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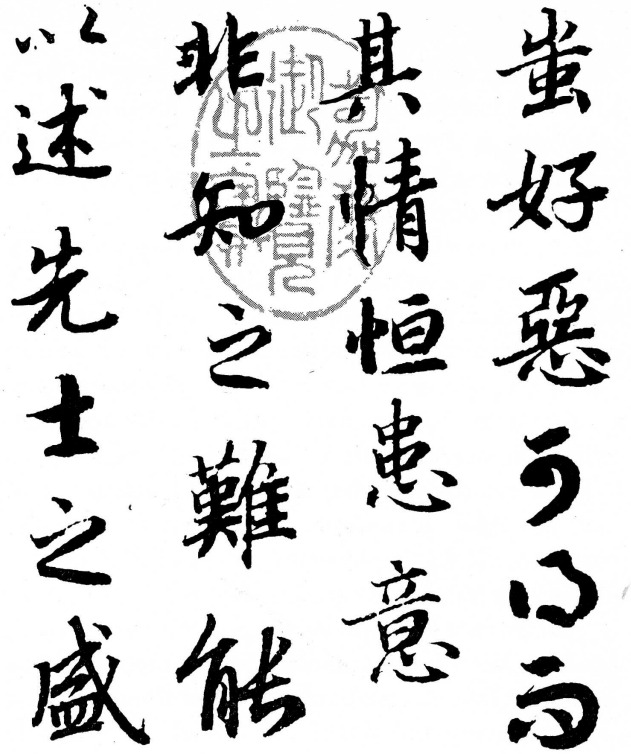


Fragment of "Wen Fu"
Lu Chi, third century

BY ARCHIBALD MAC LEISH

HEAVEN AND EARTH AND THE CAGE OF FORM

C. P. SNOW's remarks on the two cultures may or may not have advanced the cause of intellectual ecumenicism but they have certainly increased the embarrassment of poets in the presence of the scientific elite, above all when the scientific elite is accompanied by its wives. All I could think of as I prepared – or attempted to prepare – myself for this evening was how guiltily little I knew (*and* know) about the Second Law of Thermodynamics.

Had it not been for the blessed name under which this lecture is given I very much doubt if I should have found the courage to come. But the thought of Ellery Sedgwick supported me. Ellery Sedgwick was not only one of the gods of my youth and of everyone's youth when I was young. He was also a man of letters in the old, the classic, style. And a man of letters in the old style was a man who believed that everything human concerned him, *and*, more to the point, that everything which concerned him was, or could be made to be, human . . . human enough, at least, to be discussed in the *Atlantic*. Ellery Sedgwick's reply to Lord Snow (Sir Charles as he was at the time of the Rede Lecture) would have been: Rubbish! There is only one culture and if you will try hard enough to put what you mean into English the *Atlantic* may – *may* – publish it.

I am not quite that bold. If I think of Ellery I hear Sir Charles, and I have decided, therefore, to deploy myself, if you will permit the expression, on neutral ground: to discuss neither the Second Law of Thermodynamics nor the first law of that "synthetic and magical power" to which Coleridge said he would

"exclusively appropriate the name of imagination": to discuss instead the present state of the practise by which the analytic and imaginative processes are, or ought to be, related to each other. I mean, of course, the practise of criticism.

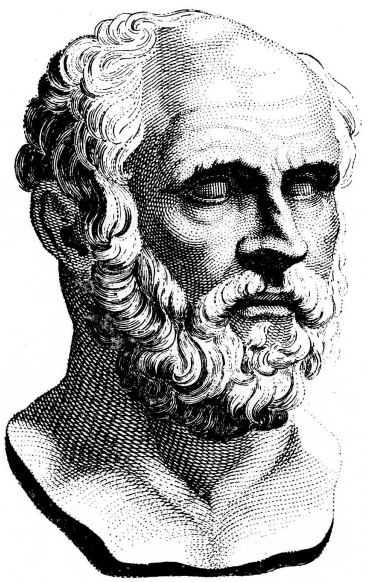
I should confess at the start that I approach my subject with anything but a disinterested mind. I take, as most writers do, a dim view of the state of criticism at any time – particularly my own. I am also convinced, as writers usually are convinced, that the trouble with contemporary criticism is its approach to contemporary literature. Let me illustrate.

Some months ago I happened on a piece in one of our principal periodicals which, quite literally, *struck* me. It was a piece announcing the discovery of the greatest living novelist. But what gave it its impact was not the superlative: greatest living novelists have been fairly numerous in my time. Nor was it the fact that this particular greatest living novelist was relatively unknown: the world of letters is thronged with names no one ever heard of until everyone is deafened by them. What flabbergasted me was the stance, if I may borrow Cummings' word, of the discoverer of this prodigy: his orientation on his Peak in Darien – the quadrant of the sky he gazed at.

"what may happen"

Traditionally a literary critic on the hunt for the greatest living something – novelist, poet, "maker" of one sort or another – would climb to the top of his head of land or his foremast or whatever, placing himself not only above the work he was reviewing but above the world as well, at a point from which the two could be observed in their relation to each other: the work as it bore upon the world, the world as it was pictured in the work. In the classic East, if we may allow that third-century Chinese poet and general, Lu Chi, to speak for it, the essential of the literary task was to capture Heaven and Earth in the cage of form, and the greatest poet was the poet whose Heaven and Earth, as the cage held them, were most completely visible. Which meant that to find the greatest poet one must observe not only the cage of form but Heaven and Earth themselves and the relation between the two.

And the same thing was true, of course, in the classic West. The criterion of the poet's work in Athens was truth to life: not truth, as Aristotle put it, to "what has happened" but truth to "what may happen," meaning by "what may happen," what the "laws of probability and necessity" permit to happen. Thus to find the greatest poet in the Aristotelean sense one would keep one's eye not only on the actor in the tragedy but on the human prototype in the real world: "how a person of a certain kind will on occasion," in Aristotle's words, "speak and act according to the law of probability or necessity." For Aristotle himself this greatest poet was Euripides



"Euripides kept his eye not only on the actor but on the human prototype in the real world"

who was "felt to be the most tragic of poets" because his tragedies were, quite simply and quite finally, "right."

What was self-evident to Aristotle, however, and to Lu Chi, was not self-evident to my discoverer of the Greatest Living Novelist. Heaven and Earth were not so much as visible from the book-lined room he used for look-out, and as for the way "a person of a certain kind will on occasion speak and act" the question never even presented itself. Life was not involved in his equations: only literature. His greatest living novelist was greatest living novelist not because he had most successfully captured Heaven and Earth in the cage of form, nor because his novel was truest to "what may happen" in human life, but

because he had solved the technical problems of the modern novel better than his competitors in the literary competition. The prize was his because he wrote entertainingly, because he had read everything, and because his cage of form, whatever (if anything) it might turn out to contain, was skillfully constructed.

I say this attitude, this orientation, this posture struck me. I should add that it struck me not because I had never met it before but because, as I realized in reading the review, I had met it far too often. And not only in what we call "book-reviewing" when the criticism of books turns up in the newspapers and magazines, but in what we call "the teaching of English" when the same thing happens in colleges and classrooms. Both forms of criticism, as we can hardly help knowing, are in trouble in our generation. English teachers complain – or my friend and former student, Professor Benjamin DeMott, complains for them – that they suffer from a "forced retreat to the periphery" of their subject, an inability to escape their "profession-imposed obligation to triviality – an obligation to names not things, apparatus not inquiry, the window not the view." And as for the book-reviewers, most of us will remember for a long time Eric Sevareid's eloquent denunciation of their performances when Svetlana Alliluyeva's *Twenty Letters* was published: their meticulous and myopic inspection of everything but the essential, the woman as the book revealed her.

But though one is aware of these things in a general way from the perusal of learned papers submitted to professional associations or from moments – rare moments – of enlightenment on the television screen, it takes a specific event, a particular occasion, to drive the realization home, and the review I speak of was such an event for me. I had known like everyone else that the critical atmosphere had been curdled and granulated in recent years, producing intellectual symptoms much like the physical symptoms associated with metropolitan smog, but I hadn't known why. Now suddenly I saw or thought I saw. If the critic as reviewer, the critic as English teacher, is concerned with "names not things"; "the window not the view"; writing, not what is written; in brief, literature not life; then obviously the atmosphere he exhales will be an atmosphere of motes and particles difficult for the lungs to breathe or the blood to live by. And the human consequence will be the consequence familiar in Los Angeles and not unknown even in New York: stinging eyes, a rasping throat and a cold sun, pale and yellow in a nasty sky.

I am not, I hope, attaching undue importance to one particular book review. I am merely saying that there are moments in our sleep-walking lives as observers of our own experience when we suddenly see what we have long been looking at, and that this review, quite unintentionally, provided such a moment for me. It forced me to realize what I should have discovered long ago, that what has gone wrong with the critical function in the middle of this astonishing century of ours is quite simply and literally that it has lost its footing, its foundation, its relation to life. Or, more precisely, that the relation to life of the works of art it examines no longer concerns it. It has taken to averting its eyes from the struggle of art with life – the struggle of art to contain life – which occupied Lu Chi and Aristotle. And it has come close to practising what might be called, in memory of the "Men of the Nineties," criticism for criticism's sake: criticism which fixes its attention on the act of criticism; criticism which hopes to be praised, not for enlarging life by enlarging the understanding of the work of art as a means to life, but for its virtuosity in taking the work apart, revealing its mechanism and, hopefully, putting it back together again.

Lifeless criticism

I do not mean to suggest that contemporary critics have literally emulated Lionel Johnson and Ernest Dowson and Arthur Symons and the rest of the contributors to the *Yellow Book* who left the living of life to their servants and committed themselves publicly and explicitly to the pursuit of art for the sake of art. Criticism for criticism's sake would hardly make a slogan: certainly no one in his senses would rage against it as Yeats raged against the "terrible queen" adored by his "Companions of the Cheshire Cheese." But whether or not the banner has been raised and the manifesto issued, the practise exists. Criticism is written and read with us not as an adjunct to literature but as an end in itself. Ours is an age increasingly preoccupied with analysis and description, a generation in which the imagination is chiefly valued as a tool for technological advance or scientific

breakthrough, and the critic *belongs* with us as he has not belonged since the Eighteenth Century. He preaches to our condition. He communicates with our souls. And when he tells us, as he frequently does, that the novel is dead or that the great age of poetry is over, we are not unduly concerned. At least *he* is still there. Which is, quite possibly, just what he means.

But it is one thing — and this is *my* concern — to practise criticism for its own sake as an analytical exercise in an analytical age and another thing altogether to practise it, analytically or not, without regard to the relation of literature to life. For the subject of literary criticism, after all, *is* literature. And the subject of literature *is* life. And no matter how life and literature (*and* criticism) may change from century to century, the inescapable relationship remains. Aristotle's phrasing of it may be old-fashioned, but though it is any critic's privilege to reject Aristotle — a privilege contemporary French criticism has availed itself of with enthusiasm — it is no critic's privilege to ignore Aristotle's *issue* for that issue lies across the threshold of the possibility of criticism. Unless the question of the relation of the novel or poem or play to the actual conditions of actual life is at least raised criticism cannot take place.

Great artist, great experience

"The great artist," says Camus, "is first and foremost a man who has had a great experience of life."[1] If Camus is right — and every perceptive reader knows he is — it follows as a matter of course that the work of art cannot be examined in an experiential void. To praise a novel not because it has a meaningful relation to the world it came out of but because it has a meaningful relation to other novels written in the same period by other novelists is not to practise literary criticism but to report literary fashions — a form of journalism which has been the bane of contemporary literature ever since the magazines of feminine fashion began exploiting its possibilities after the First World War.

And yet it is precisely this unrelated criticism our contemporaries in the English classroom and the book review section, including the most scholarly book review sections — including particularly the most scholarly book review sections — appear to prefer. One of the best of contemporary critics, commenting on the addiction of the novelists she admires to the literature of "extreme situations" — sexual aberrations, madness of various kinds, drugs, suicide, violence, perversion — observes that the reason for this addiction, meaning the reason in actual experience, in human life, is not apparent . . . and leaves it at that. While, as for English teachers, Professor DeMott, who is one of the most distinguished of them, has this to say: "English teachers are bound by professional convention to oppose student involvement in the text, 'identification with the hero' and the like. The student may 'identify,' God forgive him, on his own time, but please to keep the muck of his life out of my classroom."[2] *His* life, that is to say, and all the other lives: life in general.

The window, not the view

My particular critic, in other words, my Darien discoverer, is an instance, not an exception. But that fact, far from disposing of him, enhances his importance, for if reviewing such as his is in fact an accepted form of contemporary criticism it poses a question somewhat larger than itself. It poses the question: Why? Why are literary critics *not* concerned with the fact that the "experience" of their novelists has no apparent relation to actual experience? Why are teachers of English driven out to the peripheries of their subject? — to the window, not the view?

The answer so far as English teachers are concerned would require, says Professor DeMott, a book, but he provides, notwithstanding, a few hints as to what such a book might contain: it would discuss the "enormously complicated community pressures toward innocuousness and . . . a bootless mastery of mechanics"; it would describe the "cult of historical research," the Symbolist idea of the poem as "a set of relations within itself, a fascinating clockworks that told no time"; it would mention the New Criticism, now no longer new, and "the tendency of some literary men of positivistic cast to aspire to the condition of scientist — clear out the human junk"; it would dwell, above everything, upon "the widespread and ignorant conviction that only the mindless can speak with interest about details of feeling . . ."[2]

But these considerations, though anyone familiar

[1] *This and all other references appear on page 9.*

with the teaching of English will recognize them and thank Mr. DeMott for his candor and courage, do not necessarily or always apply to book-reviewing, and book-reviewing is at least as deeply committed to critical irrelevance as the teaching of books. One suspects that the real reason for the revolt against Aristotle must lie deeper – must lie, indeed, in the critical mind itself, in the reason, conscious or unconscious, which has led the contemporary critical mind to divorce itself from the Aristotelean sense of responsibility to world *and* work, to Heaven and Earth as well as to the cage of form.

And of course there is such a reason, a reason not only affecting the contemporary critical mind but acknowledged by it – more than acknowledged, asserted, proclaimed. The contemporary critic, the advanced contemporary critic, does not wait to be charged with mutiny, he boasts of it. He has rejected the Aristotelean notion that art must be true to life because, he says, that notion is founded on a wholly inadequate and even ignorant conception of what life is. Aristotle, he asserts, did not realize – was incapable of realizing – lacked the courage perhaps to realize – what *we* have discovered and have dared to face: the fact that life is *"absurd."* And failing to recognize that fact, Aristotle failed to comprehend the relation between art and life. For if life is absurd art can have no direct, no imitative, relation to life without becoming absurd itself. If life is absurd there can be no laws of life except the mortal law – the law of mortality we all obey which is the source of the absurdity. If life, in short, is absurd, art cannot be judged by life and the function of criticism becomes a counter function: to reverse the classic process and judge life by art. Which means, so far as the judgment of art is concerned, that art is left to be judged by itself. Which means, in turn and finally, that criticism, which will continue to do the judging, becomes the master in an empty house.

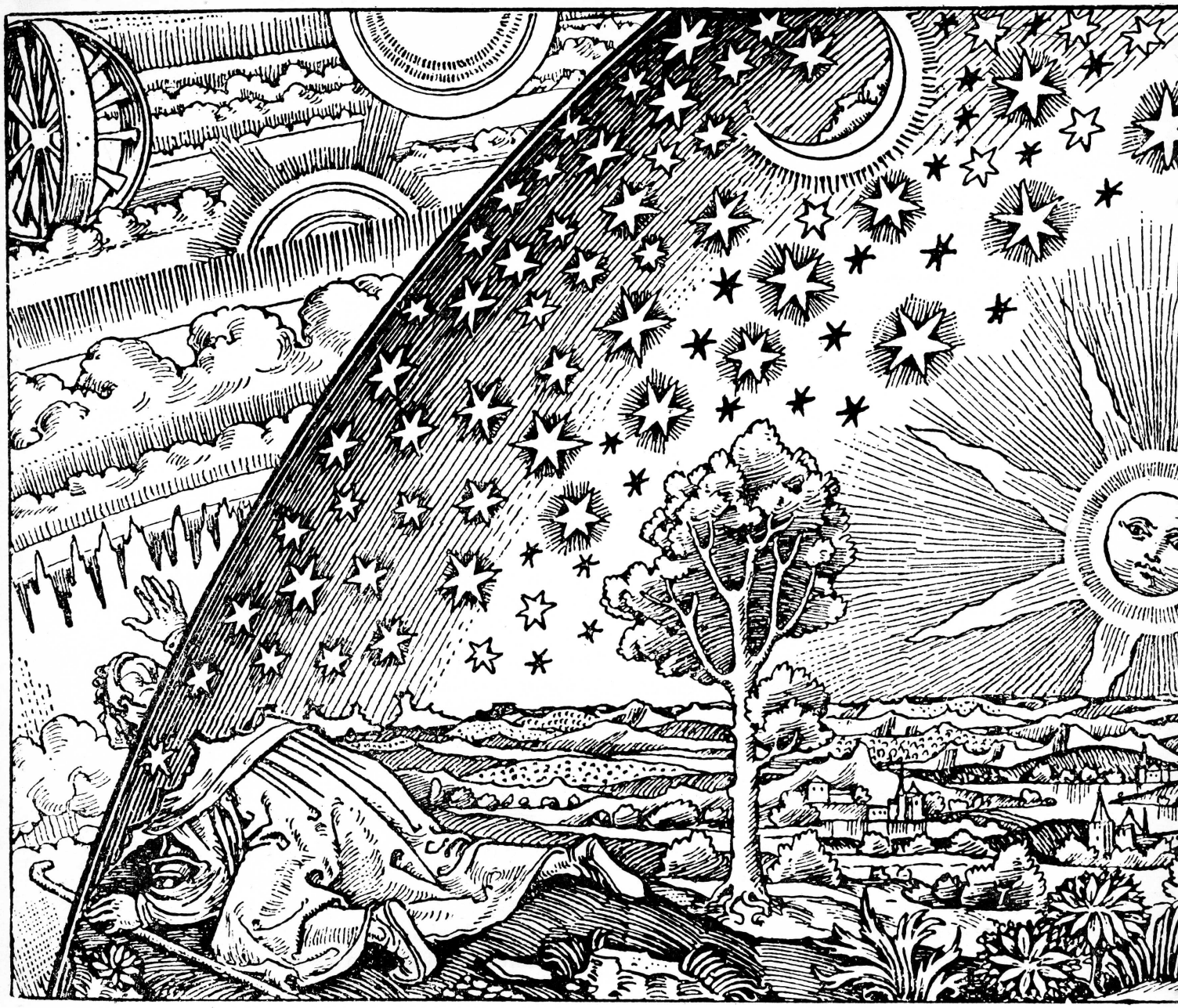
It is a logical reason but it is also, one notices, rather more than logical. There is emotion in this thinking – longing in it. The absurdity of life in this conception is not an abhorrent fact, a tragic fact – it is an alluring fact, a fascinating fact, a fact to which the contemporary mind, at least the contemporary critical mind, is attracted as flies are attracted by certain odors on the air. One is reminded of the limestone country of Yucatan where the surface crust occasionally breaks through to reveal drowned pools and subterranean waters where the ancient sacrificial victims are. Our modern crust of consciousness has cracked and broken through in much the same way and we rush to peer at the abyss. We throng to stare at it. Not necessarily because we love blackness, not because we are necrophiles at heart, but rather because our human posture at the rim excites us, because the image of man at the edge of the abyss of his own death excites us. And when the abyss of death becomes the abyss of meaninglessness, of absurdity, the excitement becomes overwhelming. For mortal man poised above the meaninglessness of his death takes on a paradoxical meaning, a tragic stature. He becomes in his unheroic trembling there, heroic.

But though it is fairly obvious that we welcome the notion of the absurdity of human life, and understandable enough *why* we welcome it, there is one aspect of this business which is not altogether obvious or truly understandable – a rather important aspect. I refer to the notion itself, to the validity of the notion, the authenticity of the discovery.

"Love saves us"

Discoveries of this kind, discoveries relating to the nature of human life, have, of course, been made from time to time in human history – made, it would seem, simultaneously by whole generations of mankind – accepted, over a few years or a few generations, by mankind as a whole, by great peoples of men, entire races. But is the discovery of the absurdity of life such a discovery? Is it true, really true, true in fact, that our generation of mankind has come to know, to perceive, to realize, that human life is, in its nature, in its condition, an absurdity? Or is this another kind of discovery? A discovery not by mankind but by its philosophers or some of them, its theologians, its publicists? Has our sensibility, even the sensibility of our critical intelligences, our advanced intellectuals, truly changed? Or has nothing really altered but the vocabulary in intellectual use, the bag of images, the metaphor?

I suppose the greatest literary propagator of the discovery of the absurd was Camus, but did Camus believe in the absurd? – truly believe in it? Reading *The Stranger* one can only answer, Yes, for *The Stranger* was written to demonstrate that "the in-



"When the night was overflowing with stars his gestures stood out against the sky's immense and silent face . . ."

evitability of death," in Philip Thody's words, "destroys all values." But when one goes beyond the novels, the set pieces, to the Note Books one finds oneself in such an antiphony of delight and despair, of love of the world and revolt against it, that the head spins. You recall the docker with the broken leg:

In the café he tells me the story of his life. The others have gone. Six glasses stand on the table. He lived alone in a small house in the suburbs, going home only in the evening to do the cooking. A dog, a tom and a female cat, six kittens which the cat cannot feed. They die one by one. Every evening a stiff dead body and filth. Two smells: death and urine mingling together. On the last evening (he stretches his arms across the table wider and wider apart, slowly and gently pushing the glasses toward the edge) the last kitten died. But the mother had eaten half of it—half a cat left as you might say. And still all the filth. The wind howling around the house. A piano in the far distance. He sat in the middle of these ruins and wretchedness. And the whole meaning of the world had suddenly surged up into his mouth. (One by one the glasses fall from the table as he stretches his arms wider and wider apart.) He stayed there for a long time, shaking with a vast, wordless anger, his head in his hands and the thought that he had got to get his dinner ready . . .[1]

But four months later we find Camus saying of a different, a more personal protagonist,

> And he went into the water washing off the dark and contorted images left there by the world. Suddenly the rhythm of his muscles brought back to life the smell of his own skin. Perhaps never before had he been so aware of the harmony between himself and the world, of the rhythm linking his movements with the daily course of the sun. Now when the night was overflowing with stars his gestures stood out against the sky's immense and silent face . . .[1]

And always there are the attempted resolutions of these antiphonies:

> With all my silence I shall protest to the very end. . . . It is my revolt which is right, and it must follow this joy which is like a pilgrim on earth, follow it step by step.[1]

And again in an imagined conversation:

> . . . it doesn't seem as if this world satisfies you from the way you talk about it.
>
> It doesn't satisfy me because it's going to be taken away from me — or rather it's because it satisfies me too much that I can feel all the horror of losing it.[1]

And again:

> The misery and greatness of this world: it offers no truths but only objects for love. Absurdity is king but love saves us from it.[1]

"Absurdity is king but love saves us." Life is absurd — and therefore we must live our own lives — find our own meanings in life — love's meanings. As one reads the Note Books one sees that it is not life which is absurd to Camus but the *idea* of life — the idea of life ending in death — the idea of life with all its happiness and death beyond for answer. Life, life *as* life, is as dear to Camus as it was to Sappho herself to whom "the bright and the beautiful" belonged "to the desire of the sunlight." To attribute to *him* the notion that human existence as such is an absurdity which has no relevance to art, which cannot measure the work of art, to which the work of art need not be referred, is grotesque.

But if Camus is not a witness to the *truth* of the discovery that human life is absurd, who is? One looks in these matters to the poets, "God's spies." The new perceptions, the massive realizations, of an epoch form in its poems: in the *Odes* of Keats, in the *Illuminations* of Rimbaud, in the *Elegies* of Rilke. If it is true that the age we live in has discovered the previously unperceived absurdity of human life, the fundamental meaninglessness of existence, we should look, for traces of that discovery, to the greatest poets of the time. Would we find it?

Would we find it in Frost who lived longest in this time? Frost quarreled with the world, quarreled with it constantly, was prouder, perhaps, of his quarrel with the world than of anything else in his long life. Had *he* discovered its tragic absurdity?

> Far in the pillared dark
> Thrush music went —
> Almost like a call to come in
> To the dark and lament.
>
> But no, I was out for stars:
> I would not come in.
> I meant, not even if asked,
> And I hadn't been.[3]

Or did Sandburg who was deeper in the human misery of his time than any other American? — Sandburg who was old-country proletarian (son of an illiterate immigrant father and mother) and new-country prodigy; socialist revolutionary and Lincoln biographer; familiar of Hoovervilles and hobo jungles and all the rest of the open sores of the age and guitarist also of old tunes and sentimental melodies?

> One of the early Chicago poets,
> One of the slouching underslung Chicago poets,
> Having only the savvy God gave him,
> Lacking a gat, lacking brass knucks,
> Having one lead pencil to spare, wrote:
>
> 'I am credulous about the destiny of man,
> and I believe more than I can ever prove
> of the future of the human race
> and the importance of illusions . . .'[4]

Or leave the United States. Go back to Europe where the old sophistication is. Go back to the poets of Europe. This time of ours of which we are so conscious, which we are forever poking and prodding and questioning as the men of Athens and Rome and Paris and high England never poked and prodded — this time of ours, whatever else it has been, is an age of European poets. Yeats in the islands, Kazantzakis and Seferis in Greece, Guillén and Neruda in the Spanish world, Perse in the French. What is the burden of their song? The discovery of meaninglessness? The expulsion from

Eden? The belated realization that human life is absurd in its underlying condition as human life and that the greatest absurdity therefore is to make poems of it – make sense of it in poems?

You will not find a word of this in any one of them: not certainly the final word of any one. Yeats, that famous praiser of "such men as come/Proud, open-eyed and laughing to the tomb," understands well enough that "all things pass away" but draws a contrary conclusion:

> Everything that man esteems
> Endures a moment or a day.
> Love's pleasure drives his love away,
> The painter's brush consumes his dreams;
> The herald's cry, the soldier's tread
> Exhaust his glory and his might:
> Whatever flames upon the night
> Man's own resinous heart has fed.[5]

Guillén, whose *Cántico* is one long song of praise, founds his certainty, as he puts it, "in the dark," but "the dark" to him is what man awakes *from* to the wonder of the world.

> I wish to be . . .
> To be. That suffices me –
> Absolute happiness.[6]

Even Seferis whose vision is darker than the others – Seferis who, like Perse, was statesman as well as poet and lived through the political madness of the middle century – brings back no vision of a meaningless existence. The sadness of his poems is the sadness not of newly perceived absurdity but of a present which has lost its past, of a meaning which is elsewhere.

> What are they after, our souls, traveling
> on the decks of decayed ships
> crowded in with sallow women and crying babies
> unable to forget themselves either with the flying fish
> or with the stars that the masts point out at their tips
> grated by gramophone records
> committed to nonexistent pilgrimages unwillingly,
> murmuring broken thoughts from foreign languages?
>
> What are they after, our souls, traveling
> on rotten brine-soaked timbers
> from harbor to harbor . . .
>
> We knew that the islands were beautiful
> somewhere around here where we're groping –
> a little nearer or a little farther,
> the slightest distance.[7]

And as for Perse, not even the sadness overwhelms:

> I saw smiling in the fires of the open sea
> the great festive thing: the Sea as celebrated
> in our dreams, like an Easter of green grasses
> and like a feast day that we celebrate.
>
> . . . The drums of nothingness yield to the
> fifes of light. . . .[8]

If you read the great poems of the time you do not find proof of this immense discovery which is supposed to have divorced our age from its trust in life. Indeed, if you read the great poems of the time you may find proof of the opposite, proof that our lives, precisely because we die and know we die, are dearer to us than they were when we thought we might live forever; proof that the world, precisely because we must lose it, precisely because we cannot understand our loss of it, is inexpressibly precious – such proof as Mark Van Doren gives:

> O world, my friend, my foe,
> My deep dark stranger, doubtless
> Unthinkable to know;
> My many and my one,
> Created when I was and doomed to go
> Back into the same sun;
>
> O world, my thought's despair,
> My heart's companion, made by love
> So intimate, so fair,
> Stay with me till I die –
> O air,
> O stillness, O great sky.[9]

No, the poets, the great poets of our time at least, are not the discoverers of the absurd. They do not even believe in the absurd now that the discovery has been proclaimed. But when have they ever believed in doctrine? And what is more certain, now that a few years have gone by and we have had an opportunity to grow accustomed to this terrifying word – what is more certain than the fact that the whole notion of the absurdity of life *is* doctrine: a conclusion reached not by that intense and passionate observation of life of which poetry is capable, of which art is capable, but by a purely intellectual process, by philosophizing and theologizing, by abstracting and deducing, by departing from premises to arrive at the conclusions of those premises?

No one doubts that, in the world of ideas, the inevitability of death makes human effort as pointless

as the labor of Sisyphus. But it is not in the world of ideas that life is *lived.* Life is lived for better or worse *in* life, and to a man *in* life his life can no more be absurd than it can be the opposite of absurd, whatever that opposite may be. It *is.* And *he* is, in it. Buckminster Fuller following Whitehead who knew that "the process is the reality," once remarked that "truth is a verb." Life is a verb also. It may be ridiculous to a god observing it but to ourselves who live it, who *are* the verb, the process, the becoming, it cannot be ridiculous. Hateful, yes. Brutal, often. Painful, frequently. Tragic, without doubt. But ridiculous? Only in words. Only on a printed page.

Why then have so many of us accepted this doctrine? Why have great numbers of intellectuals accepted it, founded a whole critical position upon it? – done their considerable best to herd contemporary writing through this crooked gate? Perhaps because so much has changed in this age of change that life itself, or so they think, has altered with it. Life *has* changed – but not in its condition, its reality, *as life.* And not certainly in its relation to the arts it produces. Aristotle's question is still the only question to which the arts respond with all their meaning, all their strength. To fail to ask it is not to liberate the arts into a greater freedom but to diminish them, reduce them to skills and knacks, games and devices – critics' games.

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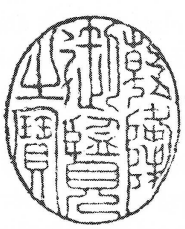


*In November poet-statesman Archibald MacLeish delivered the third Ellery Sedgwick Memorial Lecture in Caspary Auditorium [*Review *November-December]. The title "Heaven and Earth and the Cage of Form" is from a prose poem on the art of letters by the third-century Chinese critic Lu Chi, who wrote of the poet in action, "He stilled the waters of his mind to stabilize his thinking, he peered into his thoughts and one by one put them into words:/ he was trapping heaven-and-earth within a visible form, forcing all creation onto the tip of his brush./ At first he hesitated, with the brush parching his lips, but finally the stream flowed forth from the well-steeped hairs."*[10]

BEHAVIOR AND THE ORIGIN OF MAN

BY S. L. WASHBURN

THE UNDERSTANDING of human evolution comes from three different sources: from general evolutionary theory, from the fossils, and from the behavior and biology of the living primates. There has been great progress in each of these since the time of Charles Darwin (1871)[7] and Thomas Huxley (1863).[26] The nature of the modern evolutionary synthesis was clearly stated by Julian Huxley in 1963.[25] Now, knowledge of the genetic code gives an understanding of the basic chemical nature of the process of heredity and evolution. In contrast to the single skullcap of a fossil human, all that was available to Huxley in 1863, today there are hundreds of fossils connecting present populations with ancestral ones many thousands of years old. Although many of these are "bones of contention,"[4] the fossil record is unmistakable evidence that evolution has taken place. In the third source, the study of behavior, major field studies have replaced myths and travelers' tales, which in the nineteenth century were the sole source of information on the behavior of monkeys and apes.

Social Systems and Survival

As noted in many of the events celebrating the hundredth anniversary of the *Origin of Species,* the synthetic theory of evolution is remarkably close to Darwin's, and many competing theories (orthogenesis, acquired characters, mutationism, etc.[39]) have been eliminated as the nature of the evolutionary process has become understood. In 1863 Huxley[26] stated, "Whatever part of the animal fabric – whatever series of muscles, whatever viscera might be selected for comparison – the result would be the same – the lower Apes and the Gorilla would differ more than the Gorilla and Man," and this statement is supported by the latest cytological and biochemical studies.[3,14,48] Evolutionary theory states that the genetic variability of populations is ordered by selection. Certain phenotypes are more successful, leave more offspring, and this changes gene frequencies, the code of the DNA. It is behavior that determines success[2] and among primates behavior is nurtured, controlled, and ordered by the social system. It is the social system that brings the various physiological functions into relation with the essential adaptive problems of life. In this sense, the effort to understand human evolution is the attempt to reconstruct the ways of life of our ancestors, and language, cooperation, and emotion are problems just as important to this understanding as a behavior, such as locomotion, that leaves direct evidence in the bones.[10,11,17,24,57]

Running and Social Life

The importance of considering adaptation may be illustrated with three quite different examples. Patas monkeys are the greyhounds of the primate world.

Long-lasting association of mothers and infants is a prime factor in continuity of the primate group.

These elongated, fast-running cousins of the arboreal genus *Cercopithecus* live in the savanna, frequently a considerable distance from trees. Rapid running was believed to be an adaptation to this environment, but, when danger threatens, only the single adult male runs away, while the females and young freeze in the grass. The freezing to avoid danger is characteristic of some arboreal monkeys, but on the ground the arboreal adaptation would be suicidal, if it were not for the new decoy behavior of the adult male.[16] The ground life of the patas monkeys is made possible not only by the locomotor adaptation, but also by a social life in which the behaviors are sharply distinguished by age and sex. The locomotor adaptation is successful only because it is a part of a particular social system.

Fighting and Head Structure

To take a quite different kind of example, the head of *Homo sapiens* is well balanced on the vertebral column, and lacks a projecting face. In fossils with larger faces the head may be much less well balanced, and this has been extensively studied.[12] There has been extended controversy over the question of the balance of the head in the genus *Australopithecus,* and what light, if any, this feature throws on bipedal locomotion.[5,64] But it takes very little muscle to balance the head, and a minimal change in position would allow man to grow a much larger face. The problem takes an entirely different form if we consider what the animals are doing with their faces and how these actions are related to their way of life. In addition to eating with their faces, Old World monkeys and apes fight with them. In the males, large canine teeth and jaw muscles are correlated with big neck muscles, and the sex differences are maximal in ground-living forms in which the males defend the group against predators. The small nuchal area in *Australopithecus* probably has nothing to do with the balance of the head, but is additional evidence, supporting that of the teeth, that these forms did not fight with their faces, that the functions of dominance in the group and protection of the group had been transferred from teeth to tools. Consideration of the social functions of the face leads to a different interpretation not only of the face but also of the neck, and the study of structures as they function in the social group suggests many correlations that have not been made apparent by other approaches.

The Threat

A third example is communication of threats. In some monkeys the eyebrow is pulled back, exposing a light upper eyelid. This light color greatly increases the visibility of the gesture, making it obvious for a long distance. The brow motion may be coupled with motions of the ears and erection of the hair on the shoulders. Length of mane, ear muscles, and eyelid color are linked in the gesture of threat. Most of the primate characters that have been considered secondary sexual features are probably parts of the anat-

omy of agonistic display and fighting, rather than being concerned primarily with sexual attraction. These three examples show the importance of understanding social structure in evaluating running, of fighting in interpreting the structure of the head, and of threat in correlating apparently unrelated features. They demonstrate the need for considering behavior and adaptation when considering the evolution of anatomical features.

Tiger and Fox[57] have stressed the importance of a zoological perspective in the social sciences. The reverse relationship should also be emphasized. Understanding the social system is the key to the adaptive nature of many anatomical features. For example, it has long been known that man lacks the premaxillary-maxillary suture. The function of this suture is to allow for the growth that makes space for the large canine tooth. Reduction of the tooth is a prerequisite for the loss of the suture, and the reduction of these teeth is a consequence of the evolution of tools. Understanding the suture is important both biologically and socially. Examples could easily be multiplied, but the essential point is that the evolutionary meaning of apparently simple structures depends on the way they function and especially their function in a social group under natural conditions. If the synthetic evolutionary theory is accepted, it is impossible for physical anthropology to pursue its objectives without considering adaptation and behavior.

Sex and Social Behavior

The central role of social behavior in adaptation and socialization – and in giving meaning to biology – may be seen in the nature of the social group.[29] It was once thought that primate society was held together by sexual activity, and that the loss of a breeding season in primates was the key to their lasting social group. But it is now known that many monkeys do have sharply defined breeding seasons.[34] In both the Japanese macaques[40] and the Gibraltar macaques[37] mating is in the fall and births are in the spring, giving the infants the maximum time to mature before their first winter. However, in spite of a limited breeding season, the social group continues throughout the year. (According to Japanese workers, there is much more troop organization in chimpanzees than is described by Reynolds and Reynolds[45,46] or Goodall[13] [Imanishi[28]; Itani, personal communication]. A final judgment must await field work in other localities and the full publication of the reports from the Japan Monkey Centre.) Where ecological adaptation favors a small foraging group, the number of adult males may be reduced to one,[6,16,32,55] but, because of the male's nonsexual functions in defense of females and young, feeding groups always include at least one adult male.

Castrate males behave normally in most social situations (Wilson, personal communication), and this shows the importance of combining experiment with field work. Natural behavior is much too complex to be analyzable by observation alone. The idea that sex is the force that holds primate society together is refuted by the behavior of male rhesus monkeys, which may shift from one troop to another in the breeding season. Lindburg[36] describes such shifts and notes that the males that moved were those that copulated most frequently. Even one alpha male, which appeared to be in control and receiving all the rewards a monkey can, shifted to an adjacent troop. Just as estrus disrupts the female's usual social relationships, so the male sex drive may be socially disruptive, rather than binding.

Mother - Infant Bonds

The continuity of the social group depends on many factors, and one of the principal ones appears to be the lasting bonds between females and their young.[27,47] In the few studies in which individual animals are known and where they have been studied for several years, siblings are observed to continue to associate with their mothers; this relation shows in patterns of grooming, resting, feeding, and probably sleeping. The importance of these persisting relations is that they give order to the society in addition to that which depends on the dominance of adult males. MacRoberts (personal communication) has shown that juvenile monkeys that have no protector (no mother, adequately older sibling, or interested adult male) have a difficult time gaining access to food and grooming, and are exposed at the periphery of the group. It becomes clear that even without any food sharing, a protected position in the group structure is of great practical importance to the juvenile primate. The importance of continuing relations between chimpanzee mothers and their young is described by van Lawick-Goodall.[59]

Biology - Behavior

In my opinion, the importance of predation has been greatly underestimated with respect to its effect on group structure. Schaller[50] has shown that more than 20 per cent of leopard scats and over 6 per cent of tiger scats contained langur hair. These figures imply a high rate of predation, and the sleeping habits of the monkeys and apes give clear evidence of the importance of this behavior.[62] In short, it is so important for monkeys and apes to be social if they are to survive that they easily learn the fundamental behaviors. As Hamburg[18,19] has put it, the behaviors that are essential for survival must be easily learned and pleasurable to the individuals concerned. It is not a question of biology against learning; the evolutionary process has produced (through selection) a fit between the biology of a species and the behaviors essential for its survival. Whatever particular form their social life may take, the monkeys and apes are profoundly social because social life has been a fundamental adaptive mechanism for millions of years. The tremendous importance of early learning, demonstrated by the experiments of Harlow and Harlow[20] and others,[23,38,53,54] shows the interrelations between environment and biology that have evolved in a feedback relation with a social environment. It is not a matter of either biology or learning but of the evolution of a biology that makes the learning of social behavior inevitable under normal circumstances.

It might be thought that the study of the behavior of the contemporary primates has little to offer to the interpretation of the bones of our ancestors, to the study of evolution. But, however important those bones may be to the paleontologist, from the point of view of evolution, they were important only when they were parts of living animals. The understanding of evolution comes from the appreciation of the life of past populations. To show the importance of behavior, and particularly of the field studies, I want to reconsider the problem of our ancestors' descent to the ground. The traditional explanation of human bipedal locomotion is that forests were getting smaller and certain arboreal apes were forced to become ground livers and bipeds; descent to the ground and the origin of bipedalism have been considered as parts of the same evolutionary event. But man's close relationship with the African apes suggests that a quite different evolutionary sequence is possible. Both chimpanzees and gorillas are knuckle-walkers. The gorilla spends its time on the ground, and only juveniles climb to any extent.[49] The chimpanzee's diet consists largely of fruit obtained in trees, but the animals move from feeding area to feeding area on the ground.[13,45,46,59] Our closest primate relatives are adapted to life on the ground, and it is possible that our ancestors were similarly adapted to knuckle walking. The Asiatic apes (gibbon and orangutan) rarely come to the ground and have no structural adaptations for ground locomotion; the anatomical adaptations that make knuckle walking possible are confined to the chimpanzee and the gorilla.[58]

Traditionally, the apes have been viewed as primarily arboreal creatures, and their anatomy interpreted almost entirely as adaptation to arboreal life. Field studies show that this is not the case and that a sharp distinction must be made between the still-arboreal apes of Asia and the African knuckle-walkers. It appears that our ancestors were arboreal apes for many millions of years, that they then shared a common knuckle-walking stage with the ancestors of the chimpanzee and gorilla, and that only later did they become bipeds. The possibility of this order is suggested by field studies and by the close relationship of man with the genus *Pan* — shown by chromosomes,[3,30] serum proteins,[14] and albumins.[48] Obviously, it cannot be proved at the present time that our ancestors went through a behavioral stage comparable to that of the living chimpanzee or gorilla, but there is a good chance that they did, and, if so, speculations about our ancestors' coming to the ground, the origin of their bipedalism and tool using, and their living in the savanna *all* need revision.

Cause for Descent

As noted above, the traditional explanation for our ancestors' coming to the ground was that because the forests were becoming smaller they had to come to the ground. However, this explanation does not account for the ground-living knuckle-walkers, which are limited to the forests. The larger the forests, the greater the extent of the forest floor and forest edge, and the more habitat for knuckle-walkers; the fossils of *Ramapithecus* (including *Kenyapithecus*[52]) suggest a form with a range extending from Africa well into Asia, when the habitat was suitable for a tree-

living form. Further, at least four different kinds of Old World monkeys have become primarily ground-living, and this appears to be an adaptation to new areas to avoid competition with closely related forms. If the evolution of the apes is viewed with an understanding of the behavior of contemporary monkeys, it appears probable that the many small apes known to have lived in the African Miocene became extinct through competition with African arboreal monkeys.

The advantage of the large size of the chimpanzee and gorilla is that they can compete with monkeys, but the price they pay is the necessity of spending much of the time on the ground. In Asia, where the numerous and highly successful monkeys of the subfamily Cercopithecinae were absent, the small apes – gibbons – continued, and the Colobinae became highly diversified, filling the ecological niches occupied by the Cercopithecinae in Africa. (This assumes that the baboons and macaques are closely related and are of African origin. The very limited variability of *Colobus* in Africa may be compared to the great variability of leaf monkeys in Southeast Asia.) The emphasis on human evolution and on the apes as our nearest relatives has obscured the fact that, compared to monkeys, the apes are highly unsuccessful. The comparison holds whether the criterion of success is the number of genera, species, or individuals, or the number of substantially different ways of life.

In the evolution of locomotion, the interpolation of a knuckle-walking stage makes the transition from ape to man far easier to understand. Man moves slowly, compared with competing mammals. The predators that might prey on man can run faster than he can, and the ungulates, the principal prey of our ancestors, are far fleeter. It has always been difficult for me to see how a creature less fleet than man could have survived at all. But knuckle walking provides a possible intermediate condition that we know is moderately successful. The essential problem in bipedal locomotion of the human kind is that the hind legs must combine the functions of both the forelegs and the hind legs of the quadrupedal gait.[63] Knuckle walking provides a kind of intermediate condition in which, if selection were for more bipedalism, the long arms might be used less and less in locomotion. The problem of being either a quadruped or a very inefficient biped (as are monkeys) is eliminated. It should be remembered that human arms are very long and that some individuals fall well within the range of variation of the contemporary knuckle-walkers[51]; the earliest known human hand (found by Leakey at Olduvai) shows many of the features of a knuckle-walker.[41,58]

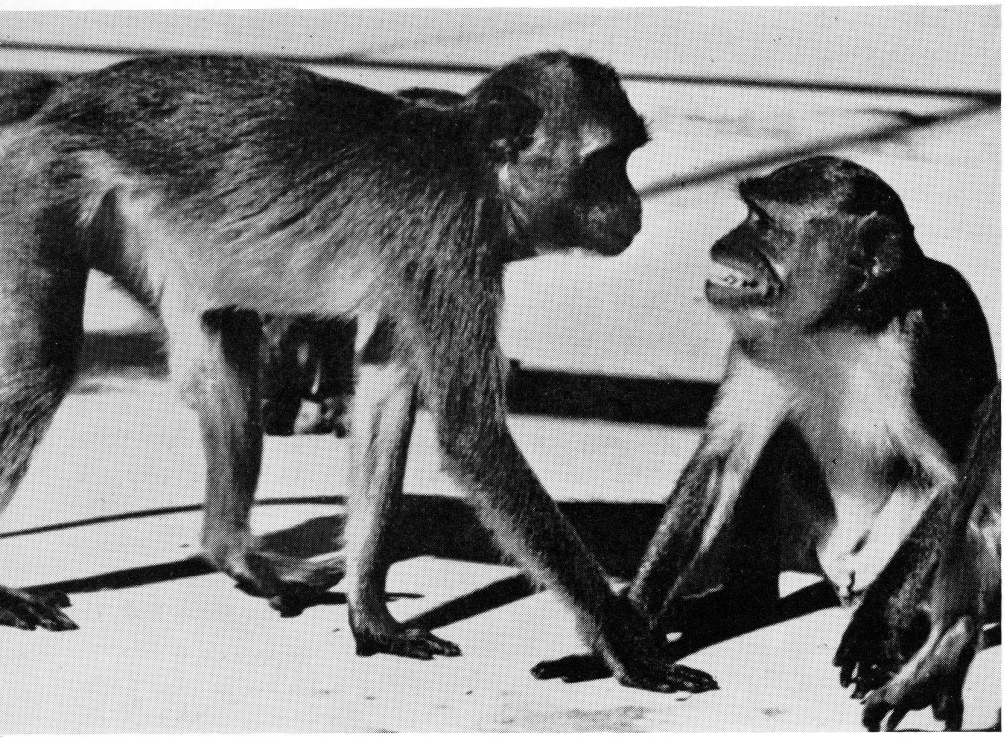
The Manipulative Primate

It has long been recognized that the significance of bipedal locomotion was in freeing the hands for the use of tools – that it was the adaptive success of what the hands were doing that dominated locomotor evolution. Here again field studies offer new ways of understanding. It has been noted that monkeys of the genus *Cebus* appear to learn object manipulation easily,[61] but Thorington[56] has shown that extensive manipulation of twigs and branches is a normal part of the feeding behavior of these monkeys. The reason they learn manipulative behavior easily in the laboratory is that it is part of their normal behavior repertoire. This raises the point discussed by Hall[15] – that some object manipulation is not necessarily a mark of great intelligence. As Oakley[43] has stressed, it is skill in object use and the use of a wide variety of improved objects for different purposes that is unique to man. And, as the case of *Cebus* shows, the ease and conditions of learning the manipulative skills must evolve.

Evolution of Manipulation

A perspective on the problem of learning to use objects may be given in the following way. Primate hands evolved from claw-bearing paws early in the Eocene. For fifty million years in many families of primates, dozens of genera, and hundreds of species, hands were used in feeding, grooming, and locomotion, but, in all this time and in all these manipulative creatures, substantial use of objects as an adaptive mechanism evolved only once. Negative evidence suggests that a very special set of circumstances is needed to account for the beginnings of tool using, and that digital dexterity, although necessary, is a very small part of the explanation. The special situation is knuckle-walking.

Now, next to man, it is the knuckle-walking chimpanzee, among the primates, which performs the greatest amount of object manipulation. Chimpanzees build nests; use sticks to get termites, ants, and honey; use stones to break nuts; use both sticks and



The tooth-baring display, left, is an example of threat communciation. The yawning baboon, below, shows the huge canine teeth that were drastically reduced during man's evolution as tools, not teeth, became the principal weapons.

stones in agonistic displays; and throw both overhand and underhand.[13,31,33,59] (In spite of all the speculation on the origin of tools, the importance of the use of objects in agonistic displays as one type of origin only became apparent after recent field studies.[15,62] The use of objects in agonistic display provides situations in which the effectiveness of the stone or stick might be discovered. Field studies suggest that the traditional notion of discovery, an event in a relatively limited time and place, is biologically wrong. Although agonistic displays may provide one kind of origin of object using, as shown by the chimpanzee and the gorilla, millions of displays over millions of years may have been required to provide the basis for the discovery.)

It would be a remarkable coincidence indeed if the genus that is closest to us in chromosomes, body chemistry, and anatomy should, through chance alone, also be the most similar in object manipulation (particularly when one remembers how unusual this kind of behavior is). Chimpanzees walk bipedally when carrying objects,[59] and field observations fit the experiments and theories of Hewes.[22] Knuckle walking permits a kind of carrying that is impossible for

quadrupedal monkeys. In the knuckle-walking position the flexor side of the fingers is up, and the animal can transport objects without this interfering with the normal gait. An ancestral form that was more bipedal than the contemporary chimpanzee could have used hands to assist in locomotion and also to carry. Knuckle-walking gives an intermediate stage between not carrying and full bipedal carrying with the hands free. Gorilla mothers must help their infants cling for approximately six weeks,[49] and chimpanzee mothers often help the infant in the first months.[60] Here is clear evidence that using one hand to help the infant is much less of a handicap to the knuckle-walkers than to a monkey.

The Tool-Users

Observations of the contemporary primates show that coming to the ground has taken place several times, and that many species of primates that are primarily arboreal spend some time on the ground, with no particular anatomical adaptations to this way of life. Field studies show that it is living away from the safety and refuge provided by trees that necessitates substantial anatomical and social adaptations. In the baboons and geladas protection is provided by the fighting ability of one or more males. The adaptation is anatomical (large canine teeth, jaw muscles, neck muscles, etc.), social (large males defending small females and young), and temperamental (aggressive males). The whole social-anatomical complex is practiced in play, to which the males have devoted hours each day over a period of years before the canine teeth erupt and serious fighting takes place. This investment in the playful preparation for fighting may be contrasted to the minimal play with objects. Even chimpanzees do not practice hitting with sticks or throwing stones and, without long practice, skillful performance is impossible. Juvenile humans wrestle and play in very ape-like ways but, in addition, manipulative skills are part of the play, and frequent repetition of manipulative acts is a normal part of play. If a species is to be away from trees and has to rely on stones or sticks for defense, the object must be in the hands ready for use, and it must be used skillfully. The change from fighting with arms and teeth to fighting with objects requires changes in learning and in play, and the acquisition of new skills. The knuckle-walking theory suggests that this long-continued transitional stage between ape and man may have taken place on the forest floor and on the edge of the forests, where flight to the trees would still be possible. According to this theory, living out in the savanna away from trees would have come long after ground living, knuckle walking, and tool making and using.

Just as the arboreal monkeys that evolved into baboons had to make major adaptations to live in the savanna, so our ancestors had to adjust to a very different life from that on the forest floor. Here important fossils give direct evidence that some of our ancestors had made the transition by two million years ago. The foot found by Leakey at Olduvai is remarkably human.[42] The great toe is in line with the other toes, showing that the climbing adaptation for escape into the trees had been lost. In this same deposit there are stone tools, hands that show many ape-like features, and animal bones that suggest these creatures were supplementing a vegetarian diet with hunting. If protection of the group had been by the kind of fighting and social organization seen in savanna-living monkeys, very large canine teeth would be expected, but precisely the opposite is found. The canine teeth of *Australopithecus* are small — no larger than those of many later members of the genus *Homo*. The location of many *Australopithecus*-bearing sites in the savanna, stone tools, animal bones, small canine teeth, the foot, and other fragmentary limb bones, all suggest a form that had been a ground-liver and tool-user for a very long period of time,[5] and this deduction from the anatomical and behavioral evidence is supported by the latest dating of the fossil remains.

Potassium-argon dates show that the *Australopithecus* stage of human evolution lasted for more than a million years[8] (confirmed by fission track,[9] and the stratigraphy of the Olduvai deposits[21]), and my best guess is that our ancestors were small-brained bipeds, making stone tools and living in the savanna for well over two million years before *Homo erectus*. Of course, the fact that *Australopithecus* lived in the savanna does not prove that species of this genus might not have lived in the forest as well. If *Meganthropus* of Java is to be considered in the genus and, perhaps, of the same large species that has been found at Swartkrans and Olduvai, the species must have adapted to a wide variety of habitats. I doubt

that a bipedal, tool-using hunter was limited to a narrow ecological niche.

In any event, there was very little evolution of tools during those two million years. Traditionally, object improvement was thought of as a stage that followed simple object use. However, termiting by chimpanzees involves both selection of material and improvement by removing any side growth that would hinder putting the stick in the hole.[59] Again, field studies suggest that the postulated order does not correspond to reality, and that even the amount of object use seen in chimpanzees necessitates careful choice of material and some measure of improvement to fit the material to the task. It has been argued that animals with a brain the size of *Australopithecus could not* do things which chimpanzees are, in fact, doing! If the transition from an ape-like ancestor to *Homo erectus* took a minimum of five million years,[48] we can obtain some notion of the time it took to evolve a biology that could learn to be human. To put the matter differently, the biology and the successful way of life evolved in a feedback relationship. The success of initial tool using, perhaps only slightly more advanced than that seen in the contemporary chimpanzee, led to selection for the biology that made tool-using possible, and study of the brain of *Homo sapiens* shows that large areas are associated with hand skills.[44] The reason tool making evolved so slowly was that the brain had to evolve before the skills of *Homo erectus* were anatomically possible.

Intelligence and Social Complexity

According to this view, the explanation of human evolution is to be sought in the feedback relation between successful behavior and the biology that makes the behavior possible. The most important changes are in the brain, which makes it possible to learn how to be human. We learn skills so easily that it is hard for us to appreciate the immense gap that separates us from the nonhuman primates. This gap is due not only to differences in the brain, but also to the development of human skills in a social system that encourages, trains, and permits the expression of the biological abilities in ways that are quite impossible for the nonhuman primates.

Ecology has been stressed as an important factor in the origin of tool using.[1,31] I would stress the social environment, and the evolution of a social system in which skillful object use was rewarded. For example, in cultures where spear throwing is important, children practice this art in play. The children see the importance of the act in their parents' lives, and throughout the extended childhood of man throwing is practiced with adult encouragement. Laughlin[35] has described how Aleut children must be taught and must practice from early childhood in order to be able to spear from a kayak. In nonhuman primates the absence of training and social reward means that the tool-using potential is never achieved. As Le Gros Clark[5] has pointed out, chimpanzees can be trained to perform tasks that are beyond their unaided capacities; in other words, a human brain can guide chimpanzee practice and reward it to develop a new skill, but without human perception, training, and reward, the chimpanzee's performance is limited by both its biology and its social system.

The point is not only that the brain ultimately makes language and complex social life possible, but also, and at a much simpler level, that the perception of what is possible must evolve along with the biology that makes the actions possible. For example, in all the nonhuman primates the range of a social group is, by human standards, extremely limited. Groups of baboons and gorillas may range over parts of as much as fifteen square miles, but the ranges of most primates are far more restricted. These animals have excellent vision and can certainly see food and water beyond a normal range. They are not limited by locomotor ability because in foraging and in the process of daily walking they travel a total distance that is much longer than the length of their ranges. They are limited only by the extent of area they can know and occupy usefully. The human use of hundreds of square miles is the result of human intelligence and a human way of life, not of the greater efficiency with which man moves compared to a baboon.

It is easy to see the relation of motor skills to adaptation and to see how the adaptive success of skills could stand in a feedback relation with the brain. It is more difficult to appreciate that the same is true for other mental abilities, because we are limited by our biological nature. Let me try to clarify the matter by suggesting how an intelligence test might be constructed if the professors who designed it were rats. The maze would be designed to be solved by tactile hairs on the sides of the snout and many clues

would be largely for the sense of smell. Tests would be given in the dark, when everyone knows one is most active and intelligent. We would all score zero, but our primitive primate ancestors could have solved that test. Evolution has not created intelligence in some abstract way; rather, our intelligence is based on particular abilities that evolved along with a succession of ways of life. What we think is normal is what succeeded in the ways of life of our ancestors, and the ability to control rage and sex and to cooperate is part of the biological basis for human social life.[18,19]

In summary, human biological abilities are the result of the success of past ways of human life. Through the feedback relation between behavior and biology, the human gene pool is the result of the behaviors of times past. From the short-term point of view, human biology makes cultures possible. It poses problems and sets limits. But from the long-term evolutionary point of view it was the success of social systems that determined the course of evolution. Whether we study a bone or a stone tool, it had importance only as it mediated in the success, or failure, of behavior.

Field studies offer new ways to appreciate anatomy. They enrich understanding of the social group. They suggest that each stage in the behavioral evolution of man must be reconsidered in the light of our knowledge of our closest living relatives, the knuckle-walkers.

The eminent primatologist and experimental physical anthropologist, S. L. Washburn of the University of California at Berkeley, is Past President of the American Association of Physical Anthropologists and of the American Anthropological Association. The above article includes themes he presented in a lecture on Human Evolution, given recently in Caspary Auditorium. It is based on his Huxley Lecture before the Royal Anthropological Institute of Great Britain and Ireland, in London last November, and is published here with the Institute's kind permission. The ideas presented in the paper have been developed as part of a continuing project on the analysis of primate behavior, supported by grant number MH 08623 of the United States Public Health Service. Dr. Washburn says that "the much greater emphasis on the social system over that in my previous writing is the result of numerous discussions with Phyllis C. Jay, and her influence and help are gratefully acknowledged."

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Dame Hester Adrian Memorial Lecture

THE FIRST Dame Hester Adrian Memorial Lecture was delivered by Alan Hodgkin, Foulerton Research Professor of The Royal Society, on January 17th, and was followed by a reception for 500 in honor of Professor Hodgkin and Lord Adrian who attended. Professor Hodgkin spoke on "The Relation Between Electrical and Mechanical Events in Muscle."

"Hester Adrian has a notable place in the history of biology," President Bronk remarked as he introduced Dr. Hodgkin. "As a girl, she formed life-long friendships with grandchildren of Charles Darwin. She was the wife of Lord Adrian, the towering genius of 20th-century physiology, and now Chancellor of Cambridge University and trustee of The Rockefeller. She was the mother of Richard Adrian, Lecturer in Physiology in Cambridge University and Fellow of Churchill College. Her daughter, Anne, is married to Richard Darwin Keynes, Director of the Institute of Animal Physiology at Babraham, Cambridge. She was a friend of a host of physiologists and medical scientists she met on her many travels with Adrian to universities and scientific congresses."

Dr. Bronk then related how Hester Adrian's own activities in the field of public service were numerous and always devoted to furthering the welfare of the socially or physically unfortunate. For her many and eminent achievements, she was created a Dame of the British Empire by Queen Elizabeth. He continued, "Gradual withdrawal during advancing years would have been unbearable for that great and much loved lady. Only that thought consoled Hester's countless friends at the time of her early death two years ago.

"One of Dame Hester's closest, dearest friends has wished to honor her by the creation of an annual lecture to be given in alternate years here at The Rockefeller University which she had often visited and at the University of Bern in sight of the Bernese Oberland where she and Adrian had often climbed and skied. It was suggested that the lecture at Bern should deal with the physiology of high altitudes where she liked to be or with mountaineering which she greatly enjoyed; that presented here should relate to the physiology of nerve and muscle, a subject to which she had often to listen as Adrian talked with a physiological friend while the three of them worked their way up a couloir or a pinnacle of rock.

"Professor von Muralt of Bern and I had no difficulty in choosing the first Dame Hester Adrian Memorial Lecturer. The only one we considered is uniquely fitted both by his distinguished achievements as a physiologist and as a close friend of Hester – a friendship that was shared by the lecturer's wife, Marion Rous Hodgkin.

"Accordingly it is my privilege and pleasure to present Alan Hodgkin, Fellow of Trinity College, Cambridge, and Foulerton Professor of the Royal Society of London."

Can One Hear the Shape of a Drum?

THE MATHEMATICAL ASSOCIATION OF AMERICA awarded the 1968 Chauvenet Prize to Professor Mark Kac for his paper "Can One Hear the Shape of a Drum?" Dr. Kac first received the Prize in 1950 and is the only individual to be so honored a second time. The citation and purse of $500 were presented to Dr. Kac at the Annual Meeting of the Association on January 26th in San Francisco. The purpose of the Chauvenet Prize is to stimulate the writing of expository works by American scholars.

The "drum" of Dr. Kac's title is more like a tambourine, which is really a membrane. "Stripped of picturesque language," Professor Kac quotes a colleague, "the problem is, if you had perfect pitch, could you find the shape of a drum." The article originally appeared in The American Mathematical Monthly and was dedicated to Professor George Uhlenbeck on the occasion of his sixty-fifth birthday.

In February, Dr. Kac delivered the fifteenth annual Thomas A. Edison Memorial Lecture sponsored by The Naval Research Laboratory Branch of The Scientific Research Society of America. The title of

Dr. Kac's address was "The World of Chance Phenomena." President-elect Frederick Seitz delivered last year's Thomas A. Edison Memorial Lecture.

The Uniqueness of Man

PROFESSOR THEODOSIUS DOBZHANSKY was one of six invited lecturers at the two-day 1968 Nobel Conference on The Uniqueness of Man at Gustavus Adolphus College, January 10-11. "Man is unique in two ways—as an individual and as a species," Dr. Dobzhansky said in part. "The individual uniqueness he shares with other living beings—this uniqueness—is a fact of life which has a simple biological basis, discovered more than a century ago by Gregor Mendel. Equality is a political, ethical and religious precept; diversity is a biological fact. No society can make people genetically identical even if this were desirable, which is definitely not the case. Cold, practical reason, no less than Christian and democratic ethics, demands that individuals be given a chance to prove themselves, regardless of their origins. Equality of opportunity is not a tactic to make everybody alike. It is, rather, a strategy to enable people to achieve self-realization in what their tastes and abilities make them select."

Alumni

◖ Alumni who have new appointments this year include:

WILLIAM F. ARNDT, JR. PH.D. 1959, Flight Surgeon in the United States Navy, has completed a tour of duty at the Da Nang Airbase in Viet Nam, where he was Senior Medical Officer of Marine Aircraft Group Eleven and Flight Surgeon for All-Weather Attack Squadron Two-forty-two. In January Dr. Arndt accepted the post of Principal Engineer-Scientist in the Advance Biotechnology and Power Department of the Douglas Missile and Space Systems Division, McDonnell-Douglas Corporation, Santa Monica, California. His specific responsibility is research on life support systems and aerospace medicine related to advance manned-spacecraft.

LEONARD E. MINDICH PH.D. 1962 has been promoted from Research Associate to Associate, Public Health Research Institute.

DONALD E. OLINS PH.D. 1964 is now an Assistant Professor, University of Tennessee, Oak Ridge Graduate School of Biomedical Sciences.

THOMAS W. SCHLEICH PH.D. 1966 has recently been appointed a Helen Hay Whitney Postdoctoral Fellow.

◖ The Society for Public Betterment of Cali, Colombia, has awarded its Medal for Civic Merit — the country's highest recognition to its distinguished citizens — to Dr. Tim Loeb, PH.D. 1962. Dr. Loeb is Assistant Professor, Facultad de Medicina, Universidad del Valle. He and Mrs. Loeb had received a legacy of $250,000, which they donated in full to the Tobias Emanuel Institute for retarded children and other social improvement projects. The Institute will house 700 children and is named in memory of their youngest son who died recently of encephalitis. The presentation was made by the President of the Society, Ramón Hernández Rengifo, at ceremonies in Cali on November 26.

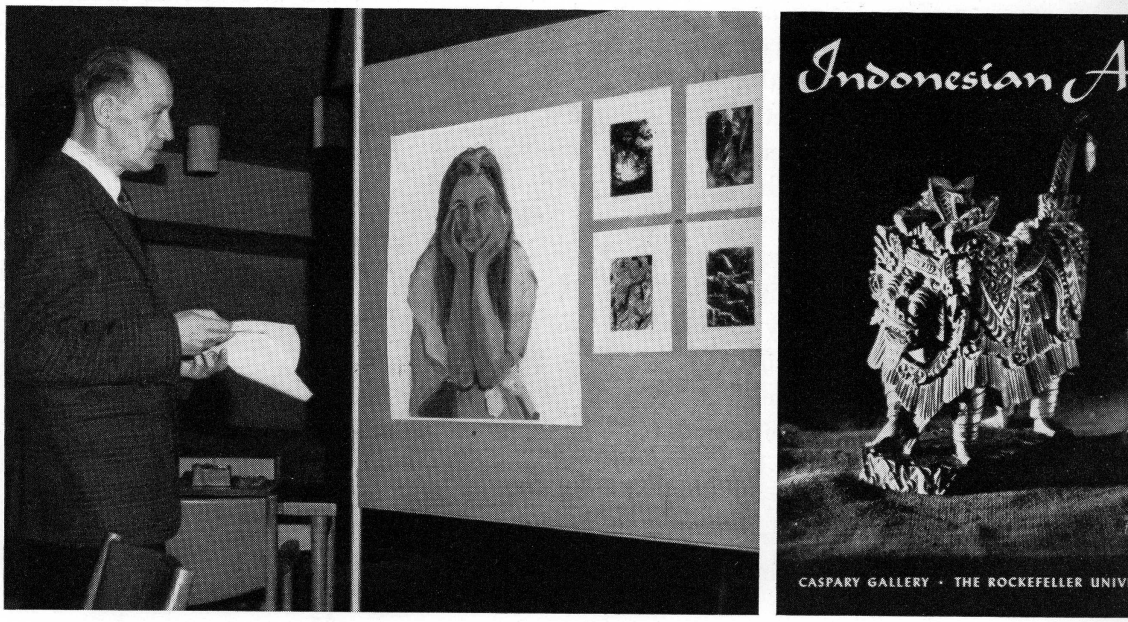
◖ Recently published books by graduates of the University include:

JOSEPH W. VANABLE, JR. PH.D. 1962 *Developmental Biology: A Laboratory Manual.* Vanable, J. W., Jr., and J. H. Clark. 180 pages. Minneapolis: Burgess Publishing Company, 1968.

"...fingers on one hand"

THE REPUTATION of the University as a center for the arts was further enhanced during the winter months when no fewer than twenty-five sculpture and art exhibits, concerts, and fine art film showings were held in the Abby and in the Caspary auditorium and gallery. Leading the season was the seventh annual Arts and Crafts Exhibition in the Faculty and Students Club. Professor Vincent Allfrey is seen [page 22] admiring the oil "Seated Figure" by Caroline Arnold, typist, and four photographs by William Lowrance, Jr., Graduate Fellow. Dr. Allfrey himself contributed a watercolor to the show. Eight other members of the Faculty, six graduate fellows, and twenty-five members of the administration and staff took part.

Among the eleven musical events arranged by Professor Theodore Shedlovsky were nine evening sub-



Arts and Crafts Exhibit, Faculty and Students Club. Indonesian Art Exhibit, Caspary Gallery

scription concerts. The most memorable perhaps was the recital by the Spanish pianist, Alicia de Larrocha, later repeated in Carnegie Hall. In addition, two Wind Ensemble Workshop concerts were given on Sunday afternoons, and a music-lecture demonstration of the viola da gamba as a solo instrument was presented by John Hsu assisted by William Austin.

Other media include the fine art cinema represented by Synge's "Playboy of the Western World" and Pinter's "The Guest"; Eastern art, including exhibits of objects from Indonesia and from Tibet; and Archibald MacLeish's reading of some of his unpublished poems *(page 1 this issue)*.

Diverse in form, "all arts are one, howe'er distributed they stand/" writes sculptor William Wetmore Story, "verse, tone, shape, color, form, are fingers on one hand."

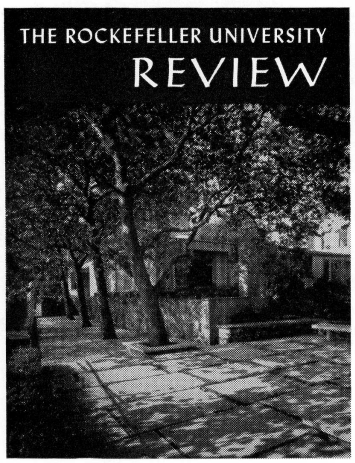
¶ Professor William H. Stein was elected Editor of *The Journal of Biological Chemistry* by the Council of the American Society of Biological Chemists, and assumed his new duties the first of January.

¶ During the opening months of the academic year, guests from abroad in residence at the Abby included Lord Adrian of Cambridge, Trustee Emeritus; Dr. Moises Agosin, Professor of Parasitology, Universidad de Chile; Dame Honor B. Fell, Director of Strangeways Research Laboratory, Cambridge; Dr. H. Fujita, Professor of Mathematics, University of Tokyo; Dr. J. B. Gurdon, Professor of Biology, University of Oxford, England; Dr. Holger V. Hydén,

The Renaissance Quartet, subscription concert, Caspary Auditorium

Director, Institute of Neurobiology, University of Göteborg, Sweden; Dr. A. Klug, Research Council Laboratory of Molecular Biology, Cambridge; Dr. Paul Leren, Ulleval Hospital, Oslo, Norway; Professor Ali Monnier of the University of Paris; Dr. Michael Oliver, Professor of Medicine, University of Edinburgh Medical School, Scotland; Dr. Tsuneo Omura and Professor Ryo Sato, Institute for Protein Research, Osaka University, Japan; Professor Y. A. Ovchinnikov of the Academy of Sciences of the USSR, Moscow; Professor Michael Robin, Hebrew University, Jerusalem; Professor Dietrich Schneider of the Max-Planck Institut für Verhaltenphysiologie, Berlin; Dr. Sten Skoglund, Professor of Anatomy, Karolinska Institutet, Stockholm; Professor Sidney Smith, St. Catherine's College, Cambridge; Sir George Taylor, Director, Royal Botanic Gardens, Kew, England; and Dr. Harald Teir, Professor of Pathology, School of Medicine, University of Helsinki; Professor Anthony Linnane, Monash University, Melbourne, Australia; Professor Albert Claude, Director, Institut Jules Bordet, Université Libre de Bruxelles, Belgium.

¶ The Rockefeller University Press released three new books in January: *The Neurosciences: A Study Program,* edited by Gardner C. Quarton, Theodore Melnechuk, and Francis O. Schmitt, and published for the Neurosciences Research Program of MIT; *Genetics,* edited by David C. Glass; and *Law and the Social Role of Science,* edited by Harry W. Jones. A second printing of *The Neurosciences* is already under way – as this issue of the *Review* goes to press – including a special edition for distribution in Japan by the University of Tokyo Press.



The President's House overlooks the East River from a niche lined with sycamores at the extreme northeast corner of the campus. The cover photograph shows the curved stone entry at right and the intimate garden and flagstone terrace facing the river. Photograph by Joseph Barnell.

ACKNOWLEDGMENTS: Pages 1 and 9 illustrations from a photograph issued by National Palace authorities in Peking in 1934, courtesy of Bollingen Foundation, from *The Art of Letters,* 1951. Page 2 illustration Culver Pictures, Inc. Page 6 illustration The Bettmann Archive, Inc. Pages 10-18 the text of the article by Dr. Washburn appeared in the *Proceedings of the Royal Anthropological Institute of Great Britain and Ireland* for 1967, and is reproduced here with the Institute's kind permission. Pages 11 and 15 photographs courtesy of Dr. Peter Marler. Page 22, left, photograph by The Rockefeller University Illustration Service. Page 23 photograph by Richard de Grab.