth—of the evening sky. With no effort at hyperbole, Harvard Astronomer Fred Whipple says the onrushing giant "may well be the comet of the century."

The great comet was discovered in March by Czech-born Astronomer Luboš Kohoutek while he was looking for asteroids with the Hamburg Observatory's 31-in. Schmidt telescope; at that time it was some 480 million miles away from the sun, or roughly in the vicinity of the orbit of Jupiter. In contrast, Halley's comet—less bright than Kohoutek's—was not spotted until it was about 170 million miles closer to the sun. Although the nucleus of a typical comet (which is thought to be composed of frozen water, methane and ammonia, as well as dust particles) is only about a mile in diameter, Kohoutek's comet seems to be a brobdingnagian 10 to 15 miles across. Moreover it will come to within 13 million miles of the sun. That relatively close flyby should produce a dazzling interaction between sun and comet.

Although the comet is now visible only as a speck of light in telescopes, solar radiation will boil off gases and dust from the nucleus as it approaches closer to the sun. In the "solar wind," the stream of electrically charged particles that continually emanate from the sun, the material from the nucleus should be swept into the characteristic comet's tail. As it reacts with the charged particles, the tail should begin to glow brightly—so brightly, in fact, that Brian Marsden of the Smithsonian Astrophysical Observatory believes that the comet could be visible to the naked eye in daylight just before its close approach to the sun in December, and even more spectacularly in the evening during January as it begins to move away. Perhaps the most remarkable sight will be seen by observers in Latin America. On the day before Christmas, an annular eclipse* will occur over South America. That should create an awesome Yuletide display: a fiery ring of sunlight, the Comet Kohoutek and the bright planets Jupiter and Venus, all grouped in the same area of the eclipse-darkened sky.

Hundreds of observers around the world are preparing to examine the comet in many frequencies of light —from ultraviolet to infra-red. Harvard's A. Edward Lilley even hopes to detect, for the first time, microwave emissions from a comet. Above the earth's obscuring blanket of air unmanned satellites—perhaps even Skylab's sophisticated observatory—may make the most fruitful observations of all. All the observations will be aimed at determining the structure of the comet and its origin—probably beyond the planet Pluto, where billions of comet-like objects are believed to be orbiting as remnants from the solar system's creation.

*Which occurs when the moon, at one of its more distant points from the earth in its elliptical orbit (when it appears slightly smaller in the sky), eclipses all of the sun except a glowing outer rim.

HALLEY'S COMET DURING LAST APPEARANCE IN 1910

LOWELL OBSERVATORY

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Which makes the Accuquartz watch many times more accurate than any kind of watch any astronaut ever wore on the moon.

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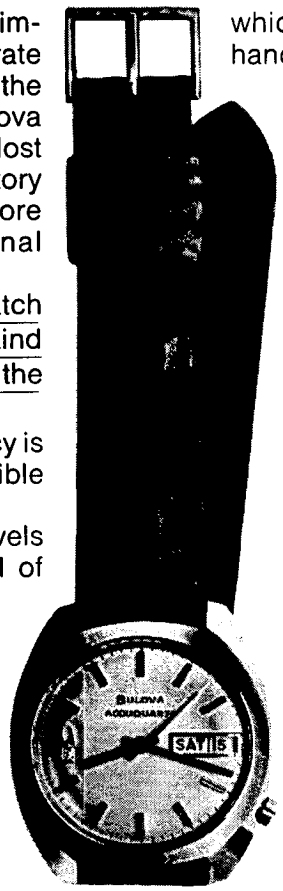

Now, you probably don't have a screaming need to time your actions to an accuracy of 1/6 of a second a day. (Even the astronauts didn't.) But think of this:

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Hexagram 10

LÜ

TREADING

The trigrams: CH'IEN: Heaven, active. TUI: Lake, joyful.

THE DECISION

Treading. He treads on the tail of a tiger, but it does not bite him. There will be progress and success.

COMMENTARY

Here the weak treads on the strong (in the lower trigram). The lower trigram indicates joy and satisfaction, and responds to the upper trigram indicating strength.

Dangerous and unpredictable people cannot harm him who treads carefully and gently as he moves forward. Observing the rules of propriety, one may safely tread amid scenes of disorder and peril.

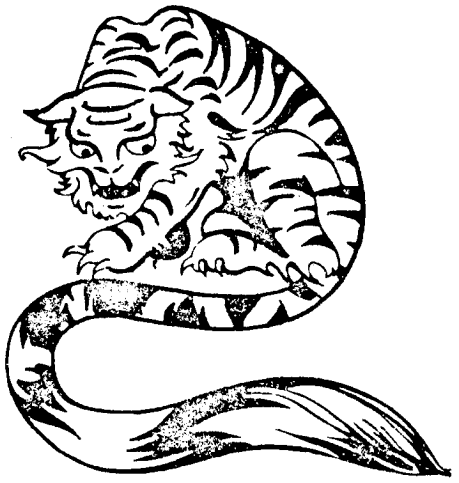
The weak stands above the strong, but because it is done gently, in a courteous manner, there is no harm and the action is blameless.

THE IMAGE

Heaven (Ch'ien) is above, the lake (Tui) below. The superior man discriminates between high and low, and considers the aims of the people.

Nine in the first place: He treads his accustomed path. If he proceeds, there will be no error.
Interpretation: Treading a safe, accustomed path, taking on no extra obligations, will keep him out of dangerous situations.

Nine in the second place: He treads the path that is level and easy. A quiet and solitary man; if he be firm and correct, there will be good fortune.



Great caution is required of him who deliberately treads on a tiger's tail

Interpretation: Good fortune is attained by the hermit who acts with restraint, wisely keeping to the middle of the road.

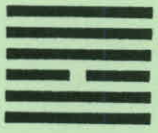
Six in the third place: A one-eyed man can see; a lame man can walk; he who treads on the tail of the tiger gets bitten. Ill fortune. The braggart acts the part of a great ruler.

Interpretation: The one-eyed man can still see, the lame man can still walk, but he who over-estimates his ability to control a dangerous situation is in the position of the man who treads on the tiger's tail; he encounters disaster.

Nine in the fourth place: He treads on the tail of a tiger, but does it apprehensively and with great caution. In the end there will be good fortune.
Interpretation: Great caution is required of him who deliberately treads on a tiger's tail; an equal degree of care is necessary in taking the dangerous step that lies ahead. But such calculated bravery is justified at this time; the outcome will be fortunate.

Nine in the fifth place: He treads resolutely. Though he be firm and correct, there will be evil.
Interpretation: Although he proceeds with proper care, in the best possible manner, peril lies ahead. Great discretion is needed if disaster is to be avoided.

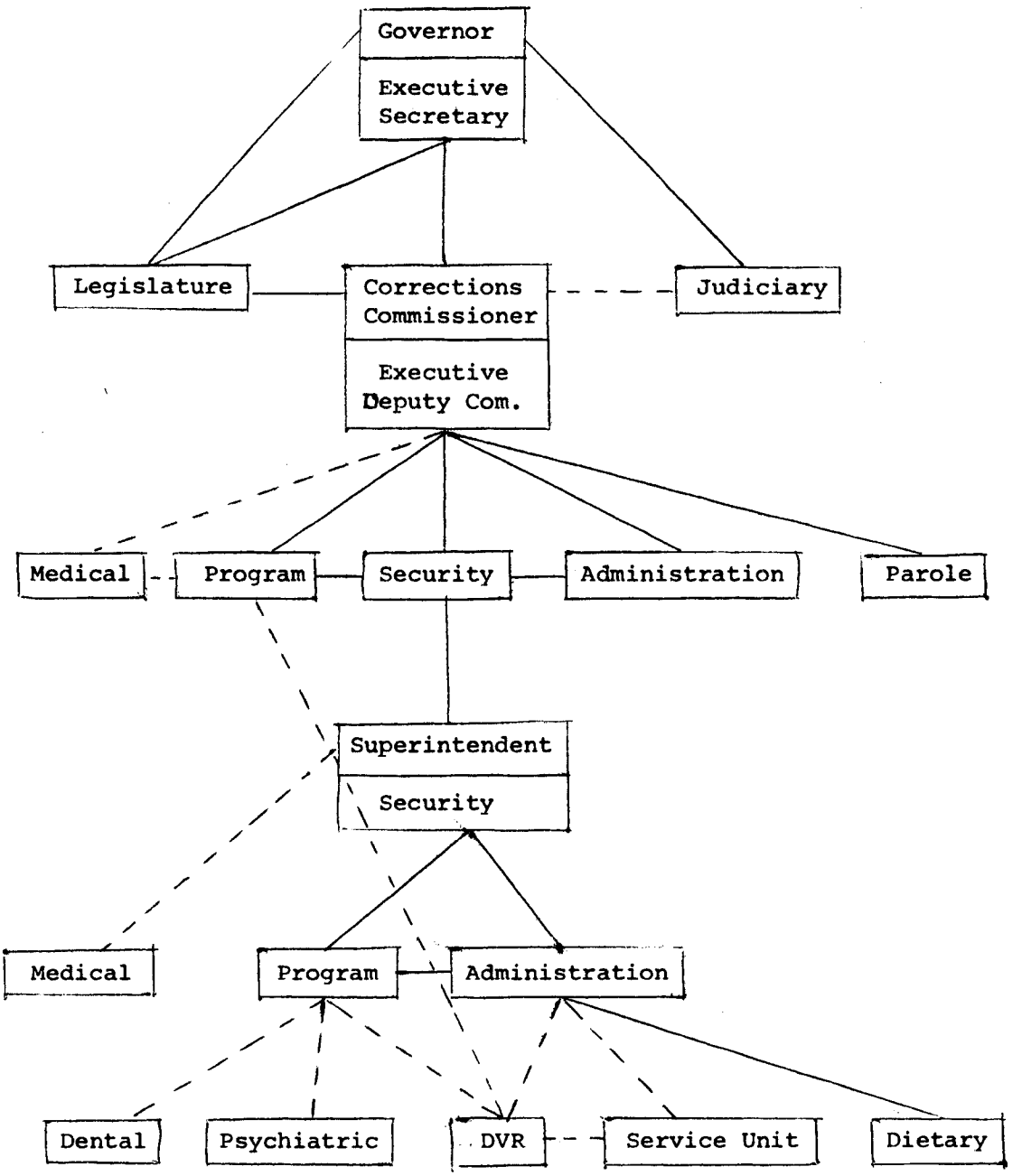
Nine in the sixth place: Look at the course which is being trodden and examine the omens it displays. If it be completed without failure there will be great good fortune.
Interpretation: Treading carefully as he moves forward, examining the ground for useful portents all the way, will lead him to a fortunate outcome.



CHARTS

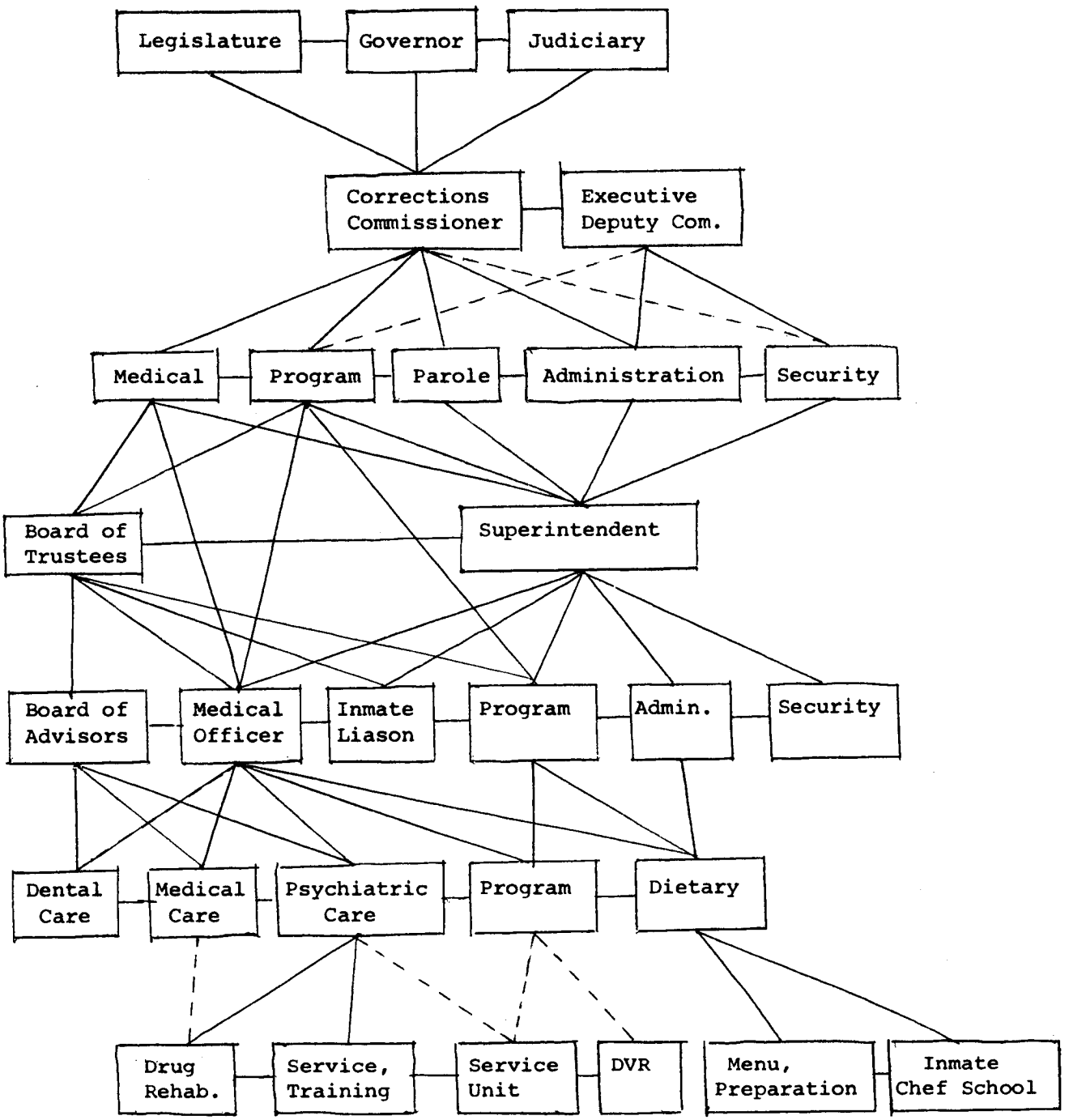
CHARTS

Perceptions about recent Attica organization (currently in great flux):



In many respects, this chart is already outdated.

Proposed preliminary Attica reorganization:



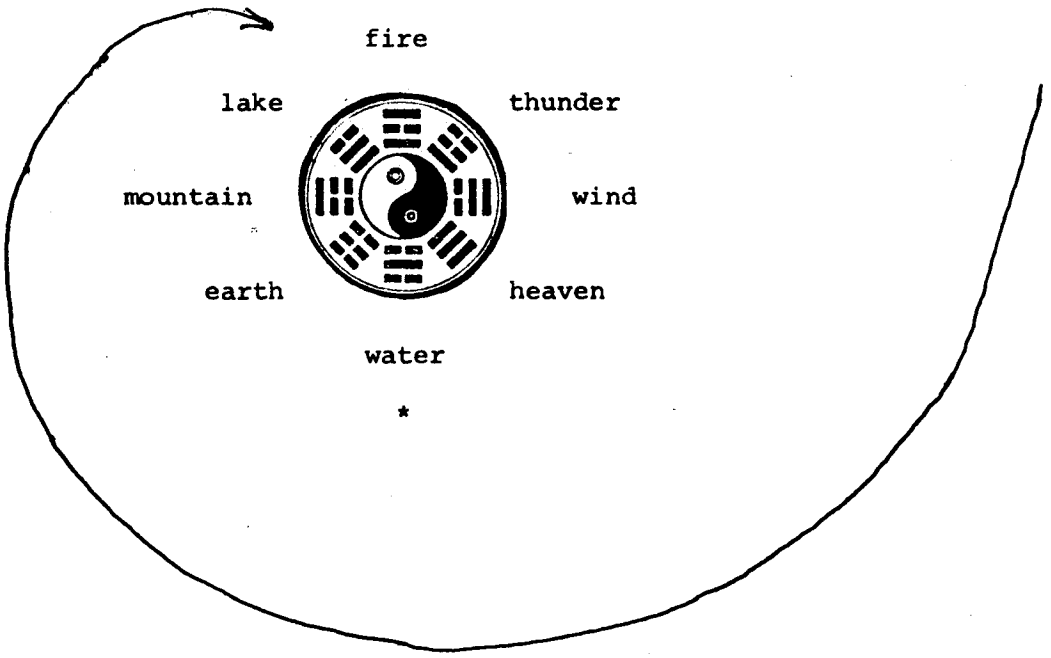
This is a rough draft, and is far from complete.

This space reserved for your perceptions of the organization of the Executive branch of the United States government:

Spirals

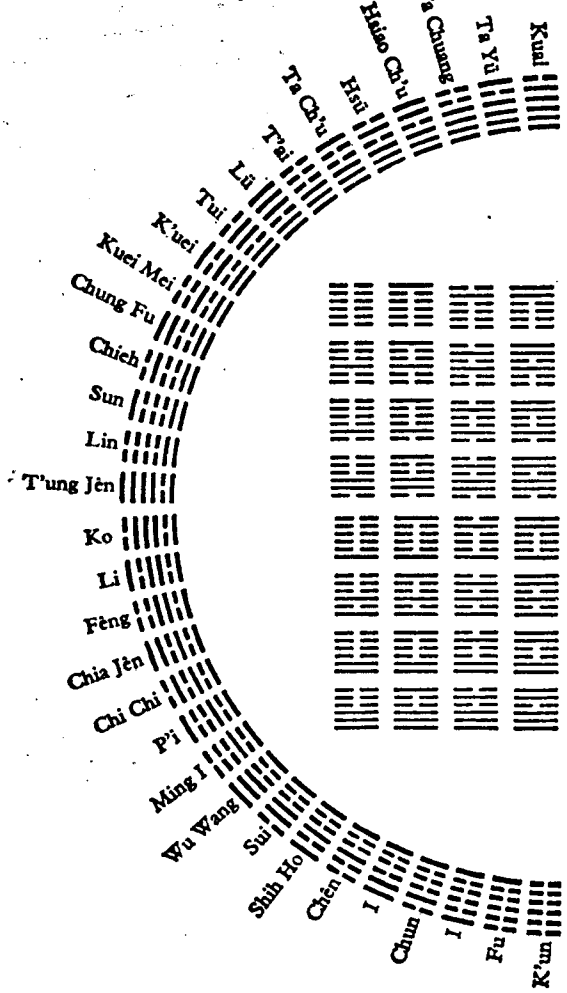
Jack spirals up the beanstalk
Spiraling up the tornado into the land of the Wizard of Oz
Alice spirals down the rabbit hole to Wonderland
He pulls the lever in the cockpit of his time machine
   and spirals into the past, then into the future
Double helix
Spiraling inflation
Spiraling vertigo
Whirlpool
Vortex

The spiralling course of
H.M.S. Beagle II

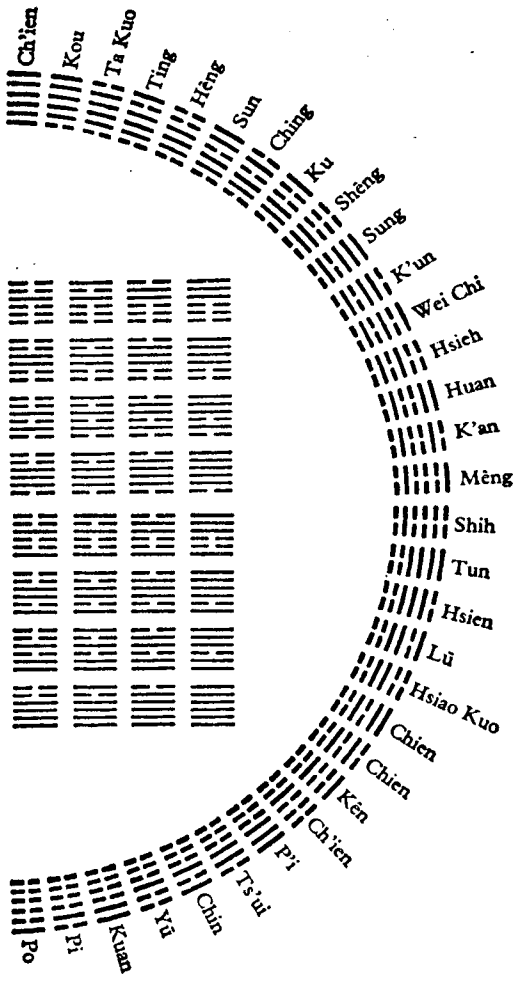


We are entering into the region of light now.

* current position of hydra and society as a whole.



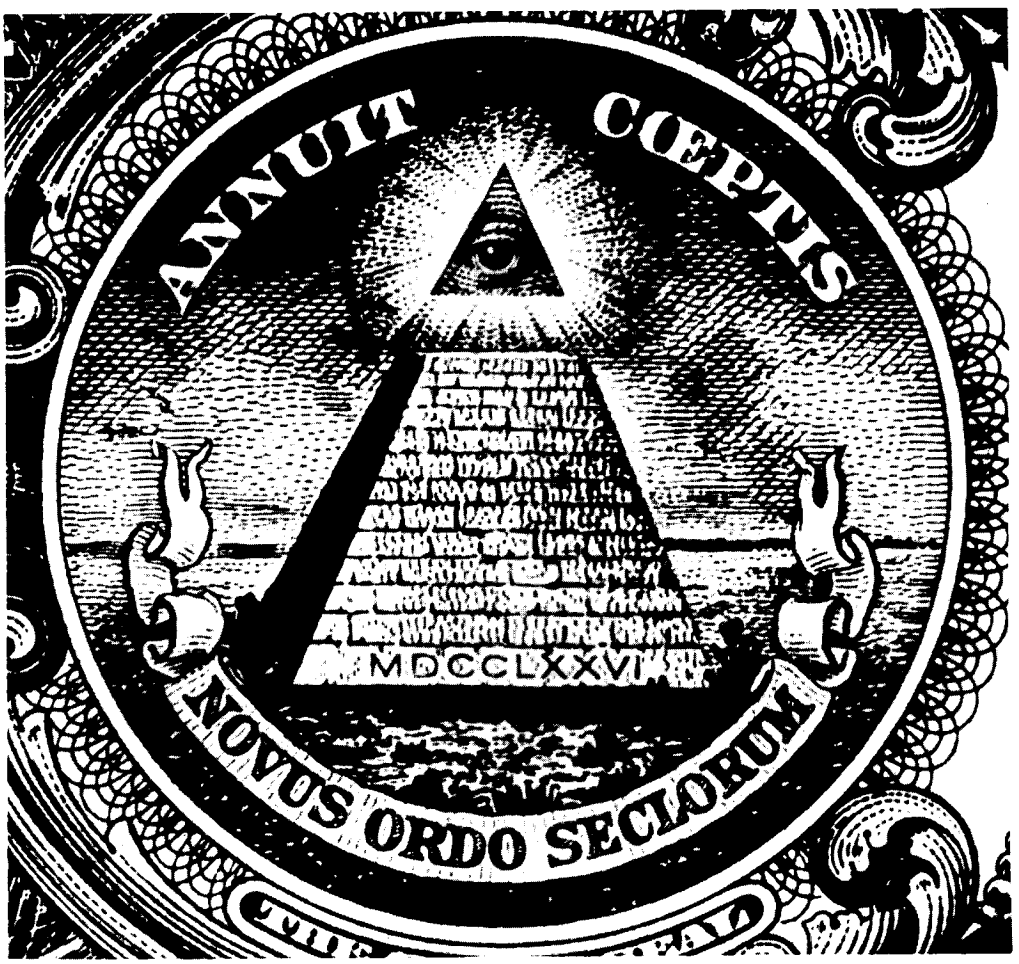
The sixty-four hexagrams displayed in the



traditional arrangement of a circle and a square

DESTINATION

DESTINATION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Camelot

This musical comedy by Lerner and Loewe was beloved by the late President. He and Mrs. Kennedy used often to listen to a record of the lyrics the last thing before going to bed.

Samuel Eliot Morison

UNIVERSITY OF ROCHESTER SCHOOL OF MEDICINE & HIGHLAND HOSPITAL

FAMILY
MEDICINE
PROGRAM

February 20, 1973

Honorable Sam Ervin
United States Senate
Congress of The United States of America
Washington, District of Columbia

Dear Sam:

I would like to express my unmitigated support of your activities in Congress during these troubled times, especially those related to your Senate Judiciary subcommittee on the separation of powers. There are many of us in communities around the Nation, mature men and concerned citizens, who are beginning to see clearly the threat to our democratic form of government which has been forming, for many very understandable but unfortunate reasons, in Washington.

I know from personal contact that Representative Frank Horton from our area shares your profound concern. If we can be of any direct assistance as citizens in a grass roots way, do not hesitate to send materials from your office to us. The times are not yet right for bringing the entire perception of what is happening before the public eye; public faith in the national news media has been eroded too far, but men of good faith can pull together with their full light hidden for a while and, I believe, disaster averted, even now at this eleventh hour.

My spirit is with you. Godspeed.

Sincerely,

William R. Morehouse, M.D.

WRM:an

355 MT. VERNON AVENUE / ROCHESTER, NEW YORK 14620 / TELEPHONE AREA CODE 716 / 442-[illegible]

United States Senate

COMMITTEE ON THE JUDICIARY
SUBCOMMITTEE ON SEPARATION OF POWERS
(PURSUANT TO S. RES. 256, SEC. 17, 92ND CONGRESS)

WASHINGTON, D.C. 20510

Dear Friend:

Thank you for writing to me concerning the breakdown of the separation of powers principle and the resultant dominance of the Executive branch of the Government in our national life. I deeply regret that I am unable to make an individual reply. I have received hundreds of letters concerning the impoundment issue and it would be impossible to reply to each letter individually. I hope you will understand. I want you to know my views on this issue, so, in the interest of time, I am using this method to reply.

The Senate Subcommittee on Separation of Powers, of which I have the honor to be chairman, has dedicated itself, since its creation in 1967, to the principle of separation of powers and to an attempt to preserve our constitutional form of government -- a government that is based on the concept of three equal branches, with separate powers, preserved by a system of checks and balances. When the powers of any of the branches are usurped by another branch, our democratic form of government is threatened.

I believe that many of the President's actions, as well as certain appointments, indicate that he is determined to usurp powers which the Constitution undertook to give to Congress.

In my view, the Constitution authorizes the Congress to appropriate monies and the Executive branch of the Government to execute the laws. For this reason, I have protested a number of actions proposed by the President which seek to impound funds appropriated by the Congress for specific purposes. Since I have been in the Senate I have advocated a balanced budget, and I have voiced my strong opposition to various spending bills, because I think the American people are overburdened with taxes. The Congress, itself, should cease being a spendthrift; nevertheless, I believe that the action of the President in impounding funds which have been lawfully appropriated by the Congress is unconstitutional in that the President sets himself up as the lawmaker, rather than the Congress.

In addition to protesting the impounding of funds, I also have protested the unwarranted invoking of Executive privilege, instances of unlawful use of the "pocket veto" power, the use of Executive orders when they are, in fact, attempts to "legislate", the entering into of agreements with foreign countries by means of Executive Agreements instead of Senate-approved treaties as provided by the Constitution, and many other acts of usurpation of power by the Executive branch.

The large volume of mail that is coming to me and to the Subcommittee protesting these Executive actions has convinced me that people throughout the country are becoming more aware of the dangers to our democratic form of government posed by the blatant usurpations of congressional power.

The Subcommittee has not devoted all of its attention to the Executive branch. It also has studied and held hearings on the powers of the Judicial branch, the use of power by agencies of the Government, and, in the Legislative branch, the "committee veto". Hearings on other separation of powers problems are planned during this Congress.

You may be assured that I shall continue to fight to preserve our form of government as conceived by the Framers of the Constitution.

I appreciate your giving me the benefit of your views.

With all kind wishes, I am

Sincerely yours,

Sam J. Ervin, Jr.

Sam J. Ervin, Jr.
Chairman
Subcommittee on Separation of Powers

Enclosures

BY STEWART ALSOP

A PARAPLEGIC PRESIDENCY

WASHINGTON—To continue to believe that President Nixon was wholly innocent of any involvement in the Watergate cover-up requires, by this time, a major act of faith. Mr. Nixon is not the sort of man who inspires major acts of faith.

John Dean III, in the week that was, resembled a small, quietly competent spider, weaving his web slowly, inexorably, around his far larger victim. It was useless to remind oneself that spiders are not nice insects, and that squealers are not nice people. Dean's seemingly total lack of human qualities—that soporific, gravel-voiced monotone, that blandly meaningless face—made the spider's performance all the more convincing.

If Dean was lying, his lie was the most complex, the most detailed, the most carefully prepared, in the long history of lies since Ananias. A heroic effort to keep an open mind remains necessary, but if the pro-Nixon witnesses, or Mr. Nixon himself, can extricate the President from the web John Dean has woven, it will be a miracle.

The miracle will be all the more miraculous because we have had a preview of the President's defense, in the long, pettyfogging memorandum sent the Ervin committee by White House counsel J. Fred Buzhardt. If the Buzhardt memorandum is the President's best defense, then the President has no defense.

TOUGHING IT OUT

Suppose, then, that the President is stuck in the web woven by spider Dean. Suppose that most of the Congress and most of the country become convinced that the President was guilty of obstruction of justice, which is a felony, a major criminal act. What then? Bar an act of God, there seem to be three possible answers.

The first and most likely answer is that Mr. Nixon will "tough it out," a favorite White House phrase, that he will remain in the White House until Jan. 20, 1977. This is a way of saying that the country will probably be presided over for the next three years and more by a paraplegic President.

The Presidential paralysis is evident already in several ways. As the Cambodia votes in the House indicate, he can no longer count on the conservative coalition that was his basic constituency on Capitol Hill. From now on, any White House proposal is likely to be fought on the Hill just because it comes from the White House.

The President no longer fully controls even his own White House turf. With the appointments of Elliot Richardson and Archibald Cox, the President has in effect abdicated control of the Justice Department, an essential instrument of Presidential power. Back to Woodrow Wilson and beyond, the No. 2 man in the White House has always been totally the President's man. Melvin Laird is his own man, not the President's.

Unless the miracle of extrication can be achieved, the Presidential paralysis will spread as the President's prestige and popularity sink. By some, the enfeeblement of the Presidency is regarded as a Good Thing, on the theory that it is past time that the power of the Presidency be reduced and the power of Congress restored. In fact, the brief periods of Congressional domination have been sad and futile, from the Reconstruction era on. The reason is simple. It is not possible for a committee of 535, or even a committee of 100, to run a big country sensibly.

IMPEACHMENT

The breakup of the inner Nixon Administration, which has already occurred, was certainly a Good Thing, and its goodness becomes clearer with every day of testimony. The picture of the inner Administration that emerges from the testimony of Dean, Magruder and company is a picture of a nest of vipers—and incompetent, paranoiac vipers at that. The vipers were blandly willing to use any Federal instrument of power, including the taxing power, to "screw our political enemies," in John Dean's elegant phrase. It was essential to clear the vipers' nest out of the White House.

The vipers, as noted many weeks ago in this space, exuded a genuine Fascist smell. But Presidential paraplegia probably involves more real danger of an American form of Fascism than any nest of vipers. To judge from the Italian and German precedents, the prime preconditions for authoritarian government are the paralysis of government authority, economic crisis and the erosion of confidence in national institutions. All three conditions seem all too likely to be met.

This is why the prospect of a paraplegic Presidency is so frightening. An obvious alternative—impeachment—is almost as frightening, and maybe more so. An attempt to impeach the President could tear this country apart like no event since the Civil War, and the disaster would be multiplied if the attempt failed to gain the necessary two-thirds vote in the Senate.

This is one reason why impeachment still seems highly unlikely. There is another. The Democrats are quite aware that there would be no political advantage to them in making Vice President Agnew the incumbent President and President Nixon a martyr to millions. Yet it must be added that there is beginning to be serious impeachment talk on Capitol Hill.

RESIGNATION

There is a third way out—the resignation of the President. Resignation is probably as unlikely as impeachment. The "I'm not a quitter" syndrome is deeply a part of the Presidential psyche, right back to his days as an animated punching bag on the Whittier College football team. There is also a practical reason why the President seems unlikely to resign.

If President Nixon were to cease to be President, he would become plain Citizen Nixon, theoretically as liable to a summons or a subpoena or even an indictment for felony as any Citizen Smith. As the testimony has made obvious, Mr. Nixon sees himself as a man surrounded by enemies, and he may also see the White House as a necessary fortress to protect him from those enemies.

Resignation is not to be ruled out completely all the same. The President no doubt meant what he seemed to mean when he told his daughter Julie: "I want to do what is good for the country—if resigning would be good for the country, well . . ." Although there are those who will never believe it, Mr. Nixon sees himself, and has always seen himself, as a deeply patriotic man.

The time could come when it will be obvious to him and to everyone else—including the grand panjandrums of the Republican Party—that "resigning would be good for the country." Indeed, if one considers the three alternatives, it seems clear already that the President's resignation is the only tolerable way out of the tragic mess in which this country finds itself. But three years and more of a paraplegic Presidency seems a far more likely prospect. It is a frightening prospect.

Tough

tough (tuf), adj. [ME.; AS. toh (< *tanh); indirectly akin to G. zahe, tough, viscous; IE. base *denk-, to bite (cf TONGS)], 1. Strong but pliant; that will bend, twist, etc. without tearing or breaking. 2. that will not cut or chew easily: as, tough steak. 3. strongly cohesive; glutinous; viscous; sticky: as, tough putty. 4. strong of physique; robust; hardy. 5. hard to convince or influence; stubborn. 6. overly aggressive; brutal in manner; rough. 7. very difficult; toilsome. 8. vigorously engaged in; violent: as, a tough fight. n. a tough person; ruffian; thug. --SYN. see strong.

Webster's New World Dictionary

Teapot Dome

All this so worried President Harding that he decided to take a trip across the country and up to Alaska. Uneasy and depressed, he fell ill of ptomaine poisoning, then of pneumonia, and died of an embolism at San Francisco on 2 August 1923.

Samuel Eliot Morison

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MARIAN T. DEUEL, Publisher and Editor

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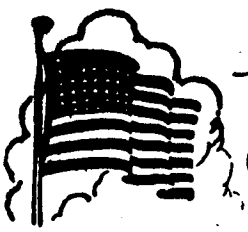


An Editor's Thoughts On This 4th Of July

Why must every TV program be mostly of war, crime or preversion and why do the Dailies need to show huge pictures of violence from movies? P. 1C -6/28 D&C. Certainly our people do not need any more "education" along these lines. Besides the above, and the long sports programs what is offered that is entertaining especially during weekends?

We contend that our people need some programs to relax them, not stir them to greater violence.

"Every cloud has a silver lining" says the old cheerer upper. And this July 4th we may well see the sense of this.

Thanks to so much rain lately, mostly cool weather and the gasoline shortage (real or manufactured, according to your idea); and the fact that crowded highways and parking areas in public camping spots have meant that many families will finally realize that their expensive homes, swimming pools and local parks, museums, the lakes and all of our local attractions offer a most satisfying vacation ---and a far more relaxing one, too!

Do you realize---

Because of the Supreme Court's recent ruling regarding pornography, the clean air of decency may sweep through Our Country--- and your children and family groups will surely pour millions of dollars back into the dying movie industry.

---There's always a silver lining---

And please don't forget how happy you can make your local merchant who has had such a difficult year in trying to buck high and ever higher prices, taxes and insurance and yet keep his business and try to serve you. He needs your help --- and your business in summer too!

So, we at the Journals combine our best wishes for a pleasant, relaxed and satisfying 4th of July.

Help save lives so innocent victims may also have happy, long uncrippled lives.

Radical

The role of government and its relationship to the individual has been changed so radically that today government is involved in almost every aspect of our lives.

Political, economic and racial forces have developed which we have not yet learned to understand or control. If we are ever to master these forces, make certain that government will belong to the people, not the people to the government, and provide for the future better than the past, we must somehow learn from the experiences of the past.

Bernard Baruch, age 93
May 11, 1964

Mindless rush

A computer study has warned that the population explosion and expanding economy must quickly be controlled or the world will face total collapse from disease and starvation. The study, conducted by the Massachusetts Institute of Technology, was sponsored by the Club of Rome, an international group of scientists, systems analysts and economists.

American Family Physician, September 1972
official journal of the American Academy
of Family Physicians

Direction

I find the great thing in this world is not so much where we stand, as in what direction we are moving... We must sail sometimes with the wind and sometimes against it, --but we must sail, and not drift, nor lie at anchor.

Oliver Wendell Holmes

My Country

She from old fountains doth new judgment draw,
Till, word by word, the ancient order swerves
To the true course more nigh; in every age
A little she creates, but more preserves.

George E. Woodberry

somewhere over the rainbow

How

moon
moor
mohair
more
mower
mow
moat
moot
moo
moon
moor

the cow
jumped over the moon.

fee
fie
foe
fum

New space program.
Is there intelligent life on earth?

Poetry Corner

INDEPENDENCE DAY

Again it's independence day,
Now Nineteen seventy-three;
Almost two hundred years have passed
Since our grand-sires set us free.

Sure it took a heap of courage
To mold this declaration;
And thanks to men both staunch and brave
We have this stalwart nation.

"All men are created equal"
These authors dared to write;
"Endowed by their Creator"
And free to voice their plight.

But even now as way back then,
To shackle us once more;
Are others who with lust for power
Sound ethics will ignore.

So fly old glory high this day,
Fair symbol of our land;
Be thankful for courageous men
Who this our freedom planned.

Donald A. Jones

Item

General Alexander M. Haig was one of the principal architects of the Lon Nol government in Cambodia. He remains on active duty in the military while functioning as White House chief of staff. In his current capacity, one of his major assignments has been to help the President redesign the Executive branch of our government. You may use your own judgment when deciding whether this man creates totalitarian or democratic patterns of organization.

Inflation

spi·ral (spī′rəl), v.i. [SPIRALED or SPIRALLED (rəld), SPIRALING or SPIRALLING], to move in or form a spiral. v.t., to cause to move in or form into a spiral: as, the war spiraled prices to new heights.

Webster's New World Dictionary

Money

Why are your dollar bills losing their value?
If you read one, it will tell you.

Now

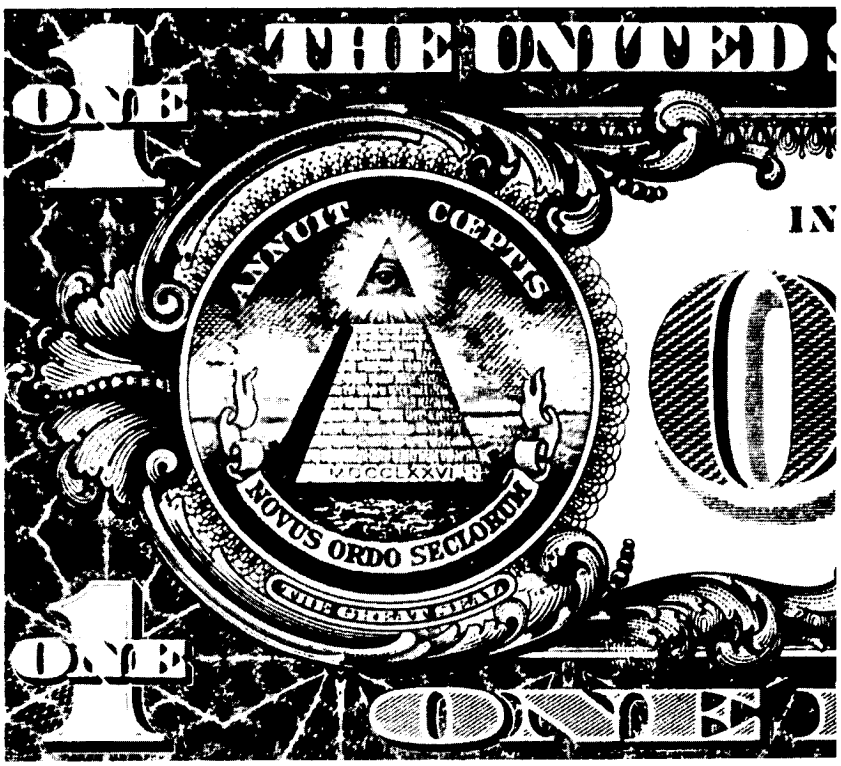
Men are being arrested in the military for distributing copies of the Declaration of Independence. Officials say that the opening lines of the document represent a threat to overthrow the government.

Last tango...

Castrate rapists?
What we need are some leaders
and a Declaration of Interdependence.

People of the world, unite!

IN GOD WE TRUST



States of America

states of mind

please don't spend my country carelessly

God bless America
and God bless each and every one of you

FINAL EXAM: APPLIED REALITY 101, July 1973

This is a take-home exam. You may use as many sources of reference in determining your answers as you wish.

Part A, short answer:

The following nations are each currently governed by an organization of human resources in which the decision-making process may be characterized as being predominantly either (a) democratic or (z) totalitarian. In the space provided after each, indicate which is which:

1. Cambodia _____
2. Chile _____
3. Greece _____
4. North Vietnam _____
5. Red China _____
6. South Vietnam _____
7. Soviet Union _____
8. Spain _____
9. United States _____
10. Yugoslavia _____

Underline those nations above which you feel qualify for membership in the "free world".

Part B, essay (choose any 4):

1. Elaborate upon and place in perspective your answers to Part A, which is rather simplistic.
2. What do the Declaration of Independence and the Constitution of the United States say about the power of oil?
3. Now that the Cold War is over, what has happened to the barrier of secrecy formerly known as the "Iron Curtain"?
4. What do Cambodia and Czechoslovakia have in common?
5. Why?
6. Where is tomorrow?
7. Is God dead?

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