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Towards More Vivid Utopias

Margaret Mead

When one is asked to speak to a group primarily interested in the sciences from a platform defined by the humanities, it seems important to state more specifically where one's own discipline lies within the academic fields and what contribution one may expect to make from its specific interests. Anthropology holds a unique position, formally recognized in its inclusion in the National Research Council, where it belongs as a biological science; the Social Science Research Council, among those sciences which take man's biological nature as given; and the American Council of Learned Societies, because of its concern with language, so often defined as a pure humanity, without reference to the larynx or the delicate mechanism of the human ear.

This triple membership springs partly from the tradition of anthropological field work, in which single workers, with small funds and a narrow margin of time, visited, in what was conceived as probably the only careful study which would ever be made, small primitive societies whose ancient and distinctive ways of life were disintegrating even as we tried to set them down. Not only did we work with urgency, as might a student of literature, trying to take down from dictation a new poem from the lips of a dying poet, or a student of painting, who found a painter of great gift drawing in an impermanent ink on the exposed, whitewashed walls of a public square—where the rain would wash it all away tomorrow or the next day—but we also, both by the nature of the situation in which we found ourselves and by the canons of our craft, looked at the whole people, at their bodies as well as at the social arrangements of their lives; at the music they made, or at least at the musical instruments with which they made it; at the dances, which might be seen as art to be appreciated as well as analyzed; at their rituals, which might be catalogued as *rites de passage* or regarded as an artistic product of generations of imaginative creativity, anonymous, time binding, with its own esthetic.

The anthropologist who works in this way comes to have an equal interest and respect for those aspects of human life which are concerned with the perception and ordering of observed regularities in nature and for those aspects of human life in which the "seeing eye" turns as much inward as outward, as the mind matches proprioception with perception in an outer world which already contains —in the shape of a roof, the line of a dance, the flick of a wrist at a sacrifice—the patterned perpetuation of earlier imaginative and creative acts.

Because we are also always committed to a scientific ordering of our material, these products of human imagination can not only be subjected to analysis of their function in a given society but can also be related to certain capacities of the human mind—themselves becoming better known through the imaginative scientific inquiries of investigators like Piaget and Inhelder, Gesell and Ilg, Erikson, and Margaret Lowenfeld. Delight in the imaginative creation of individuals or in the intuitive—that is, simultaneous and so unanalyzed—grasp of these as wholes by whole societies, does not prevent analytic work, also. The two methods of approach—that of the humanities, which focuses upon a recognition of the unique character of a work of the imagination, and that of the sciences, which attempt by careful observation, analysis, and finally experiment to understand the lawfulness of the behavior involved—can be used.

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Vision and Cultures

It is from this particular background of research that I wish to describe the role which men's visions of a possible and more desirable future play in the development of a culture. Utopias may be seen from many points of view—as projections from individual experience; as projections from individual experiences stamped by the point of view of a particular period; as sterile blueprints, too narrow to confine the natural varieties of the human mind for very long, as when they are lived out by small cult groups who pare and mould the individuals born within them to a confining and crippling mode. Or they may be seen as those visions of future possibilities which lead the minds of men forward into the future, giving life a meaning beyond the grave or beyond the simple domestic perpetuation of one's own life in the lives of one's children, with an interest in the trees planted in one's own garden but no interest in the trees in one's neighbors' gardens. The Golden Age, a retrospective utopia of the days when all men lived like gods, and walked and talked with gods—the days before death or work or separation came into the world—may also, of course, play a significant role in keeping a whole people caught in a dream unrelated to the requirements of the contemporary world.

Using models from primitive cultures, we may, from this point of view, look at those cultures in which life is held steady by a view of the past, of which the present is a poor copy, a vale of tears where once there was Olympian laughter, at those cultures which live a hand-to-mouth existence, wrapt in the small urgencies of the present, and at those which move, generation after generation, towards Heaven—which may be the heavenly Jerusalem "with milk and honey blest," the Jerusalem to be rebuilt and reinhabited, which informed the imagination of Jews throughout the Diaspora, or the Jerusalem to be built "in England's green and pleasant land." Against these may be placed Nirvana, with its insistent comment on the lack of value in all earthly and individualized life.

Within a culture as complex as our own, which draws on the inheritance of so many earlier and partly recorded pasts and which now has available an even larger number of incomparable and imaginatively stimulating "presents,"

from accounts of the peoples whose lives were part of a different stream—in Africa, in the Orient, and in the New World—it is obvious that we may live not only on different visions at different periods but also on different and incompatible visions at the same time. Part of the excitement and the difficulty of the modern world, which makes the artist feel that he has no whole context within which to create his personal, special new vision and which makes the scientist turn to the anonymous writing of science fiction nightmares, is just the way in which different sorts of utopias—one man's dream and another man's nightmare—jostle each other even within the confines of one political speech or one brief editorial, as we yearn for a past, rage at or delight in the present, or promise or threaten a future. While it always has been and will probably always be the mark of the more educated man that he lives in a longer time perspective, both into the past and into the future, than his less well educated contemporaries, where this education is underwritten by no habitual pattern of thought and speech within which such time perspectives are implicitly expressed, the presence of so many and such contrasting world views may seem fragmenting and mechanical rather than living.

Of Practical Import

Yet, from comparative materials, it seems quite clear that the utopias men live by are of vital importance in such mundane matters as whether they will struggle to preserve the identity of their society, their class, their religion, or their vocation; whether they will plant trees which take two lifetimes to mature; whether they will take thought to stop the forests from being depleted, the good soil from being washed into the sea, or the gene pool from becoming exposed to too much radiation. Men who believe that the ultimate good state will mean the abolition of identity are hardly likely to take an active interest in public health, and those who believe that the Day of Judgment is near, when the sheep will be separated from the goats and the whole world will go up in a holocaust directed by a punishing Deity, see the atom bomb as an addition to the Lord's armory of destruction.

Within any determinedly other-worldly religion, there is a perpetual conflict between the active acceptance of early death (so the little, innocent souls may go up to God at once, unstained by sin) and the need for public health measures and preventive medicine as well as for the compassionate dole to the beggar or care for the dying. The Catholic Church has fought a long battle against an otherworldliness which would have as its logic an overvaluation of death—which has occasionally been the response of literal-minded savages to enthusiastic Christian preaching about heaven. On the other hand, the modern public health movement has its problems in an overvaluation of the importance of individual life, which leads to a lowering of death rates before there is a compensating rise in the standard of living and a fall in the birth rate, with the result that famine and misery are the portion of the very individuals whose lives were to be bettered.

The Pallid Utopias

At the same time, all visions of heaven, in this world and in the next, have a curiously tasteless, pale blue and pink quality, whether the image is one of cherubim and seraphim "casting down their golden crowns around the glassy sea" or of a time when "ploughs in peaceful industry shall supersede the sword," when "the dictatorship of the proletariat shall be realized in ideological completeness," or when lions shall lie down with lambs, or of a world in which women shall have been freed from all the incidental consequences of their reproductivity and will spend long vacations with their lovers of the moment, flying Chinese kites.

Beside any picture of heaven above or heaven on earth, the pictures of hell and destruction stand out in vivid and compelling intensity, each detail strong enough to grip the imagination as the horrid creations of a Wells, an Orwell, or an Aldous Huxley unroll before our horrified eyes. Where positive utopias are insipid and a detailed heaven is unbearable to think of as a permanent abode, the creators of terror, the repudiators of man's future, have no such problem. So, if utopian visions are the stuff by which men live, it would seem a legitimate subject of inquiry to ask what is the matter with them? Why is Hell always so much more vivid than Heaven? Why, as I heard a young priest say recently, are all images of heaven "while not exactly not true, not as true as they might be"?

There have been attempts to give scientific answers to this question: that the prefiguration of bliss lies in the womb, where the child has no chance to use its distance receptors, and so the feeling remains one of undifferentiated and unspecified ecstasy; that analysis destroys a vision by introducing an element of self-consciousness and detachment of part of the self. These may be adequate explanations of the way in which the individual, in terms of his life experience, seeks for or experiences visionary ecstasy, but they seem insufficient answers to the problem of why the imagination of the human race, which has produced its long procession of great creations, has never yet succeeded in building a picture of a future really unlike the present, either in this world or in the next, where anyone passionately wished to live except when it was counterpointed against a Hell, delineated with the greatest precision. Heaven and all the pallid utopias are, in fact, even like Nirvana, blank white spaces—or spaces a little tinted with pastel and furnished with plastic gadgets—and are given reality only by contrast with the fear, pain, and agony of some other state.

Yet it is by visions of a better world or place or state that men make positive efforts—in contrast to fiddling while Rome burns or refraining from evil all their days in fear of hell-fire. So it would seem legitimate to ask why human imaginations are, apparently, so handicapped in the creation of such essential visions and whether there is any way in which our present scientific knowledge of human behavior and of the way in which societies function can be used to create conditions within which utopias might be created whose positive hold on men's minds would be stronger than the negative hold of the Infernos and Lost Paradises. For the last 50 years we have experimented with the compelling character of negative images, as the prophecies of the dangers of modern warfare have grown ever sharper. When warfare is upon them, men will struggle; but they sink into a kind of paralysis when there is need to fight even harder—in peacetime—to prevent a recurrence of war. We need more vivid utopias.

One answer to the question comes from an examination of the struggle that institutionalized religions, which present the other world as desirable, must go through to deal with suicide, either condemning it as a dereliction in stewardship, as Christianity does, and treating the living out of life on earth as a trust, or hedging it around with terribly diffi-

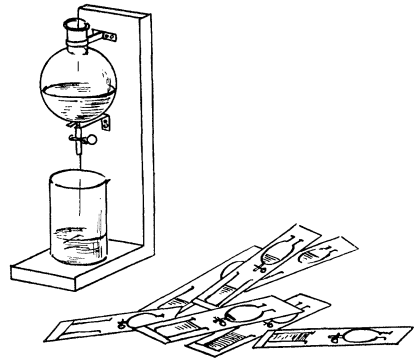

Fig. 1. Demonstration apparatus and scrambled cards from part I of Flowing Liquid Test in which a simple sequence of cards showing correct relationships is presented. [From the experimental work of Barbel Inhelder, in the Laboratory of Jean Piaget, Institut des Sciences de L'Education, University of Geneva.]

cult steps, as in parts of India, where, in order to die a holy and self-elected death, a man must give up caste and family and must become purified until, at last, dressed for the next world and in a trance, he is lowered into the earth "alive." The next world must not be so desirable that it completely competes with this one and leads a majority of believers to suicide or towards a too-willing death in war, with the promise of a warriors' heaven. A long life of preparation—as a shaven and dedicated celibate, completely cloistered or moving through the streets with a begging bowl and making a contribution to the ongoing life of the world as teacher, nurse, or supplicant—this is feasible.

Similarly, Communism has always had difficulties with those who, regarding the Soviet Union as heaven on earth, have wished to go and live there instead of remaining in their own unregenerate countries, working at dull organizational jobs in the hope of a World Revolution which they themselves might not live to see. Sometimes short trips to the Soviet Union, as circumscribed as visions of the next world to a cloistered religious, were permitted. But the tension between the vision and the present must not include any way of immediately slackening it by a self-elected entry into heaven.

Dreams—Compelling and Tempered

In fact, through the emphasis on dedication, attention is shifted from the self to the fate of others; through prayer for the souls in purgatory, teaching the young, or preparing for the revolution from which others will benefit, the necessary distance seems to be created so that a vision can be compelling, drawing one on like a magnet, but not too fast or too far. So perhaps it may be said that it is only when the visionary or the prophet, the poet or the painter wants to involve the individual directly in the future vision that the danger of immediate response is allowed for in the interpreters and spectators by a dilution of its intensity. Then Heaven or the Perfect Socialist State may be seen as being too insipid and as tasting like sawdust. A feeling of less involvement may be achieved by concentrating the individual's effort on the relation between someone else and the desired state—where the nexus can have both the intensity of devotion to the other and devotion to the dream without the temptation to relax and try to get there oneself.

Even here the other temptation—to force history at once to disgorge a visionary paradise at no matter what cost of suffering and death—is present as soon as Heaven is too vividly conceived even for the other, who must then be saved, by the rack or by brain washing, to become a denizen of someone else's too compelling dream. The ability of any people to cultivate protective devices against other people's compelling visions —against which the best defenses seem to be either laughter or else revolt against any individual being in thrall to the will of another—must also be considered as one component in their ability to create utopian dreams which inspire but do not limit them.

Appeal to Universals

But there seems also to be another explanation of the relative lack of vividness of the good vision as compared with the nightmare. In pictures of Hell, of dictatorships armed with concentration camps and thought control, the appeal is made to human beings' most shared and least differentiated responses; pain, hunger, thirst, being bound, tortured, cut off from other human beings, and battered day and night by intolerable stimuli—these are experiences which repel every human being and under which the savage and the civilized, the illiterate and the scholar ultimately break down.

Men of different temperaments will break in different ways and at different points, but the effect of Medieval images of the tortures of Hell, when conjured up by a gifted preacher, or of the tortures actually administered in Nazi and Communist prisons is, in the end, to break all but the exceptional martyr sustained by a vision (which, only in this exceptional situation, cannot be called too vivid) of another world to which he is personally totally committed. (So Jehovah's Witnesses are said to stand up well to Communist pressures, and Orthodox Jews went chanting to the gas chambers as the early Christians, in the days when the Second Coming was felt to be very near, faced the lions.)

Appeal to Diversity

But the utopian vision, which is vivid enough to compel men's imagination and yet not so compelling that men must resort to rack and torture to bring others into it—the vision which men want to share with others and entrust to their expanding imagination rather than the vision in which they wish to entrap and imprison others—is built not upon the universals of fear and pain, hunger and thirst, ultimate fatigue and weakness, but upon the great diversity of human propensities and gifts. It must be, in terms of modern information theory, redundant enough to catch the developed imagination of each so-different member of any society.

Reduction to fear and pain gives men a common basis of the unbearable which can be elaborated—a nightmare peopled with Sisyphus endlessly rolling his stone and Tityus in agony. But reduction to our common good human experience leaves us with images of milk and honey, which stand very little elaboration before they are disintegrated by the involvement of our specific imaginations, by the differences in our childhood images of love and trust and bliss: it was not honey but strawberry jam, not the hum of bees but the flash of dragonfly wings, not a pointed breast but a round one which gave one suck. The recitation of such particular delights of food and drink as goat's milk or palm wine, durian, or witchetty grubs only resonate in the minds of those who once drank or ate them and fall dead upon the ears of those who never knew these pleasures. A whole society can be drawn on only by a utopian vision which contains the separate experiences of different regions, different classes, and different vocations, combined with the varied notes on each theme played by men of different temperament, disciplined and shaped by the prevailing forms of the culture. So it is no wonder that utopias are hard to come by.

The World's Needs

Yet the world today is sorely in need of a vision which will endow our lives with meaning and responsibility and will make safe the terrible powers of destruction and the almost limitless powers of construction which scientific research has put into our hands. We can specify some of the characteristics this vision must have: it must be vivid enough to compel the heart, but not so vivid that one moves too quickly, by death or emigration or the coercion of others, to attain it; it must be so conceived that it is sought for the sake of others rather than solely for the self—for other men, for the whole next generation, or for men eons ahead—with nice adjustments which make it not too immediate (just the next generation) and not too distant, lest one become lost in a world without imaginable relation to the present; and it must be complex, redundant enough to catch and hold the imaginations of men and women of many different types of temperament and experience, and stylized enough, in terms of culture and period, to carry the weight of past ages of formal esthetic moulding and polishing and to speak with cadences and lines grown powerful by long usage.

These prescriptions I am giving are of the sort which can be derived from the scientific comparison of cultures; they are prescriptions for conditions. So one may compare ages and countries in which a particular art or science has flourished with those in which they have

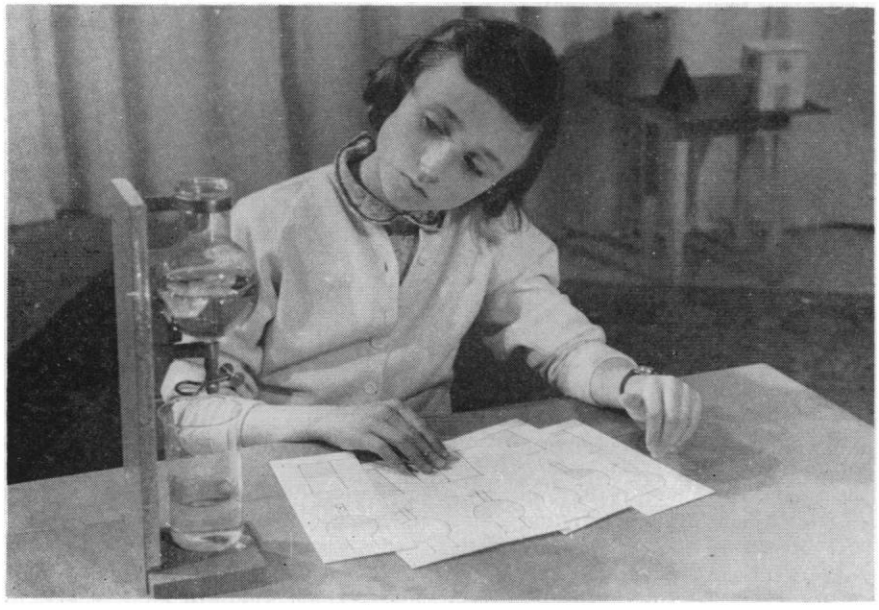

Fig. 2. A child beginning the Flowing Liquid Test.

not so flourished, dissect out what appear to be the facilitating conditions, list and describe them.

Possibly all these may be necessary but not sufficient causes. Yet it is by the specification and attempted realization of conditions within which events desired and deemed necessary may occur that the sciences that deal with man can work in the world, stating conditions within which a child can grow, an idea can take root, an institution can flourish, and a man's hand and eye can grow cunning, his mind sharp, and his imagination wide. Though we remain dependent upon the caliber of individuals for our great achievements, the contrasts between one culture and another—between peoples whose every movement is a work of art and peoples, of the same human species, who limit their artistry to a few scratches on the edge of a pot—leave little doubt that the cultural conditions for any kind of creativity are very important. And as, by the scientific comparative study of cultures, we learn more about them, we can turn from hand-wringing, viewing with alarm, and the role of Cassandra to build the world closer to our heart's desire.

Necessary Conditions

What, then, may the conditions be within which we may foster more vivid utopias? Three resources which seem accessible to us with our present knowledge are these: the imaginations of little children, where each newborn child brings a unique and new potential to our perception and ordering of the world; the provision of materials from other cultures, so that in the interplay between the great achievements of the human race in the many separate, unique, but comparable cultures men have built, new combinations and forms may occur; and the creation of conditions within which those who know the possibilities for the future, which are emerging from scientific discoveries, can combine their insights with the insights of those who know the full and astounding range of what man has achieved in the past, without mutations or the hypertrophies of extrasensory perception currently invoked by the creators of our folklore of the future, the writers of science fiction.

The Child's Perception

The imaginative capacities of young children, initially part of the processes of growth and evolution, as Edith Cobb has phrased it, are then one source to which we must turn. Within the growing child, the capacity to bring order out of the perception of the outside world and the capacity to create something unique and new out of his perception of himself in the world are, initially, two parts of one process. Concentration on one at the expense of the other robs the child, and so the world, of what could have come from both.

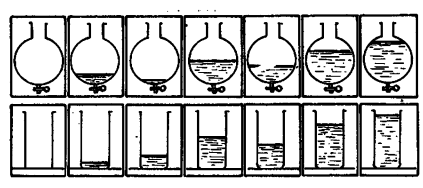

Fig. 3. A "poetic" answer to part II of the test, when the child is presented with a double set of cards. This answer, made by a boy of 5 years and 8 months of age, is described by the experimenter as containing "some mistakes characteristic of children of this age." Note the complexity of the rhyming, like a Bach two-part invention.

The current experiments of Jean Piaget and Barbel Inhelder, in Geneva, provide a vivid illustration of these two approaches. Piaget and Inhelder have developed a set of experiments to test the child's growing capacity to recognize some of the principles essential to scientific thought. One of these, which Piaget calls "reversibility," is exemplified in the child's recognition that when a large, round lump of clay is thinned out to a narrow cylinder, it will still have the same weight and be the same amount of clay. When these experiments are reported only in words, with the emphasis placed upon growth, with chronological age and school training, of the ability to recognize such points, the *other* things the child does are catalogued simply as failure. But when a method of reporting is used which records the entire behavior of children at different ages—through sound film, film and tape, or the verbatim recording of words—then the whole child comes into the picture and we see something else.

Thus, in the test situation (Figs. 1 and 2), the child is presented with a laboratory apparatus by which a colored fluid can be released gradually from the upper glass chamber, through a cock, into a glass below. The child is shown how this works and is allowed to try it. Then he is given series of cards picturing the state of the apparatus before any fluid enters the glass, at various stages, and, finally, when all of it has entered the glass. The card series are presented to the child in a scrambled state, and the child is asked to arrange them. One little boy, whose achievement on the test—like that of many children of his age—would have been reported as "failure," made a response which can be described as poetic (Fig. 3) as he "rhymed" the cards instead of arranging them to represent the reality of colored water passing into a glass in an orderly way (Fig. 4). Using the same materials, he drew on another capacity of his mind. Had this been a class in "design" or in "making pleasing patterns," his answer would have been the "right" answer, whereas when he was being tested for ability to use a kind of thinking basic to modern science, it was a "wrong" answer.

In the kind of training given in European schools of the Swiss type, the child has to learn to handle this kind of reversibility after first encountering a world in which rigid one-way sequences in behavior and among material things have been heavily emphasized. By contrast, it is the problem of how to handle rigid sequences—which cannot be reversed in fact, however they may be reversed in thought—that must be learned by the first generation of a people who encoun-

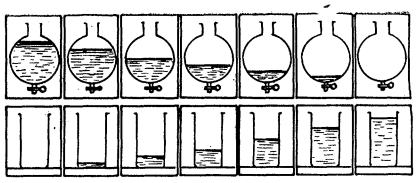

Fig. 4. The correct answer to part II of the test.

ter factory methods, people who have arranged life in their heads in poetic patterns and who have not been told that this is the "wrong" answer. Recently I saw a group of educated men and women who had been presented with some simple problems in building manifolds by means of brightly colored units; the men classified the exercise as "art" and, although they were much better in mathematics and science in college than the women, failed, while the women, who also classified the exercise as "art," at which they thought themselves good, succeeded easily. By failing to cultivate both sides of the child's ability, by opposing them and negating one or the other, we are losing not only artists but also scientists, and we are splitting our society, as well as our individual children, into incompatible parts, destructively at war with each other. A different type of education, which recognizes the early stage in which children can apprehend form through color and kinesthetic feel and the recognition of sets, is a precondition for preserving the creativity with which each generation of newborn children enters the world.

A Whole View of the Past

The second necessary condition, a knowledge of what men have done before, again involves the presentation of wholes—not the current split between the history of science and technology, on the one hand, and art museums and literature courses, on the other. In real life the imagination of the painter and the poet are essential to the conditions within which the scientist works, for the fearful presage of the poet reaches ahead of invention. A few years ago an attempt was made to design an exhibition which would show the effect upon painting of modern scientific invention in building design; but in looking at the materials it was discovered that in every case the painter's vision had preceded the necessary technological invention, as the myth of Icarus preceded the Wright brothers. So we need arrangements which will bring together, for the experience of the student and the adult, whole historic periods—their buildings and their ideas, their books and their economics, their painting and their technology, their mathematics and their poetry—so that out of the perceived relationships and comparisons among them new ideas may be born and the present ignorance among scientists of man's past and present greatness, surpassed only by the ignorance among most humanists and many artists of man's future, made possible by science, may be overcome.

"Chairs of the Future"

Finally, it seems to me, in this age when the very survival of the human race and possibly of all living creatures depends upon our having a vision of the future for others which will command our deepest commitment, we need in our universities, which must change and grow with the world, not only chairs of history and comparative linguistics, of literature and art—which deal with the past and sometimes with the present—but we need also Chairs of the Future, chairs for those who will devote themselves, with all the necessary scholarship and attention, to developing science to the full extent of its possibilities for the future, and who will devote themselves as faithfully to the fine detail of what man might very well—in the light of all our knowledge—be as any classicist or medievalist devotes himself to the texts of Pindar and Horace or to the thought of St. Thomas Aquinas.

Bibliography

M. Carstairs, *The Twice Born* (Hogarth, London), in press.

E. Cobb, "The ecology of imagination in childhood, unpublished.

E. H. Erikson, *Childhood and Society* (Norton, New York, 1950).

L. K. Frank, "Imagination in education," in *Imagination in Education*, Proceedings of the Bank Street College Conference (Bank Street College of Education, New York, 1956), pp. 64–72.

A. Gesell and F. Ilg, *Infant and Child in the Culture of Today* (Harper, New York, 1946).

W. Grey-Walter, *The Curve of the Snowflake* (Norton, New York, 1956).

G. R. Harrison, *What Man May Be, The Human Side of Science* (Morrow, New York, 1956).

G. Hendrix, "Prerequisites to meaning," in *Math. Teacher* 43, 334 (1950).

M. Lowenfeld, "The world pictures of children, a method of recording and studying them," *Brit. J. Med. Psychol.* 18, pt. 1, 65 (1939); "Poleidoblocs" (forthcoming series of tests on children's mathematical imagination; available at the Institute for Child Psychology, 6 Pembridge Villas, London W. 11).

M. Mead, "Arts in Bali," in *Yale Rev.* 30, 335 (1940); "On the implications for anthropology of the Gesell-Ilg approach to maturation," in *Am. Anthropologist* 49, 69 (1947); "Some relationships between social anthropology and psychiatry," in *Dynamic Psychiatry*, F. Alexander and H. Ross, Eds. (Univ. of Chicago Press, Chicago, 1952), pp. 401–448; "Cultural discontinuities and personality transformation," in *J. Social Issues* (Kurt Lewin Memorial Award Issue, Suppl. Ser., No. 8).

C. Morris, *Varieties of Human Values* (Univ. of Chicago Press, Chicago, 1956).

J. Piaget, *Le développement de la notion de temps chez l'enfant* (Presses Universitaires de France, Paris, 1946), chap. 1, pp. 5–36.

E. Sewell, *The Field of Nonsense* (Chatto and Windus, London, 1952).

J. Tanner and B. Inhelder, Eds., *Psycho-biological Development of the Child* (International Universities Press, New York, 1956; 1957), vols. 1, 2.

Molecular Growth Requirements of Single Mammalian Cells

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A technique developed in our laboratory for plating single mammalian cells in petri dishes containing nutrient medium permits each cell to grow in isolation to form a macroscopic colony (*1–3*). The method is comparable, both in simplicity and accuracy, to the standard agar plating procedure of quantitative bacteriology. It has been used for demonstration of the existence of mutant human cell strains and for the isolation of clonal cell lines with stable differentiating characteristics (*4*). It has provided accurate and reproducible analysis of growth curves of single mammalian cells under a variety of conditions (*1–3*) and has made possible quantitative studies of the action on them of agents such as ionizing radiation (*5*), antibodies, drugs, and hormones (*6*). This article (*7*) describes the application of this method to study of the molecular growth requirements of mammalian cells.

Procedure and Results

These experiments were carried out with the S3 clonal strain of the HeLa cell (*1*). Elegant studies on massive populations of the parental HeLa strain

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