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ABSTRACT

Recommendations concerning the reading, writing, and mathematics skills that are needed by students entering degree programs in Minnesota postsecondary institutions are offered by a Minnesota Higher Education Coordinating Board task force. In addition to describing reading skills that students need for most college degree programs, conditions under which degree credit may be appropriate for college reading instruction are addressed. Recommendations concerning high school and postsecondary instruction in reading are presented. Writing skills are also described, along with applications of those skills that typify the college student's experience. Writing expectations and standards at high school and college are distinguished, and recommendations are offered to improve students' readiness to develop college-level writing skills. Specific mathematics competencies for college study are listed, and suggestions to improve the teaching of these skills at high school are made. Appended are three typical reading assignments in college literature, social science, and science courses, as well as recommendations of national agencies concerning mathematics. (SW)

DEFINING COLLEGE-LEVEL SKILLS

TASK FORCE REPORT

Minnesota Higher Education Coordinating Board, 1986

REPORT OF THE TASK FORCE ON DEFINITION OF COLLEGE-LEVEL SKILLS

January 15, 1986

Minnesota
Higher Education
Coordinating Board

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PREFACE

The Task Force on Definition of College-Level Skills was sponsored by the Higher Education Coordinating Board to recommend the reading, writing, and mathematics skills that should be expected of students entering degree programs in all Minnesota post-secondary institutions.

Throughout this report, we use the following vocabulary and definitions:

- **Post-secondary education and post-secondary institutions** refer to all formal institutions offering instruction to adults beyond high school. Colleges, technical institutes, and vocational schools are considered post-secondary institutions.

- **Colleges or collegiate institutions** are those post-secondary institutions that offer a core of instruction in the liberal arts to develop general intellectual capabilities of students. The University of Minnesota, the state universities, the community colleges, and two- and four-year private colleges are collegiate institutions which grant associate and baccalaureate degrees built upon such a core.

- **Technical institutes and other vocational schools** are post-secondary institutions that offer only programs, usually lasting two years or less, to prepare students for specific occupations. General education for non-vocational goals is not a primary mission. Both public vocational-technical institutes and private vocational schools serve Minnesota. Until recently, these institutions did not offer associate or baccalaureate degrees upon program completion. The State Board of Vocational Technical Education in Minnesota, however, now has the authority to award associate degrees to graduates of selected programs that include a general education component. Several private vocational schools also offer associate degree programs.

- **Degree credit** is academic credit that counts toward associate and baccalaureate degree requirements. For administrative purposes, some institutions may award other forms of credit that do not apply to college degrees. Our report defines expectations for degree credit instruction only.

- **College degrees** include associate and baccalaureate degrees whether awarded by a college, technical institute, or vocational school.

- **College-level instruction or college-level skills** refer to instructional content that is sufficiently complex and rigorous to be appropriate for degree credit in post-secondary institutions.

• **Remedial instruction and developmental instruction** refers to instruction in post-secondary institutions that is pre-college-level. Generally, such instruction prepares students to begin college-level work, although some programs include other goals as well. Remedial instruction reviews concepts and material previously taught in the student's elementary and secondary school program. Developmental instruction, in contrast, introduces concepts and material that the student was not exposed to in earlier grades. Some campuses maintain a distinction between these two definitions while others do not.

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CHAPTER I. INTRODUCTION AND BACKGROUND

Each fall over 50,000 students enter Minnesota post-secondary institutions for the first time. Many of these students are new graduates of 639 public and private high schools in Minnesota. Others are returning to education several years after high school graduation.

In the past, collegiate institutions limited admission to students who had taken a prescribed college preparatory curriculum. Today, many colleges, technical institutes, and vocational schools admit students without regard to specific courses taken in high school, but they still expect students to be ready to enroll in regular freshmen-level courses. When students do not enter with adequate background, they may be offered developmental or remedial instruction on a credit or non-credit basis. The need for developmental programs has grown rapidly as students have come from more diverse academic backgrounds.

This report is the result of discussions about the skills and knowledge that should be characteristic of degree credit instruction in reading, writing, and mathematics in Minnesota post-secondary institutions. It outlines a recommended consensus among degree granting institutions which would convey a common message about needed high school preparation in these subjects. Our efforts are part of increased communication about curriculum and educational quality both within post-secondary education and between post-secondary and secondary education.

Charge

We are a group of secondary and post-secondary educators who were brought together by the Higher Education Coordinating Board. Our charge, as given to us by the Coordinating Board executive director, was as follows:

- To specify the knowledge, skills and understandings in reading, writing, and mathematics that should become the base levels of competency to be recognized with degree credit from Minnesota post-secondary institutions.

- To clarify relationships between the competencies expected for all high school graduates and the competencies necessary to succeed in regular, credit-bearing programs in colleges and vocational schools.

- To develop criteria for evaluating the reading, writing, and mathematics skills, knowledge and understandings of entering post-secondary students so that institutions can identify those who will need special assistance to complete degree and certificate programs.

• To suggest evaluation questions and methods to evaluate the effects of our recommendations.

• To transmit our final report with recommendations to the Higher Education Coordinating Board, the state's post-secondary institutions and systems, and the Commissioner and State Board of Education.

Several features of the charge deserve further comment. First, the charge directed us to define competencies that are sufficiently developed to receive credit in undergraduate college programs. We were not asked to describe standards in certificate, diploma or other non-degree programs. The charge assumes that college degrees in Minnesota should reflect common understanding of the level of instruction appropriate to those credentials.

Second, we focus on reading, writing, and mathematics because these skills are essential to success in all degree programs. Most post-secondary institutions have found it necessary to teach these skills on a remedial or developmental basis.

Our charge speaks to specific outcomes of instruction rather than course titles since course titles are imperfect descriptors of content. We believe that the structure of the curriculum in terms of specific courses should be developed by faculty at each institution.

By articulating these guidelines, we hope to make it easier for high schools to instruct and guide their students. Our report, however, recognizes that post-secondary institutions and high schools must each be responsible for their own curricula. Post-secondary institutions cannot dictate instructional programs in secondary schools, but they should be explicit about the expectations that students will meet when they enroll in degree programs.

We believe that our report contains information useful to post-secondary and secondary educators and to students preparing to enter degree programs in colleges and vocational schools. To our colleagues in post-secondary institutions, we recommend that the chapters which follow be a guide in determining whether mastery of certain skills will be recognized by awarding credit toward associate and baccalaureate degrees. For many institutions, our statements merely repeat existing policy, while for other institutions, they may imply that some existing credit courses would be offered on a non-degree credit basis in the future. By making such changes, we will assert publicly the meaning of our degrees, facilitate transfer of credit among programs, and encourage high school students to take appropriate college-preparatory courses.

While we believe that our recommendations concerning degree credit are a reasonable consensus, appropriate for Minnesota at this time, we recognize that they must be discussed further by faculty and governing bodies. As our charge directs, we are submitting our report to the University of Minnesota Board of Regents, the State Board for Community Colleges, the State University Board, the State Board of Vocational Technical Education, the Minnesota Private College Council, Minnesota Association of Private Post-Secondary Schools, and the Higher Education Coordinating Board. We ask their assistance in continuing statewide discussions concerning degree standards, student preparation for entry into post-secondary education, and collaboration with educators in secondary schools.

To secondary teachers and curriculum planners, we offer our statement as a basis for designing local instructional programs that will qualify students to earn college degrees without the need to take non-degree credit, prerequisite courses. By linking expected competencies to degree credit requirements at post-secondary institutions, we provide high school students with an incentive to enroll in the academic courses that will prepare them for any further educational opportunities. We recognize that, in part, open or near open post-secondary admissions policies have made it difficult for high school teachers and counselors to convince students of this need.

This report is shared with the Commissioner and State Board of Education to encourage further discussion of our recommendations and their implications for elementary and secondary schools.

Finally, the policies we recommend must be brought to the attention of students in grades 7-12 so that they can plan their high school programs. Our report is not prepared directly for them, but the most pertinent material should be available in a form that communicates with this audience.

Assumptions

Several assumptions are important to understanding our report:

- We have assumed that responsibility for credit evaluation and degree standards remains with the faculty and administration of each institution. Our recommendations about degree credit are directed to these individuals; we would not mandate their use through statewide regulation.

- We have assumed that post-secondary institutions will continue to apply a variety of admissions criteria. Our recommendations are not intended to be used as admissions requirements by all institutions. They are, instead, a basis for advising students on preparation to enter degree programs and for establishing minimum standards for degree credit coursework.

• We have assumed that institutions will continue to provide developmental programs, as we define them here, on a non-degree credit basis. In the public institutions, we have assumed that such programs will be state-funded on the same formula as degree credit instruction. We understand that current state policy allows such funding. Our recommendations should not be used to deny student access to developmental programs they will need to succeed in degree credit courses.

• We have assumed that state and local efforts to improve the quality of student preparation for post-secondary education will be multifaceted and ongoing. Our charge was limited, and our report is not a comprehensive statement about improvement in secondary and post-secondary education. Staff development, funding levels, and teacher education are some of the related areas that must support our goals. We touch upon some of these only briefly, but we do not dismiss their importance.

• We have assumed that, in addition to the areas covered in our report, schools and post-secondary institutions must respond to significant changes in the backgrounds, attitudes, and futures of high school students. While this is not the occasion to cover the data in detail, recent reports such as *Minnesota K-12 Education: The Current Debate, The Present Condition* point to instabilities in the family, the community, and the state which are having a dramatic effect on teenagers.[1] These changes require sensitive revisions to both curriculum content and instructional methods.

Related Activities

Our work has taken place during a period of exceptional national and state inquiry into the quality of education. Much of this activity began with concerns over the outcomes of elementary and secondary education. More recently, similar discussions about post-secondary education have taken place. Several other Minnesota projects, in particular, are related to our charge.

The task force was created as a result of a Higher Education Coordinating Board study on remedial programs in post-secondary institutions.[2] That study documented the variation in degree credit policies for basic courses in reading, writing, and mathematics. In essence, courses considered "remedial" or "developmental" at one institution have been recognized fully as "college-level" at others. To provide a consistent message to students preparing for post-secondary education and to clarify degree standards, the Coordinating Board recommended that a task force should try to achieve a consensus on expectations for degree credit instruction. A goal of this recommendation was to assure that there are incentives for high school students to take college preparatory courses without denying access to those who, for one reason or another, will need developmental help to complete degree programs.

[1]*Thomas R. Peek, Edward L. Duren, Jr., and Lawrence C. Wells, Minnesota K-12 Education: The Current Debate, The Present Condition, Center for Urban and Regional Affairs, University of Minnesota (1985).*
[2]*Minnesota Higher Education Coordinating Board, Remedial and Skills Development Instruction in Minnesota Post-Secondary Education (May 1984).*

In 1983, at the University of Minnesota-Twin Cities, another task force also recommended a serious effort to inform prospective students about the specific skills they are expected to have upon entrance.[3] This group noted that within the University alone, multiple admissions standards probably confuse students and diminish their understanding of the need for a solid high school preparation.

The 1985 Minnesota Legislature directed the Higher Education Coordinating Board to begin informing all eighth graders about post-secondary education opportunities and academic expectations.[4]

Post-secondary efforts to define learning expectations follow significant work on outcomes in elementary and secondary education. For the past eight years, the State Department of Education has published model sets of expectations called *Some Essential Learner Outcomes.* In 1985, the legislature mandated the Department to consult with the public post-secondary systems and the Coordinating Board "in developing model learner expectations appropriate for entrance into post-secondary institutions."[5] Our report should assist the Department in responding to that mandate.

Implications for Post-Secondary Enrollment Options

In fall 1985, Minnesota began a unique program that allows high school juniors and seniors to enroll in post-secondary institutions at state expense. Although in its initial stages, the Post-Secondary Enrollment Options Program already is highlighting relationships between the secondary and post-secondary curriculum.

Under this program, high school students may enroll in any credit course that counts toward a degree, certificate, or diploma. Eligible courses therefore include those earning credit toward associate and baccalaureate degrees, as we use those terms in this report. Eligible courses also include those courses that are part of non-degree, vocational and other programs that we do not address here. In both instances, however, the program excludes remedial or developmental instruction that does not apply to regular program requirements.

Our recommendations distinguish between college-level instruction in reading, writing, and mathematics and instruction that typically is taught in high schools. We believe that college-level instruction should develop mature skills in these areas based upon a foundation built in the elementary and secondary school years. The legislative intent of the Post-Secondary Enrollment Options Program to "promote rigorous academic pursuits" seems based on a similar assumption that post-secondary instruction for credit requires more independence and a faster pace than most high school programs.

[3]*Report of the Task Force Concerning Support and Development of Academic Skills, University of Minnesota (October 1983).*
[4]*Laws of Minnesota for 1985, First Special Session, Chapter 11, Section 3.*
[5]*Laws of Minnesota for 1985, First Special Session; Chapter 12, Article 8, Section 15.*

If our degree credit recommendations are followed, most post-secondary courses which essentially duplicate non-honors reading, writing and mathematics courses in high schools will be eliminated from eligibility. However, such non-college-level instruction still can be made available to students under agreements between high schools and post-secondary institutions outside the Post-Secondary Enrollment Options Program.

In investigating their choices under the Post-Secondary Enrollment Options Program, young people must be encouraged to assess realistically their academic and personal readiness to pursue college-level work. As our report emphasizes, there is (or should be) a difference between high school and college degree credit instruction in reading, writing, and mathematics. Furthermore, most students who participate in the Post-Secondary Enrollment Options Program will be called upon to demonstrate college-level reading, writing, and mathematics skills in other eligible courses.

The description of college-level skills in our report can help counselors and teachers advise students who are considering participation in the Post-Secondary Enrollment Options Program. Upon examining the challenges of college-level work, some high school students will know they are ready, while others will recognize that they would benefit from further high school preparation. In interpreting our report to students, it is important to add that readiness for college-level work is not solely dependent on academic skills. Students must be ready for greater independence and a faster pace than they generally experience in high school. Most high school age students also continue to need social events, extracurricular activities, and counseling services tailored to their developmental stage. In many instances, high schools are better prepared to provide these opportunities than post-secondary institutions.

Implications for Transfer Students

Implementing our recommendations would facilitate the transfer of credits from one institution to another. A consensus about college-level degree credit instruction would reduce instances in which students seeking to transfer degree credit courses find that the receiving institution regards the courses as too elementary for credit toward their degrees. Courses which are considered developmental or remedial in Minnesota would be consistently clearly identified for students in publications.

Our recommendations would not, however, solve all losses of credit upon transfer. Students still would find that receiving institutions might deny transfer credit when they do not offer a similar degree credit course. Students who change their educational goals might not be able to apply all previously earned credits to a new degree program.

Work Plan

Members of the Task Force were named in Spring 1985 by the executive director of the Higher Education Coordinating Board based on nominations by post-secondary systems and institutions and the State Department of Education. The full Task Force met seven times.

Much of our work took place in reading, writing, and mathematics subgroups. Our own experiences and training provided the foundation for these discussions. As reference materials, we used the *Some Essential Learner Outcomes* publications of the State Department of Education. We also reviewed numerous reports from other states that have completed projects which are somewhat related.

Although the subgroup reports were drafted independently, our final report reflects subsequent discussion and consensus by the entire group.

CHAPTER II. STATEMENT ON COLLEGE-LEVEL READING

No matter what disciplines college students pursue, the majority of their courses will require extensive reading. Most students entering college will find that both the volume and difficulty of the reading required is substantially greater than that found in high school. Students entering many post-secondary vocational programs also must learn from technical manuals and other written materials.

High school students should prepare themselves for post-secondary education by taking courses that require extensive reading of different kinds of materials, including literary works, writings in the humanities and social sciences, and scientific and technical writing. Students should have available and seek out reading instruction while in high school. Such instruction should include remedial/corrective work in such areas as word recognition and literal comprehension, if needed, and higher level work in such areas as critical reading and study skills. Students also should read beyond the minimal requirements of their courses, attempt to read extensively in areas in which they have particular interest, and make every effort to acquire vocabularies that are both rich and broad.

In this chapter, we describe the reading skills students must be able to use in most college degree programs. We then address the conditions under which we believe that degree credit may be appropriate for instruction in reading at post-secondary institutions. Finally, we offer comments and recommendations concerning high school and post-secondary instruction in reading. Appendix A contains college-level samples of a literary passage, a social science passage, and a science passage, along with questions and answers illustrating many of the reading skills college students will need.

General Expectations and Standards for Reading in College Degree Programs

The vast majority of reading done at the college level is of connected discourse, that is, of complete texts. College texts represent a variety of genres and are of various lengths. Some college texts are short. These include sentences being parsed in linguistics classes, word problems being solved in mathematics or physics classes, brief poems being analyzed in literature classes, and lists of rules being learned in physical education classes. However, the texts read in many, quite possibly most, college classes are fairly lengthy. These include essays, short stories, monographs, government reports, novels, and expository books — in some cases books of well over 1,000 pages. Thus, students entering college must be able to deal both with various sorts of discourse and with texts of various lengths.

The taxonomy which follows is a brief attempt to characterize many of the skills students need in order to deal adequately with these texts, particularly the longer texts. Several caveats are in order. Because the taxonomy deals with discourse level skills, it does not include vocabulary. However, knowledge of the vocabulary used in any text is crucial to its understanding. Additionally, the taxonomy is not designed to be definitive. It is not an exhaustive list of the skills students need, the categories are not mutually exclusive, it has not been empirically tested, and a variety of other taxonomies are possible and would undoubtedly be valuable. However, the present taxonomy does provide a reasonably comprehensive list of the skills needed.

The taxonomy includes six major categories — literal comprehension including recognition and recall, text-based inferential comprehension, reader-based inferential comprehension, critical reading, literary understanding and appreciation, and study skills. The extent to which skills in these areas are taught as opposed to assumed and the appropriateness of instruction in each of the areas vary from course to course and instructor to instructor.

Specifically, literal comprehension is very seldom directly taught at the college level, and it is usually only appropriately taught in courses that employ technical or otherwise very difficult texts. College-level study skills are also seldom taught, but students are expected to use them. Some instruction in how to study a particular text is probably appropriate in many courses. Text-based inferential comprehension is somewhat more likely to be taught, and it is probably appropriately taught when texts are quite difficult. Reader-based inferential comprehension and critical reading are still more likely to be taught, and most college courses that deal with extended text will provide some instruction in these areas. Finally, although basic literary understanding and appreciation are assumed, some courses — for example, those in literature and the humanities — are likely to teach sophisticated levels of literary understanding and attempt to foster appreciation, while other courses give little attention to this area. It probably would be appropriate if more courses dealt with the literary quality of the texts studied and with developing appreciation for good writing.

Discourse Level Reading Skills

Literal Comprehension, Including Recognition and Recall

Literal recognition requires the reader to identify explicitly stated information with the text available, while literal recall requires the reader to remember the same sort of information. Specifically, the college-level reader should be able to:

- **Identify main ideas.** The reader must identify and recall the main ideas of paragraphs and longer units when they are explicitly stated.

• **Identify subordinate ideas.** The reader must identify and recall subordinate ideas when they are explicitly stated.

• **Identify patterns of organization.** The reader must recognize and recall patterns of organization such as simple listing, temporal sequence, cause/effect, and comparison/contrast when such patterns are explicitly signaled in the text.

• **Identify logical relationships.** The reader must recognize and recall logical relationships such as synonymy, antonymy, class inclusion, attribution, and cause and effect when such relationships are explicitly noted in the text.

Text-Based Inferential Comprehension

Text-based inferential comprehension requires the reader to infer information that is not explicitly stated in the text. The answers to such questions often are found by combining information from two or more places in the text. Also, the answers can be supported by reference to the text. The college-level reader should be able to use inference to identify main ideas, subordinate ideas, patterns of organization, and logical relationships as described above.

Reader-Based Inferential Comprehension

Reader-based inferential comprehension requires the reader to use information that is not explicitly stated or implicitly presented in addition to using information that is in the text. Such comprehension depends on both information gained from the text and knowledge gained elsewhere. Thus, the answers to reader-based inferential comprehension cannot be supported fully from the text alone. The college-level reader should be able to use this sort of comprehension to identify main ideas, subordinate ideas, patterns of organization, and logical relationships as described under literal comprehension.

Critical Reading

Critical reading requires the reader to evaluate various aspects of the text and to make judgments. It uses information explicitly stated in the text, implicitly present in the text, and from outside the text. Thus, the answers to critical reading questions cannot be supported fully from the text alone. Specifically, the college-level reader should be able to:

- **Distinguish fact from opinion, whether explicit or implicit in the text.**
- **Recognize the author's assumptions, purposes, and biases, whether expressed or implied.**
- **Separate one's own opinions and assumptions from the writer's.**
- **Evaluate the author's competence in the topic.**
- **Evaluate the moral worth of the ideas presented in the text.**

Literary Understanding and Appreciation
The college-level reader should be able to:

- **Understand literary devices.** The reader must recognize and understand literary devices such as simile, metaphor, allusion, imagery, and point of view.

- **Evaluate literary worth.** The reader must evaluate such aspects of literary worth as plot structure, use of figurative language, clarity, appropriateness of tone, and dramatic or persuasive impact.

- **Appreciate good writing and develop reading habits.** The reader should develop an appreciation of good writing and reading habits that will make him or her a life-long reader of good writing from various genres.

- **Recognize that great literature is a major art form and that it transcends good writing.**

Study Skills
Students in all post-secondary programs need to be able to:

- **Follow written directions.** The reader must follow explicit written directions and make inferences about implied issues.

- **Use textbook aids and survey material.** The reader must use such textual aids as indices, tables of contents, and prefaces to find needed information, and he or she must be able to survey material to obtain an overview of its contents.

- **Underline, take notes, outline, and summarize.** The reader must be able to use each of these techniques as appropriate to understand, learn, and memorize information.

- **Read various sorts of material.** The reader must recognize different sorts of writing such as fiction, exposition, and poetry, and realize that different sorts of writing demand different methods of reading.

- **Vary the approach to reading, depending on the material.** Having recognized a certain sort of material, the reader must identify and use an appropriate approach in dealing with it. Such approaches would include scanning the material to find a specific piece of information, surveying the material before reading it, quickly reading the material, and reading the material slowly while taking copious notes.

• **Use library tools.** The reader must be able to use such library tools as the card catalogue, the Reader's Guide and other common indices, and computerized search services.

Degree Credit for Reading Courses in Post-Secondary Institutions

Reading differs from mathematics and writing in that there are relatively few reading courses offered in post-secondary institutions. Those that are offered are frequently remedial. That is, they provide instruction in skills that are assumed of high school graduates. Most of the reading in post-secondary institutions is done in subject matter courses in such areas as biology, political science, anthropology, or English. Subject matter instructors rarely deal directly with the teaching of reading at all, assuming that students have the higher level reading skills necessary for understanding in their courses. Many good post-secondary students, therefore, will benefit from a reading course which uses college-level texts and which does not repeat instruction in skills taught in earlier grades.

Because students do not receive systematic instruction in reading in most high school and post-secondary courses, we believe it can be appropriate to give degree credit for selected reading courses in post-secondary institutions. We recommend, however, that if degree credit be granted, no more than one 2-4 quarter credit reading course be permitted in a student's program. Students should not be allowed to receive degree credit for additional courses in reading.

We further recommend that degree credit courses meet specific criteria for instruction in college-level reading skills. Students needing courses which emphasize pre-college reading skills should not receive degree-credit for this work. Most post-secondary reading courses today do not qualify for degree credit under these standards.

Pre-College-Level Reading Courses

The following word identification competencies are considered to be pre-college-level skills: knowledge of letter-sound correspondences; the ability to blend sounds, to recognize syllables in polysyllabic words, and to recognize the component parts of compound words; the ability to use context to identify words that are not immediately recognized in print; and knowledge of common prefixes, inflectional suffixes, and derivational suffixes. No degree credit should be given for courses in which instruction in these areas constitutes more than 10 percent of the course.

The following word and sentence level competencies are also considered to be pre-college-level skills: recognition vocabulary of approximately 50,000 words; the ability to use context to determine word meanings; a knowledge of common non-English roots; skill in using a standard dictionary to determine the spelling, meaning, and pronunciation of unknown words; and the ability to interpret standard English sentences. No degree credit should be given for courses in which instruction in these areas constitutes more than 10 percent of the course.

On the other hand, study in the technical vocabulary of a particular subject (for example, medicine) study of less-common roots and affixes when presented within a theoretical framework (for example, the formal study of English morphology), study in specialized dictionaries (for example, the Oxford English Dictionary), and study of sophisticated figurative uses of language (for example, metaphor) may constitute legitimate topics of college-level courses. Although courses which deal with these topics should receive careful scrutiny to insure that they are dealing with college-level skills, those courses that deal with such matters in a sophisticated fashion are worthy of degree credit.

College-Level Reading Courses

Unless the course deals with the vocabulary skills specifically listed above as being worthy of degree credit, the majority of courses offered for degree credit should focus on discourse level skills, as listed on pages 9-12, with no more than 10 percent of each course devoted to word identification and word and sentence level skills. Additionally, courses that focus on comprehension must include attention to text-based inferential comprehension, reader-based inferential comprehension, and critical reading. Not more than 20 percent of the course should deal with literal comprehension.

These criteria allow for several sorts of degree credit courses. For example, credit might be awarded for a maximum of one of the following: (1) a course could deal solely with the aspects of vocabulary listed as being worthy of degree credit; (2) 10 percent of a degree credit course could deal with word recognition and word and sentence level skills, 20 percent of it with literal comprehension, and the remainder of it with text-based inferential comprehension, reader-based inferential comprehension, and critical reading; or (3) a degree credit course could deal with college-level study skills and/or literary understanding.

Summary Comments and Recommendations

An increasingly large segment of our society is seeking post-secondary instruction in programs requiring college-level reading skills. In 1984, the Andersen Commission on the Future of Post-Secondary Education suggested that in the future 80 percent of Minnesota's youth must receive instruction at a post-secondary institution for the state to maintain its economic viability.[6] As a result, both student interest and economic necessity soon may require up to 80 percent of Minnesota's high school students to graduate reading at or near the college level.

Although secondary students are not expected to drive cars, type letters, or fix televisions merely through exposure to modern technology, they are expected to learn how to read and understand secondary-level expository prose largely through exposure to high school reading texts. With only minimal instruction, secondary students are expected to comprehend texts couched in sentence, discourse, and thought structures not typically used in their everyday speech. They also are expected to comprehend concepts and non-technical vocabulary that are alien to their personal experience and oral use of language. Such reading is cognitively more difficult to master than the driving and typing skills students acquire via direct instruction in the state's high schools.

Furthermore, automatic and accurate performance of secondary reading tasks is also only the minimum level of reading proficiency needed for success in most post-secondary programs. In college, written texts replace lecture, discussion, and experiential learning as the primary vehicle of instruction. Therefore, students must be able to function as independent learners of ideas and information solely by reading expository texts. In vocational-technical programs, written texts are playing a more prominent instructional role than in the past, reflecting the increasing importance of the ability to learn through reading on many jobs. Vocational students often are expected to use technical manuals proficiently and to learn detailed procedures by reading written instructions.

High schools have historically graduated students who can perform post-secondary-level reading tasks. Research suggests, however, that many of these students acquired post-secondary-level reading skills largely because they came from advantaged backgrounds, possessed natural ability in verbal learning, or were avid avocational readers. To prepare students for the emerging realities of post-secondary training and the modern job market, secondary schools must now assume a new task, one beyond the scope of present remedial reading instruction.

[6]*Commission on the Future of Minnesota Post-Secondary Education, Post-Secondary Education in Minnesota: A Commitment to Quality, Access and Diversity (April 1984).*

We therefore recommend that the State Board of Education require the inclusion of instruction in reading within the secondary school curriculum. Secondary reading programs should be designed to teach students (1) to use reading as their primary source of information and instruction, and (2) to read and retain extended expository and narrative texts accurately and easily. At the same time, we recommend that the State Board of Education continue to promote appropriate instruction in reading and study skills in the secondary school content areas.

Implementation of this recommendation will require changes in the pre-service and in-service education of Minnesota teachers. Many of Minnesota's secondary content teachers are not prepared to develop students' reading skills in preparation for post-secondary education. We recommend that the Board of Teaching require instruction in the teaching of reading and study skills for students preparing to become secondary teachers in content areas. We stress that we recommend significant preparation in the teaching of reading skills, not minor additions to present methods courses. Additionally, currently licensed teachers of secondary subjects should receive extensive in-service instruction to develop students' reading skills in preparation for post-secondary education.

Finally, we encourage interaction and cooperation between post-secondary reading and content area instructors. Such cooperation might take the form of informal meetings, in-service presentations, and cooperative curriculum development efforts in reading or content courses.

This interaction and cooperation should address the concept of reading as a developmental process, closely linked to the acquisition of knowledge. In addition, it should consider how that process can be fostered effectively at the college level.

Secondary and post-secondary reading teachers should meet regularly to share efforts and clarify goals to ensure that students will be better prepared for college-level reading. Ongoing dialogue among reading professionals will encourage the development of effective and credible programs on both the secondary and post-secondary levels.

CHAPTER III. STATEMENT ON COLLEGE-LEVEL WRITING

As described in the preceding chapter, reading is seldom taught as a separate skill after the elementary grades. Writing instruction, however, continues through high school and, at least, the initial terms of college degree programs. Students entering degree programs after high school can expect significant writing assignments both in writing courses and throughout the curriculum. Students who acquire good writing skills in high school will be well prepared to continue to develop as writers and to succeed in college degree credit courses.

In contrast to most high school seniors, freshmen in college degree programs should be developmentally ready or about to become ready to manipulate abstract thoughts and writing situations where the implied author is an expert and the audience is public. They also are moving toward having the ability to understand the complexity of many topics and the diversity of competing opinions about them, and to reflect complexity and diversity in their thinking and writing.

In the following sections we outline the writing skills which post-secondary students are expected to learn and apply in degree credit courses. We then list applications of those skills which typify the college or university student's experience. Since the skills are generally shared between high school and college, we distinguish between expectations and standards at the two levels. Finally, we give a brief list of recommendations to improve students' readiness to develop college-level writing skills.

General Expectations and Standards in Freshman Composition

The major focus of freshman composition, usually the most basic degree credit writing course in colleges, is to teach students how to understand and respond appropriately to a variety of college-level, academic writing assignments in any program. This course may include attention to the processes which inform writing of all sorts, from personal and creative writing to professional applications. It almost surely will include academic essays.

We recognize that few post-secondary students will need to use the academic essay form after they graduate. The real benefits of the academic essay are the opportunities it gives students to think critically, explore their own ideas imaginatively, wrestle with the issues of expression and communication, audience and voice, and build confidence about their writing skills. Students are encouraged toward autonomy in their writing, and even encouraged to step outside the demands of the essay form when they can do so consciously and with confidence.

Composition teachers want students to learn how to communicate through writing and (to a lesser degree) speaking in the context of their academic program. In the freshman course students learn how to discuss their own and other students' writing plans, written drafts, and finished products. They learn an appropriate vocabulary with which to communicate their comments, and they learn to speak in different ways about their papers as they move toward completion. They also learn how to be helpful about others' writing in a classroom environment where helping rather than evaluating is the central theme.

Composition teachers care about all the skills and text features which are outlined in this chapter, but they encourage students to pay attention to those features selectively, depending on the assignment — thus, an in-class draft (e.g., a blue book exam) has different standards for editing and correctness than does a formal paper developed over several days or weeks.

Post-secondary students are expected to take the trouble to ensure that their writing conforms to the standards of edited English, particularly when the writing is a final draft which has been written out of class. Successful writers are careful about spelling, typing, grammar, and punctuation. Students are expected to submit work that is their own and to cite thoughts or passages taken from other sources.

Specific College-Level Writing Skills

The student writer should be conscious of the writing process and should expect that most college-level writing tasks will require a number of drafts and stages before reaching final form. Freshman composition and other college-level writing courses emphasize this process.

Prewriting

The college-level writer should be able to:

- Recognize that prewriting is especially suited to exploring a topic and generating ideas; thus it can be a tool for learning in all disciplines,
- Use writing to record and organize observations,
- Use writing as a means to organize thoughts and clarify relationships (i.e., grouping ideas under appropriate categories),
- Use writing to discover a central focus,
- Use writing to identify audiences and purposes clearly, while also recognizing that some professors are interested chiefly in papers which display knowledge gained from the course.

Composing and Rewriting

The composing process consists of many stages, of which drafting and rewriting are essential components. Writing can serve as a means for finding out what you know about a topic and for discovering new connections and new insights. Redrafting implies that students will be patient and persistent about their writing so as to allow clearer and more convincing language to take shape through successive drafts. A polished piece of major writing frequently requires changes in content, organization, and tone.

The college-level writer should be able to:

- State the controlling ideas clearly and succinctly
- Maintain focus and unity
- Establish and maintain a consistent point of view and authorial tone
- Organize according to purposes and audiences
- Develop a style appropriate to purposes and audiences (this includes syntactic structures, precision in word choices, and figurative language)
- Use appropriate transitional elements (between sentences and between paragraphs) to achieve cohesion
- Rearrange words, phrases, or paragraphs to produce a more effective order of explanation
- Develop and support ideas with appropriate elaboration (details, arguments, statistics and illustrations, anecdotes) and present the elaborations effectively.

Final Revision and Editing

Student writers should be able to anticipate and answer the questions readers will ask when they read the text. They also should be able to read writing in progress and identify what works and what needs work, and be able to make suggestions that will help other writers and use others' suggestions.

The college-level writer should be able to:

- Add words to fill out meaning (expansion), change words to sharpen meaning, and delete words to tighten sentences (economy)

- Revise sentences to combine ideas and details, to separate major points, and to show coordination and subordination

- Evaluate paragraphs and their role in offering adequate development of individual ideas and their place in the effective presentation of those ideas; recognize that paragraphs have different forms (lengths, structures) depending on their function in the paper

- Sharpen punctuation to make reading easier

- Proofread.

Applications

In the college degree programs, writers should expect to use different forms of writing to achieve various purposes.

The following list includes writing assignments found in freshman composition and other degree credit courses:

- Reports, such as laboratory and field reports

- Research papers and documented essays of various lengths (i.e., writing from sources, both published and personal)

- Essays (including essay examinations)

- Summaries (of lectures, books, and articles)

- Media reviews (book, film, play)

- Journalistic forms (report, editorial, feature)

- Descriptions and narratives (particularly for the sciences)

- Case histories

- Interviews

- Journals and notes (both to be used privately and to be turned in for a course).

The college-level writer should be able to mix forms as appropriate, e.g., use description to enhance narration, place a summary in a report or essay.

In documenting sources the college-level writer should observe the scholarly conventions and formalities required by academic audiences, and should have general familiarity with a standard documentation system and understand the function of such systems.

Distinctions Between High School and College-Level Writing

Standards and expectations for student writers at the end of high school do not vary markedly from standards and expectations for student writers in college degree programs. In both cases, writers are expected to understand and apply the various stages of the writing process. They are expected to produce writing which is clear and coherent and which is written for an identified purpose and audience. In addition, they are expected to be able to use a variety of written forms and be able to apply the standards of American edited English.

The primary difference lies in the fact that college-level writers are expected to be more independent and more self-reliant about their writing. Because the pace of the college-level course is quicker, students must take more responsibility for their own development as writers with less prompting from the instructor.

The degree credit college course in writing, in most instances, is aimed higher. There is more instruction in thought, organization and style, and less direct instruction in the mechanics of writing (e.g., sentence structure, paragraphing, punctuation, etc.). Revision, in the college-level course, counts for more, and it goes beyond correcting fragments and run-ons; it means a willingness by the student to re-think, re-order, and at times, rewrite an entire paper. Instructors teach their students to critique much of their own writing as well as to accept and use evaluative comments made by others.

Another significant difference is that writing in colleges and universities tends to have a fairly narrow academic focus. The college composition class may experiment with many forms, but the formal essay receives much of the attention. When writing occurs in courses outside the composition class, it is often done to explicate or transmit course content, with the professor serving as audience and evaluator.

The goals of the high school writing program need to be much broader to reflect the developmental and life-long needs of all students. Students need to understand and appreciate that writing can be used for much more than transmitting information, that it can be used to inspire and entertain, and can be a tool for personal growth. Accordingly, high school students need continual practice with writing across a broad range of purposes and for many audiences. It is not that those needs disappear when students get to post-secondary education, it is just that writing for varied audiences and purposes, as a priority, appears only intermittently in college degree programs.

A careful listing of high school writing priorities appears in *Some Essential Learner Outcomes in Communications/Language Arts,* which is available from the Elementary and Secondary Education Section of the Minnesota Department of Education.[7]

Degree Credit for Writing Courses in Post-Secondary Institutions

Post-secondary institutions usually offer instruction for students who have not developed or practiced adequately the skills outlined in *Some Essential Learner Outcomes in Communications/Language Arts* or who are not prepared to fulfill routine assignments effectively, carefully, and with reasonable efficiency. Other students may receive special tutoring or course work to accomplish the goals of the freshman composition course.

Courses which focus predominantly on grammar, usage, punctuation review, or effective sentences and paragraphs are considered remedial (i.e., remediating what was not learned in high school), and should not receive degree credit.

We concur with the following statement from *Involvement in Learning:* "Institutions should offer remedial courses and programs when necessary but should set standards and employ instructional techniques in those programs that will enable students to perform well subsequently in college-level courses."[8]

Assessment

The criteria for evaluating student writing as students enter degree programs in post-secondary institutions are made explicit throughout this chapter. Our efforts at clarifying these criteria will be rewarded if secondary teachers familiarize themselves and their students with these criteria, which are also expectations of writing skills those students must be able to meet as they pursue degree credit instruction after high school.

[7]*Minnesota Department of Education, Some Essential Learner Outcomes in Communications/Language Arts, Curriculum Bulletin No. 61 (1982).*

[8]*National Institute of Education, Involvement in Learning: Realizing the Potential of American Higher Education, Report of the Study Group on the Conditions of Excellence in American Higher Education (1984).*

Minnesota post-secondary institutions apply widely varying practices in assessing the writing skills of entering students. Some depend heavily on the students' scores on national tests, others on examinations and writing samples designed and administered by the individual campuses. Individual campuses may follow well-established and researched testing practices in holistic or primary-trait scoring of writing samples, or mixtures of assessment methods appropriate to their needs. We note with approval that most assessments include careful and expert reading of student writing samples, as well as procedures for appealing placement decisions when mis-testing occurs.

We believe that assessment of student writing skills can be improved by encouraging the following:

- Administrative support at all institutions for training of assessment directors and readers in the best possible testing and examination theories and procedures

- Broad faculty (and administrative) involvement in examinations

- Inclusion of area secondary teachers in the assessment process

- Inclusion in admissions and recruitment materials prepared by post-secondary institutions of clear statements on criteria and procedures for assessing the writing skills of entering students.

Summary Comments and Recommendations

Writing in college degree credit courses occurs in all formats and disciplines, from the term paper in history, to the lab report in chemistry, to the case study in business. To prepare students for that diversity of writing tasks and contexts, writing in high school should be assigned in all subjects. Neither post-secondary institutions nor high schools should assume that writing is the exclusive responsibility of the English department or the language arts teacher.

Effective and credible programs in writing across the curriculum at both levels may demand that teachers be educated in some of the best methods for the teaching of writing. As noted in the general recommendations in this report, such education and follow-up support are best accomplished through cooperation between the secondary schools and post-secondary institutions throughout the state.

While all teachers would prefer to have smaller classes, the issue is especially critical for effective writing instruction. The reasons are, we believe, fairly obvious — to help students improve their writing, teachers must make frequent assignments which must be read with care and with concern for each student's progress. Reductions in class size and teaching loads obviously will add significantly to the costs of writing instruction. As a state, however, we cannot expect to graduate good writers from high schools and post-secondary institutions without making this investment. We therefore urge school and post-secondary boards and administrators to take the particular demands of writing instruction into account when they determine staffing needs and assignments.[9]

Finally, we note that parents can have important effects on the quality of their children's writing. They should provide resources, encouragement, and opportunities for writing within the home. Furthermore, they can be good models by reading and writing regularly and by showing their children the important role language plays in their lives.

[9]*For nearly 50 years, the National Council of Teachers of English has advocated that secondary composition classes have not more than 25 students, and that teachers have no more than four such classes. The Association of Departments of English recommends that college writing instructors (1) teach no more than 20 students per section, and no more than 15 in developmental (remedial) courses; (2) teach no more than three sections per term; and (3) prepare no more than three different courses in a given term.*

CHAPTER IV. STATEMENT ON COLLEGE-LEVEL MATHEMATICS[10]

As both the Mathematical Association of America and the National Council of Teachers of Mathematics have noted, "Mathematics is a highly structured subject in which various concepts and techniques are highly dependent upon each other." Reflecting this, the mathematics curriculum in high school and college consists of a sequence of courses, each with specific topics to be learned, to enable students to build upon their skills and understanding of mathematical operations. Students who have not acquired adequate skills and understanding at one course level will find it exceedingly difficult to comprehend the course content at the next level.

We define college-level mathematics as work that builds upon a foundation acquired during at least three years of algebra and geometry, normally taken in high school In this chapter, we list the specific competencies from these courses that students should master as preparation for continued study in mathematics at the college level. We also offer several recommendations to improve the teaching of these skills in Minnesota high schools.

In addition to material in this chapter, we endorse two statements appearing in the appendices. The first statement, in Appendix B, has been adopted by the Board of Governors of the Mathematical Association of America and National Council of Teachers of Mathematics. The second statement, in Appendix C, resulted from a national conference on "School Mathematics: Options for the 1990s."

General Expectations and Standards for Mathematics in Degree Programs

The amount of high school mathematics needed by students intending to enter college degree programs depends on the major field of study to be pursued, regardless of any specific admissions requirement in mathematics. Students who plan to major in a physical or life science, engineering, pre-medicine, other science-related fields, business, or economics should prepare for the mathematics requirement in these majors by taking at least four years of mathematics in high school. Many majors in the social sciences or other professional and pre-professional fields require baccalaureate-level statistics or calculus, sometimes both. Three years of high school mathematics are essential for study of mathematical statistics and may be required for applied statistics as well.

[10]*Portions of this chapter have been adapted from two statements by similar task forces in other states: Academic Senates of the California Community Colleges, the California State University and the University of California, Statement on Competencies in English and Mathematics Expected of Entering Freshmen (November 1982), and New Jersey Department of Education and Department of Higher Education, Report of the Joint Statewide Task Force on Pre-College Preparation (January 1984).*

To prepare students for a full range of degree programs, we make the following general recommendations:

1. All high school students intending to enter college degree programs should complete elementary algebra, geometry, and intermediate algebra or the equivalent. Students preparing for selected non-degree vocational programs in technical areas will also need this preparation.

2. Students who intend to pursue a baccalaureate degree in fields requiring the study of calculus should complete a fourth year of mathematics which includes trigonometry, analytic geometry, a study of functions, and other pre-calculus topics. In this course the concept of functions should be a central theme.

3. All high school students intending to enter college degree programs should take a college preparatory mathematics course during their senior year.

4. All mathematics courses should emphasize problem solving. Students should be graded on their ability to solve problems correctly and to display problem-solving processes in a clear, complete, and accurate manner.

5. Computers and hand calculators should be used in imaginative ways to introduce and reinforce learning and to motivate students as proficiency in mathematics is gained. Students should develop adequate arithmetic skills in order to avoid reliance upon calculators for simple numerical computations. Calculators and computers should be used to supplement and enhance the study of computational techniques.

6. The grade assigned in each mathematics course should include the results of a comprehensive final examination.

7. All college-bound students should receive diagnostic assessment during the junior year. Examinations used for this purpose should measure achievement levels necessary for success in college-level mathematics and should guide the selection of proper mathematics courses in the senior year. These exams should be given statewide and administered by the Higher Education Coordinating Board.

8. A calculus course, when taken by high school students either at their high school or at a college, should be taken only by those students who can demonstrate mastery in algebra, geometry, trigonometry, and coordinate geometry.

9. All mathematics courses should emphasize the application of mathematics to areas such as the physical, biological and social sciences, and business.

10. Computer science and programming courses should not displace essential mathematics topics or courses.

11. Students should be motivated to develop their ability to read mathematics. Reading assignments should be made in conjunction with problem assignments, and students should be encouraged to enhance their understanding of mathematical concepts by reading discussions of the concepts.

Mathematic Concepts to Be Introduced and Developed Before the Study of Algebra Is Begun

The following basic mathematical concepts should be introduced and developed before students begin algebra. Related skills then can be developed and extended, and new mathematics skills learned with effective use of a calculator. The following list highlights major areas. This section is not as detailed as that describing the desired outcomes of a high school program that fully prepares students for college-level mathematics.

Before beginning the study of algebra, students should be able to:

- Compute with whole numbers, fractions and decimals
  - perform mental computations involving addition and multiplication of single digit numbers and related subtraction and division
  - obtain the correct answer for problems involving larger whole numbers, fractions and decimals
- Understand the meaning of fractions, decimals, and percent and their relationship to one another and demonstrate the facility to convert from one to another
- Select the correct arithmetic operation to solve simple application problems
- Use rounding, approximation, and numerical estimation; be alert to the reasonableness of numerical answers
- Compute with positive integral exponents and square roots of perfect squares
- Recognize geometric figures
- Classify geometric figures

• Determine perimeters and areas of plane figures as well as surface areas and volumes of three dimensional figures

• Collect, organize, and interpret data using the elementary statistical concepts of mean, median, mode, and range

• Use and interpret graphs and tables

  — construct and read graphs and tables that display data

• Demonstrate understanding of both the English and metric systems of measurement

  — convert accurately within each system from one measurement to another and make approximate comparisons between the systems

• Understand elementary concepts of probability such as those illustrated by drawing cards, flipping coins, and throwing dice.

Skills and Concepts to Be Mastered Through High School Algebra and Geometry

All students intending to enter college degree programs should complete courses (normally called elementary algebra, geometry, intermediate algebra) which together lead to all the abilities listed below. The division of skills among these courses is not rigid. Certain skills may be introduced earlier or later. Skills introduced in one course should be reinforced in later courses. Applications and problem solving should be emphasized throughout.

Readiness for college-level mathematics is normally achieved after two years of study of algebra and one year of geometry. Specifically, students prepared to begin study of college-level mathematics should be able to:

• Simplify algebraic expressions:

  — Compute with real numbers
  — Know order of operations
  — Group symbols
  — Simplify expressions involving absolute value
  — Use field properties

- Graph linear and quadratic functions through:

  - $ax + by = c$
  - $y = ax^2 + bx + c$

- Solve linear equations and inequalities in one variable including both literal and numerical coefficients

- Apply the concepts of ratio, proportion, and variation in solving problems

- Use the properties of exponents and radicals to simplify expressions and solve equations

- Perform operations on polynomials and rational expressions

  - Use special products and factoring
  - Expand $(a + b)^n$ when n is a positive integer

- Solve and graph systems of linear inequalities in two variables and use the results to solve problems

- Solve systems of linear equations in two and three variables

- Solve quadratic equations by factoring and formula

- Solve quadratic inequalities using algebraic and geometric techniques

- Use algebraic techniques in applications

- Use the concepts and symbolism of sets and logic, including set notation, "and," "or," implication, necessary and sufficient conditions, and negation

- Understand the concepts of relation and function including composition, inverses, arithmetic and algebraic operations, and graphing

- Understand and use complex numbers:

  - In computation
  - In graphing
  - As solutions to polynomial equations

- Understand the structure of the complex number system and the relationships among the various subsets

- Solve equations and inequalities involving rational expressions which lead to linear or quadratic equations and inequalities

- Solve polynomial equations

  — Understand the relationship of the factors of the polynomial P(x) and the roots of the equation $P(x) = 0$
  — Apply synthetic division

- Work with sequences and series

  — Generate sequence given the general n^{th} term or recursive rule
  — Compute n^{th} term of geometric and arithmetic sequences given the first few terms
  — Find the sum of finite arithmetic and geometric series

- Understand exponential and logarithmic functions

  — Recognize equivalence between $a^x = b$ and $\log_a b = x$
  — Use properties of logarithms to simplify and modify expressions
  — Graphing
  — Use in applications
  — Solve logarithmic and exponential equations

- Demonstrate understanding of the basic concepts of geometry including point, line, plane, angle, parallelism, perpendicularity, symmetry, congruence, and similarity

- Apply formulas for perimeters, areas, volumes, and surface areas of geometric figures

- Solve problems involving the geometry of polygons and the geometry of the circle

- Perform geometric constructions using only a compass and a straight-edge

- Explain and apply the concept of locus

• Demonstrate the relationship between algebra and geometry through the use of coordinate geometry

  — Understand the analytic geometry of the straight line
  — Use algebraic means to solve geometric problems and prove geometric theorems

• Solve problems involving right triangles through the use of special right triangles (30-60-90 and 45-45-90), right triangle trigonometry and the Pythagorean Theorem

• Utilize geometric skills and concepts in problem solving

• Demonstrate knowledge of three-dimensional figures and their properties

• Demonstrate an understanding of an axiomatic system

• Recognize the need for formal proofs; be able to follow and construct simple proofs

• Recognize that there are geometries other than Euclidean geometry

• Understand the postulates and theorems of Euclidean geometry

• Understand basic geometric transformations; i.e., reflection, rotation, and translation.

Senior Year Mathematics Courses

All high school students who will use or enroll in mathematics in post-secondary education should take a mathematics course during their senior year. The mathematics studied during that year should reflect the student's plans as well as mathematical ability and attainment. Students taking only three years of math in high school should take intermediate algebra that year.

There are elective courses which may be appropriate for seniors who have completed the equivalent of two years of algebra and one of geometry. Electives include probability and statistics, calculus, linear algebra, topics in discrete mathematics, and integrated courses. Topic descriptions for these courses are not included in this report.

Degree Credit for Mathematics Courses in Post-Secondary Institutions

Many high school students do not know if they will go on to post-secondary education. As many as three-fourths, however, eventually will pursue further training. To keep their options open, all students should take as much mathematics as is available. To enable students to have full access to college and vocational programs and career opportunities, we have recommended that all students master the skills and techniques of high school mathematics through intermediate algebra. This means that all prospective post-secondary students should take at least one full-year course each in elementary algebra, geometry, and intermediate algebra, or their equivalent.

Students who wait until post-secondary education to take these courses should not expect to receive degree credit for them. Even though some post-secondary institutions grant degree credit for this work, we recommend that this practice be discontinued.

In addition to the concepts presented, mathematics at the college level differs from that taught in secondary schools in several other ways. One of the most apparent is the pace of instruction. Typically the material taught for a full year to accelerated high school students is covered in a semester or even a quarter of college study. In addition, the content is more substantial, based on theory rather than technique.

Another difference is in the degree of student responsibility required. Students are expected to read their textbooks without help from the instructor and sometimes to consult auxiliary references. They must do more self-evaluation of their own abilities and progress and determine for themselves the strategies needed to be successful.

The degree of rigor and the emphasis on higher order thinking skills are usually greater in introductory college-level courses than in advanced high school classes. Students are expected to understand the derivations and proofs of the fundamental concepts they use. In high school, students often are given principles illustrated with many examples. In college, they are required to generalize from specifics.

Summary Comments and Recommendations

As listed above, our recommendations for mathematics instruction to prepare students for a full range of post-secondary education opportunities include the following highlights:

• School districts should make every effort to offer a multilevel program of preparatory courses in mathematics in order to provide students at each level with challenging courses.

• All mathematics courses should emphasize problem solving.

• Students planning to enter college degree programs should master skills and techniques of high school mathematics through intermediate algebra. This means that prospective degree students should take as a minimum full-year courses in elementary algebra, geometry and intermediate algebra or their equivalents.

• Degree credit should not be awarded by post-secondary institutions for work equivalent to elementary algebra, geometry, or intermediate algebra.

• All students should be offered a statewide diagnostic assessment during their junior year to evaluate readiness for college-level instruction in mathematics.

In addition to recommendations about the content of pre-college-level courses in mathematics, we identified related issues that could improve mathematics preparation in high school. We conclude this chapter with our statements on improving teacher education and on strengthening ongoing communications between secondary and post-secondary mathematics faculty.

Teacher education and licensure in mathematics in Minnesota are controlled by the Board of Teaching. We make some recommendations which would set directions for future changes in licensure requirements.

Mathematics is most often considered a tool used in the study of other disciplines. However, mathematics is a way of thinking, and it has a structure and beauty all its own. It is essential that teachers of mathematics have an appreciation of the beauty of mathematics and are able to convey it to students.

Teachers of mathematics at the elementary school level should have better training in mathematics than now is required. This might be accomplished with in-service programs in mathematics content as well as more required mathematics courses in pre-service programs. This process should lead to a future system in which all mathematics in grades 4-6 is taught by specialists in mathematics. These people also should supervise and provide in-service help to primary teachers in their school systems.

Methods should be devised to identify master secondary teachers of mathematics who would teach mathematics in their schools, and in addition would assist other secondary math teachers. Eventually all secondary mathematics should be taught by master teachers.

In all preparation for teaching of mathematics, courses should be taught with an emphasis on problem solving, applications, and other higher order thinking skills.

The impact of computers in all areas of study undoubtedly will be felt by curriculum developers. This will result in increased emphasis on discrete topics of mathematics. This report reflects the mathematics curriculum as it is today. As conditions change, both secondary and post-secondary education will need to work together.

A new committee should be formed with an objective of increasing dialogue between secondary and college teachers of mathematics. This dialogue should include discussions leading to curriculum development and coordination in grades 7-14. It should also concern itself with teaching procedures at these levels.

CHAPTER V. SUMMARY AND GENERAL RECOMMENDATIONS

Our primary charge from the executive director of the Higher Education Coordinating Board was to recommend the skills of reading, writing, and mathematics that should be considered college-level — worthy of degree credit — in Minnesota post-secondary institutions. We also were asked to distinguish college-level competencies in these areas from competencies expected of high school graduates. Chapters II, III, and IV of this report contain our recommendations. They can be summarized as follows:

- **Reading.** Degree credit courses in reading should emphasize critical reading and comprehension, especially of longer texts similar to reading assignments in other degree credit classes. Courses dealing substantially with non-technical vocabulary, word identification, and reading of everyday materials should not receive degree credit. Most students should enter degree programs with well-developed reading skills. We therefore recommend that students should not receive degree credit for more than one course meeting our definition of college-level work.

- **Writing.** College-level writing courses should involve development of complex and abstract ideas for different writing situations. They should emphasize different steps of the writing process leading to polished expression. Courses that focus on grammar, usage, punctuation, or effective sentences and paragraphs should not receive degree credit in post-secondary institutions.

- **Mathematics.** College-level mathematics courses should build upon the competencies acquired during the equivalent of at least three years of high school algebra and geometry. When offered in post-secondary institutions, courses covering concepts introduced in elementary algebra, geometry, and intermediate algebra should not receive degree credit.

In each chapter, we included recommendations concerning high school instruction in these skills and assessment of students entering degree programs in post-secondary institutions. Several concerns common to all three areas emerged as we prepared our report.

As faculty and administrators in secondary and post-secondary education, we support the articulation of learning expectations for students at all levels. But we know that student learning cannot be guaranteed solely through maintaining expectations and standards. Other components of our education system must support high educational goals as well. In our discussions, we focused on three: resources, staff development, and communications. We have grouped general recommendations in these areas according to the individuals responsible for acting upon them.

Higher Education Coordinating Board

We recommend that the Board, with its responsibility to gather and evaluate data and to provide information to institutions, students, and parents:

- Endorse the credit guidelines in this report

- Transmit our report and recommendations to the state's post-secondary governing boards and the Commissioner and State Board of Education

- Inform high school students and their parents about the academic expectations and preparation needed to succeed in post-secondary education

- Work with mathematics educators to develop an 11th grade test to advise students about their readiness for college-level mathematics

- Monitor 11th grade mathematics test results to determine the impact of our recommendations concerning the awarding of college degree credits on student achievement in high school

- Gather base-line data and monitor enrollments in post-secondary courses which are pre-college-level according to our definitions

- Monitor changes in campus decisions regarding the granting of degree credit for reading, writing, and mathematics courses

- Periodically gather data on numbers of college students exempt from freshman composition

- Study and make recommendations concerning the instruction of students whose first language is not English

- Observe and report on changes in pre- and in-service preparation of teachers.

Governing Boards

Our school boards and post-secondary governing boards provide leadership and set policies to allocate resources. To support enhanced student preparation for post-secondary degree programs, we recommend that boards at both levels:

- Endorse the degree credit guidelines in this report and publicize them to students and parents

• Establish appropriate class sizes, total student loads, and number of preparations for instruction in core skills

• Support the professional development of faculty who are working to develop the skills of students entering post-secondary education by

  — structuring time for faculty to talk to colleagues about instruction

  — providing funds for faculty to attend state and national meetings, workshops, and courses on current instructional content and methods

  — encouraging faculty publication which reflects attention to this issue

• Support increased communication between faculty in high schools and post-secondary institutions by

  — establishing regional networks so that post-secondary and secondary faculty can exchange information and work together on issues such as curriculum and assessment

  — supporting local, regional, and statewide programs of in-service education involving both secondary and post-secondary faculty

• Develop means of recognizing high achievement of teachers and students

• Consider changes in the required or available secondary school curriculum to reflect these guidelines

• Observe and report on changes in pre- and in-service preparation of teachers.

Administrators

We recommend that administrators in secondary and post-secondary institutions:

• Endorse and implement the degree credit guidelines in this report and publicize them to students and parents

• Work with school boards and post-secondary governing boards to establish appropriate class sizes in core skills, support the professional development of faculty, increase communications, and recognize achievement of teachers and students

• Draw on the expertise of our task force members in designing and implementing staff development programs in the separate skill areas

• Learn about changes in reading, writing, and mathematics instruction and ensure that curricula are current and coordinated with other levels of education

• Work to improve communications between school and home at the secondary level and between students and advisors at the post-secondary level.

Faculty

We recommend that teachers in our secondary schools and post-secondary institutions:

• Endorse and implement the degree credit guidelines in this report and discuss them with students and parents

• Participate in continued professional development by:

  — joining state and national professional associations in their disciplines and by assuring dialogue between associations which draw membership mostly from one level or the other

  — attending professional conferences and reading professional journals

  — contributing to development of new knowledge in the field and in the teaching of the field

  — exchanging successful materials and practices with colleagues

• Initiate activities to improve communications between levels of education by:

  — participating in regional communications networks and joint conferences

  — inviting colleagues in nearby schools and post-secondary institutions to participate in in-service education programs

• Develop curricula based on knowledge of instructional outcomes in adjacent levels of education.

Students and Parents

We recommend that students preparing to enter post-secondary education and their parents:

- Learn about the competencies students will need to enter and succeed in their chosen programs

- Work with high school teachers and counselors to select academic courses that will prepare students with these competencies.

Conclusions

Both high schools and post-secondary institutions have become more diverse during the past 20 years. They are serving more and different students with a broader array of educational programs. Because of these changes, coordination between the two sectors has become more difficult and more important.

In this report, we offer our consensus concerning the appropriate standards for beginning college-level instruction in reading, writing, and mathematics. If implemented, these recommendations will establish a basis for awarding and transferring degree credits in degree-granting post-secondary institutions with varying admissions standards and requirements. Our recommendations also can be a basis for developing secondary curricula and advising students on course selection in high school.

We in Minnesota enjoy sound systems of secondary and post-secondary education. With increased and improved communication, we can help more students achieve advanced academic and lifelong goals.

APPENDIX A. EXAMPLES OF COLLEGE-LEVEL READING ASSIGNMENTS

The following passages illustrate typical freshman reading assignments in college literature, social science, and science courses. These sections are designed to provide concrete examples of the various skills listed in the taxonomy on discourse level reading skills on pages 9-12. They also are designed to illustrate college-level applications of the skills; that is, the sorts of answers that would generally be acceptable in college classes. They are not the only acceptable answers to the questions posed and would not necessarily be considered acceptable by any particular instructor.

One aspect of college-level reading that the questions and answers do not illustrate, and one that is specifically addressed only in the first category of the taxonomy, is the necessity of recalling information as well as initially comprehending it. Importantly, students must be able both to use various comprehension skills to initially understand texts, and they must be able and willing to use the study skills that will enable them to remember that information.

SHOOTING AN ELEPHANT

by George Orwell

In Moulmein, in Lower Burma, I was hated by large numbers of people-the only time in my life that I have been important enough for this to happen to me. I was sub-divisional police officer of the town, and in an aimless, petty kind of way anti-European feeling was very bitter. No one had the guts to raise a fist against me, but if a European woman went through the bazaars alone somebody would probably spit betel juice over her dress. As a police officer I was an obvious target and was baited whenever it seemed safe to do so. When a nimble Burman tripped me up on the football field and the referee (another Burman) looked the other way, the crowd yelled with hideous laughter. This happened more than once. In the end the sneering yellow faces of young men that met me everywhere, the insults hooted after me when I was at a safe distance, got badly on my nerves. The young Buddhist priests were the worst of all. There were several thousands of them in the town and none of them seemed to have anything to do except stand on street corners and jeer at Europeans.

All this was perplexing and upsetting. For at that time I had already made up my mind that imperialism was an evil thing and the sooner I chucked up my job and got out of it the better. Theoretically--and secretly, of course--I was all for the Burmese and all against their oppressors, the British. As for the job I was doing, I hated it more bitterly than I can perhaps make clear. In a job like that you see the dirty work of Empire at close quarters. The wretched prisoners huddling in the stinking cages of the lock-ups, the gray, cowed faces of the long-term convicts, the scarred buttocks of the men who had been flogged with bamboos--all these oppressed me with an intolerable sense of guilt. But I could get nothing into perspective. I was young and ill-educated and I had had to think out my problems in the utter silence that is imposed on every Englishman in the East. I did not even know that the British Empire is dying, still less did I know that it is a great deal better than the younger empires that are going to supplant it. All I knew was that I was stuck between my hatred of the empire I served and my rage against the evil-spirited little beasts who tried to make my job impossible. With one part of my mind I thought of the British Raj as an unbreakable tyranny, as something clamped down, in saecula saeculorum, upon the will of prostrate peoples; with another part I thought that the greatest joy in the world would be to drive a bayonet into a Buddhist priest's guts. Feelings like these are the normal by-products of imperialism; ask any Anglo-Indian official, if you can catch him off duty.

One day something happened which in a round-about way was enlightening. It was a tiny incident in itself, but it gave me a better glimpse than I had had before of the real nature of imperialism--the real motives for which despotic governments act. Early one morning the sub-inspector at a police

station the other end of the town rang me up on the phone and said that an elephant was ravaging the bazaar. Would I please come and do something about it? I did not know what I could do, but I wanted to see what was happening and I got on to a pony and started out. I took my rifle, an old .44 Winchester and much too small to kill an elephant, but I thought the noise might be useful in terrorem. Various Burmans stopped me on the way and told me about the elephant's doings. It was not, of course, a wild elephant, but a tame one which had gone "must." It has been chained up, as tame elephants always are when their attack of "must" is due, but on the previous night it had broken its chain and escaped. Its mahout, the only person who could manage it when it was in that state, had set out in pursuit, but had taken the wrong direction and was now twelve hours' journey away, and in the morning the elephant had suddenly reappeared in the town. The Burmese population had no weapons and were quite helpless against it. It had already destroyed somebody's bamboo hut, killed a cow and raided some fruit-stalls and devoured the stock; also it had met the municipal rubbish van and, when the driver jumped out and took to his heels, had turned the van over and inflicted violences upon it.

The Burmese sub-inspector and some Indian constables were waiting for me in the quarter where the elephant had been seen. It was a very poor quarter, a labyrinth of squalid bamboo huts, thatched with palm-leaf, winding all over a steep hillside. I remember that it was a cloudy, stuffy morning at the beginning of the rains. We began questioning the people as to where the elephant had gone, and, as usual, failed to get any definite information. That is invariably the case in the East; a story always sounds clear enough at a distance, but the nearer you get to the scene of events the vaguer it becomes. Some of the people said that the elephant had gone in one direction, some said that he had gone in another, some professed not even to have heard of an elephant. I had almost made up my mind that the whole story was a pack of lies, when we heard yells a little distance away. There was a loud, scandalized cry of "Go away, child! Go away this instant!" and an old woman with a switch in her hand came round the corner of a hut, violently shooing away a crowd of naked children. Some more women followed, clicking their tongues and exclaiming; evidently there was something that the children ought not to have seen. I rounded the hut and saw a man's dead body sprawling in the mud. He was an Indian, a black Dravidian coolie, almost naked, and he could not have been dead many minutes. The people said that the elephant had come suddenly upon him round the corner of the hut, caught him with its trunk, put its foot on his back and ground him into the earth. This was the rainy season and the ground was soft, and his face had scored a trench a foot deep and a couple of yards long. He was lying on his belly with arms crucified and head sharply twisted to one side. His face was coated with mud, the eyes wide open, the teeth bared and grinning with an expression of unendurable agony. (Never tell me, by the way, that the dead look peaceful. Most of the corpses I have seen looked devilish.) The friction of the great beast's foot had stripped the skin from his back as neatly as one skins a rabbit. As soon as I saw the dead man I sent an orderly to a friend's house nearby to borrow an elephant rifle. I had already sent back the pony, not wanting it to go mad with fright and throw me if it smelled the elephant.

The orderly came back in a few minutes with a rifle and five cartridges, and meanwhile some Burmans had arrived and told us that the elephant was in the paddy fields below, only a few hundred yards away. As I started forward practically the whole population of the quarter flocked out of the houses and followed me. They had seen the rifle and were all shouting excitedly that I was going to shoot the elephant. They had not shown much interest in the elephant when he was merely ravaging their homes, but it was different now that he was going to be shot. It was a bit of fun to them, as it would be to an English crowd; besides they wanted the meat. It made me vaguely uneasy. I had no intention of shooting the elephant--I had merely sent for the rifle to defend myself if necessary--and it is always unnerving to have a crowd following you. I marched down the hill, looking and feeling a fool, with the rifle over my shoulder and an ever-growing army of people jostling at my heels. At the bottom, when you got away from the huts, there was a metalled road and beyond that a miry waste of paddy fields a thousand yards across, not yet ploughed but soggy from the first rains and dotted with course grass. The elephant was standing eight yards from the road, his left side towards us. He took not the slightest notice of the crowd's approach. He was tearing up bunches of grass, beating them against his knees to clean them and stuffing them into his mouth.

I had halted on the road. As soon as I saw the elephant I knew with perfect certainty that I ought not to shoot him. It is a serious matter to shoot a working elephant--it is comparable to destroying a huge and costly piece of machinery--and obviously one ought not to do it if it can possibly be avoided. And at that distance, peacefully eating, the elephant looked no more dangerous than a cow. I thought then and I think now that his attack of "must" was already passing off; in which case he would merely wander harmlessly about until the mahout came back and caught him. Moreover, I did not in the least want to shoot him. I decided that I would watch him for a little while to make sure that he did not turn savage again, and then go home.

But at that moment I glanced round at the crowd that had followed me. It was an immense crowd, two thousand at the least and growing every minute. It blocked the road for a long distance on either side. I looked at the sea of yellow faces above the garish clothes--faces all happy and excited over this bit of fun, all certain that the elephant was going to be shot. They were watching me as they would watch a conjurer about to perform a trick. They did not like me, but with the magical rifle in my hands I was momentarily worth watching. And suddenly I realized that I should have to shoot the elephant after all. The people expected it of me and I had got to do it; I could feel their two thousand wills pressing me forward, irresistibly. And it was at this moment, as I stood there with the rifle in my hands, that I first grasped the hollowness, the futility of the white man' dominion in the East. Here was I, the white man with his gun, standing in front of the unarmed native crowd--seemingly the leading actor of the piece; but in reality I was only an absurd puppet pushed to and fro by the will of those yellow faces behind. I perceived in this moment that when the white man turns tyrant it is his own freedom that he destroys. He becomes a sort of hollow, posing dummy, the conventionalized figure of a sahib. For it is the condition of his rule that he shall spend his

life in trying to impress the "natives," and so in every crisis he has got to do what the "natives" expect of him. He wears a mask, and his face grows to fit it. I had got to shoot the elephant. I had committed myself to doing it when I sent for the rifle. A sahib has got to act like a sahib; he has got to appear resolute, to know his own mind and do definite things. To come all that way, rifle in hand, with two thousand people marching at my heels, and then to trail feebly away, having done nothing--no, that was impossible. The crowd would laugh at me. And my whole life, every white man's life in the East, was one long struggle not to be laughed at.

But I did not want to shoot the elephant. I watched him beating his bunch of grass against his knees, with that preoccupied grandmotherly air that elephants have. It seemed to me that it would be murder to shoot him. At that age I was not squeamish about killing animals, but I had never shot an elephant and never wanted to. (Somehow it always seems worse to kill a large animal.) Besides, there was the beast's owner to be considered. Alive, the elephant was worth at least a hundred pounds; dead, he would only be worth the value of his tusks, five pounds, possibly. But I had got to act quickly. I turned to some experienced-looking Burmans who had been there when we arrived, and asked them how the elephant had been behaving. They all said the same thing: he took no notice of you if you left him alone, but he might charge if you went too close to him.

It was perfectly clear to me what I ought to do. I ought to walk up to within, say, twenty-five yards of the elephant and test his behavior. If he charged I could shoot, if he took no notice of me it would be safe to leave him until the mahout came back. But also I knew that I was going to do no such thing. I was a poor shot with a rifle and the ground was soft mud into which one would sink at every step. If the elephant charged and I missed him, I should have about as much chance as a toad under a steamroller. But even then I was not thinking particularly of my own skin, only of the watchful yellow faces behind. For at that moment with the crowd watching me, I was not afraid in the ordinary sense, as I would have been if I had been alone. A white man mustn't be frightened in front of "natives"; and so, in general, he isn't frightened. The sole thought in my mind was that if anything went wrong those two thousand Burmans would see me pursued, caught, trampled on and reduced to a grinning corpse like that Indian up the hill. And if that happened it was quite probable that some of them would laugh. That would never do. There was only one alternative. I shoved the cartridges into the magazine and lay down on the road to get a better aim.

The crowd grew very still, and a deep, low, happy sigh, as of people who see the theatre curtain go up at last, breathed from innumerable throats. They were going to have their bit of fun after all. The rifle was a beautiful German thing with cross-hair sights. I did not then know that in shooting an elephant one would shoot to cut an imaginary bar running from ear-hole to ear-hole. I ought, therefore, as the elephant was sideways on, to have aimed straight at his ear-hole; actually I aimed several inches in front of this, thinking the brain would be further forward.

When I pulled the trigger I did not hear the bang or feel the kick--one never does when a shot goes home--but I heard the devilish roar of glee that went up from the crowd. In that instant, in too short a time, one would have thought, even for the bullet to get there, a mysterious, terrible change had come over the elephant. He neither stirred nor fell, but every line of his body had altered. He looked suddenly stricken, shrunken, immensely old, as though the frightful impact of the bullet had paralyzed him without knocking him down. At last, after what seemed a long time--it might have been five seconds, I dare say--he sagged flabbily to his knees. His mouth slobbered. An enormous senility seemed to have settled upon him. One could have imagined him thousands of years old. I fired again into the same spot. At the second shot he did not collapse but climbed with desperate slowness at his feet and stood weakly upright, with legs sagging and head drooping. I fired a third time. That was the shot that did for him. You could see the agony of it jolt his whole body and knock the last remnant of strength from his legs. But in falling he seemed for a moment to rise, for as his hind legs collapsed beneath him he seemed to tower upwards like a huge rock toppling, his trunk reaching skywards like a tree. He trumpeted, for the first and only time. And then down he came, his belly towards me, with a crash that seemed to shake the ground even where I lay.

I got up. The Burmans were already racing past me across the mud. It was obvious that the elephant would never rise again, but he was not dead. He was breathing very rhythmically with long rattling gasps, his great mound of a side painfully rising and falling. His mouth was wide open--I could see far down into the caverns of pale pink throat. I waited a long time for him to die, but his breathing did not weaken. Finally I fired my two remaining shots into the spot where I thought his heart must be. The thick blood welled out of him like red velvet, but still he did not die. His body did not even jerk when the shots hit him, the tortured breathing continued without a pause. He was dying, very slowly and in great agony, but in some world remote from me where not even a bullet could damage him further. I felt that I had got to put an end to that dreadful noise. It seemed dreadful to see the great beast lying there, powerless to move and yet powerless to die, and not even to be able to finish him. I sent back for my small rifle and pored shot after shot into his heart and down his throat. They seemed to make no impression. The tortured gasps continued as steadily as the ticking of a clock.

In the end I could not stand it any longer and went away. I heard later that it took him half an hour to die. Burmans were bringing dahs and baskets even before I left, and I was told they had stripped his body almost to the bones by the afternoon.

Afterwards, of course, there were endless discussions about the shooting of the elephant. The owner was furious, but he was only an Indian and could do nothing. Besides, legally I had done the right thing, for a mad elephant has to be killed, like a mad dog, if its owner fails to control it. Among the Europeans opinion was divided. The older men said I was right, the younger men said it was a damn shame to shoot an elephant for killing a coolie, because an elephant was worth more than any damn Coringhee coolie. And afterwards I was

very glad that the coolie had been killed; it put me legally in the right and it gave me a sufficient pretext for shooting the elephant. I often wondered whether any of the others grasped that I had done it solely to avoid looking a fool.

Comprehension Questions for "Shooting An Elephant"

1. Why does he (the sub-divisional police officer) send for the elephant rifle?

   Skill: Literal comprehension

   He walked through that quarter of the town where the elephant had destroyed somebody's bamboo hut, killed a cow, raided some fruit stalls and devoured the stock, overturned a van, and he saw how the elephant had killed a black Dravidian coolie. Therefore, he sent for the elephant rifle to use merely as a way of defending himself. (page 41)

2. Why did the sub-inspector at the other end of the town call him to do something about the elephant?

   Skill: Text-based inferential comprehension

   The sub-inspector across town was a Burmese. The narrator was a British police officer who had to keep order in the town. The Burmese sub-inspector did not want the responsibility of deciding what had to be done with the elephant. (pages 40-41)

3. What would have happened if he hadn't shot the elephant?

   Skill: Reader-based inferential comprehension

   If he hadn't shot the elephant, he might be thought of as an ineffective British police officer. The Burmese would consider him a coward and a fool and would have no respect for him. They also would jeer him and chide him about being a person who considered an elephant's life to be more sacred than a human's life and he would be forced to leave his job or be transferred to another town. (pages 43-44)

4. Are the narrator's feelings the normal byproducts of imperialism?

   Skill: Critical reading

   The narrator has slanted this story toward the evils of imperialism. He wants the reader to infer the negative aspects of imperialism through the eyes, thoughts, and mind of a British police officer. If the reader places himself/herself in the place of Burmese, s/he might have a different feeling of imperialism.

   The European rule brought benefits to this dependent territory and its people which included a better system of law and higher standards of health and education. With these benefits, especially better education, the subject peoples would soon want and be able to better govern themselves. Therefore, the narrator's feelings are not necessarily the normal byproducts of imperialism. It depends on one's point of view. (Entire passage)

5. The author uses the narrator's voice as the only one the reader hears. What is the effect of using this point of view?

   Skill: Understanding literary devices

   The author very cleverly uses the first person narration and descriptive details to vividly project his bias toward the evils of imperialism. (Entire passage)

6. How might the reader use study skills to better understand the story's message?

   The reader should be able to identify the introduction, the rising action of the story, the climax, and the descending action and ending. S/he should also use marginal notes, underlining, and notetaking to carry on a dialogue with the author by questioning his assumptions and thoughts as well as the use of literary devices.

COLUMBUS, THE INDIANS, AND HUMAN PROGRESS

by Howard Zinn

Arawak men and women, naked, tawny, and full of wonder, emerged from their villages onto the island's beaches and swam out to get a closer look at the strange big boat. When Columbus and his sailors came ashore, carrying swords, speaking oddly, the Arawaks ran to greet them, brought them food, water, gifts. He later wrote of this in his log:

> They...brought us parrots and balls of cotton and spears and many other things, which they exchanged for the glass beads and hawks' bells. They willingly traded everything they owned...They were well-built, with good bodies and handsome features...They do not bear arms, and do not know them, for I showed them a sword, they took it by the edge and cut themselves out of ignorance. They have no iron. Their spears are made of cane...They would make fine servants...With fifty men we could subjugate them all and make them do whatever we want.

These Arawaks of the Bahama Islands were much like Indians on the mainland, who were remarkable (European observers were to say again and again) for their hospitality, their belief in sharing. These traits did not stand out in the Europe of the Renaissance, dominated as it was by the religion of popes, the government of kings, the frenzy for money that marked Western civilization and its first messenger to the Americas, Christopher Columbus.

Columbus wrote:

> As soon as I arrived in the Indies, on the first Island which I found, I took some of the natives by force in order that they might learn and might give me information of whatever there is in these parts.

The information that Columbus wanted most was: Where is the gold? He had persuaded the king and queen of Spain to finance an expedition to the lands, the wealth, he expected would be on the other side of the Atlantic--the Indies and Asia, gold and spices. For, like other informed people of his time, he knew the world was round and he could sail west in order to get to the Far East.

Spain was recently unified, one of the new modern nation-states, like France, England, and Portugal. Its population, mostly poor peasants, worked for the nobility, who were 2 percent of the population and owned 95 percent of the land. Spain had tied itself to the Catholic Church, expelled all the Jews, driven out the Moors. Like other states of the modern world, Spain sought gold, which was becoming the new mark of wealth, more useful than land because it could buy anything.

There was gold in Asia, it was thought, and certainly silks and spices, for Marco Polo and others had brought back marvelous things from their overland expeditions centuries before. Now that the Turks had conquered Constantinople and the eastern Mediterranean, and controlled the land routes to Asia, a sea route was needed. Portuguese sailors were working their way around the southern tip of Africa. Spain decided to gamble on a long sail across an unknown ocean.

In return for bringing back gold and spices, they promised Columbus 10 percent of the profits, governorship over new-found lands, and the fame that would go with a new title: Admiral of the Ocean Sea. He was a merchant's clerk from the Italian city of Genoa, part-time weaver (the son of a skilled weaver), and expert sailor. He set out with three sailing ships, the largest of which was the Santa Maria, perhaps 100 feet long, and thirty-nine crew members.

Columbus would never have made it to Asia, which was thousands of miles farther away than he had calculated, imagining a smaller world. He would have been doomed by that great expanse of sea. But he was lucky. One-fourth of the way there he came upon an unknown, uncharted land that lay between Europe and Asia--the Americas. It was early October 1492, and thirty-three days since he and his crew had left the Canary Islands, off the Atlantic coast of Africa. Now they saw branches and sticks floating in the water. They saw flocks of birds. These were signs of land. Then, on October 12, a sailor called Rodrigo saw the early morning moon shining on white sands, and cried out. It was an island in the Bahamas, the Caribbean sea. The first man to sight land was supposed to get a yearly pension of 10,000 maravedis for life, but Rodrigo never got it. Columbus claimed he had seen a light the evening before. He got the reward.

So, approaching land, they were met by the Arawak Indians, who swam out to greet them. The Arawaks lived in village communes, had a developed agriculture of corn, yams, cassava. They could spin and weave, but they had no horses or work animals. They had no iron, but they wore tiny gold ornaments in their ears.

This was to have enormous consequences: it led Columbus to take some of them aboard ship as prisoners because he insisted that they guide him to the source of the gold. He then sailed to what is now Cuba, then to Hispaniola (the island which today consists of Haiti and the Dominican Republic). There, bits of visible gold in the rivers, and a gold mask presented to Columbus by a local Indian chief, led to wild visions of gold fields.

On Hispaniola, out of timbers from the Santa Maria, which had run aground, Columbus built a fort, the first European military base in the Western Hemisphere. He called it Navidad (Christmas) and left thirty-nine crewmembers there, with instructions to find and store the gold. He took more Indian prisoners and put them aboard his two remaining ships. At one part of the island he got into a fight with Indians who refused to trade as many [illegible] and arrows as he and his men wanted. Two were run through with swords and died to death. Then the Nina and the Pinta set sail for the Azores and Spain. When the weather turned cold, the Indian prisoners began to die.

Columbus's report to the court in Madrid was extravagant. He insisted he had reached Asia (it was Cuba) and an island off the coast of China (Hispaniola). His descriptions were part fact, part fiction:

> Hispaniola is a miracle. Mountains and hills, plains and pastures, are both fertile and beautiful...the harbors are unbelievably good and there are many wide rivers of which the majority contain gold...There are many spices, and great mines of gold and other metals...

The Indians, Columbus reported, "are so naive and so free with their possessions that no one who has not witnessed them would believe it. When you ask for something they have, they never say no. To the contrary, they offer to share with anyone..." He concluded his report by asking for a little help from their Majesties, and in return he would bring them from his next voyage "as much gold as they need...and as many slaves as they ask." He was full of religious talk: "Thus the eternal God, our Lord, gives victory to those who follow His way over apparent impossibilities."

Because of Columbus's exaggerated report and promises, his second expedition was given seventeen ships and more than twelve hundred men. The aim was clear: slaves and gold. They went from island to island in the Caribbean, taking Indians as captives. But as word spread about the Europeans' intent they found more and more empty villages. On Haiti, they found that the sailors left behind at Fort Navidad had been killed in a battle with the Indians, after they had roamed the island in gangs looking for gold, taking women and children as slaves for sex and labor.

Meanwhile, back on his base on Haiti, Columbus sent expedition after expedition in search of his mission. They found no gold fields, but had to fill up the ships returning to Spain with some kind of dividend. In the year ahead, they went on a great slave raid, rounded up fifteen hundred Arawak men, women, and children, put them in pens guarded by Spaniards and dogs, then picked the five hundred best specimens to load onto ships. Of those five hundred, two hundred died in route. The rest arrived alive in Spain and were put up for sale by the archdeacon of the town, who reported that, although the slaves were "naked as the day they were born," they showed "no more embarrassment than animals." Columbus later wrote: "Let us in the name of the Holy Trinity go on sending all the slaves that can be sold."

But too many of the slaves died in captivity. And so Columbus, desperate to pay back dividends to those who had invested, had to make good his promise to fill the ships with gold. In the province of Cicao on Haiti, where he and his men imagined huge gold fields to exist, they ordered all persons fourteen years or older to collect a certain quantity of gold every three months. When they brought it, they were given copper tokens to hang around their necks. Indians found without a copper token had their hands cut off and bled to death.

The Indians had been given an impossible task. The only gold around was bits of dust garnered from the streams. So they fled, were hunted down with dogs, and were killed.

Trying to put together an army of resistance, the Arawaks faced Spaniards who had armor, muskets, swords, horses. When the Spaniards took prisoners they hanged them or burned them to death. Among the Arawaks, mass suicides began, with cassava poison. Infants were killed to save them from the Spaniards. In two years, through murder, mutilation, or suicide, half of the 250,000 Indians on Haiti were dead.

When it became clear that there was no gold left, the Indians were taken as slave labor on huge estates, known later as "encomiendas." They were worked at a ferocious pace, and died by the thousands. By the year 1515, there were perhaps fifty thousand Indians left. By 1550, there were five hundred. A report of the year 1650 shows none of the original Arawaks or their descendants left on the island.

The chief source--and, on many matters the only source--of information about what happened on the islands after Columbus came is Bartolome de las Casas, who, as a young priest, participated in the conquest of Cuba. For a time he owned a plantation on which Indian slaves worked, but he gave that up and became a vehement critic of Spanish cruelty. Las Casas transcribed Columbus's journal and, in his fifties, began a multivolume History of the Indies. In it, he describes the Indians. They are agile, he says, and can swim long distances, especially the women. They are not completely peaceful, because they do battle from time to time with other tribes, but their casualties seem small, and they fight when they are individually moved to do so because of some grievance, not on the orders of captains or kings.

Women in Indian society were treated so well as to startle the Spaniards. Las Casas describes sex relations:

> Marriage laws are non-existent: men and women alike choose their mates and leave them as they please, without offense, jealousy or anger. They multiply in great abundance; pregnant women work to the last minute and give birth almost painlessly; up the next day, they bathe in the river and are as clean and healthy as before giving birth. If they tire of their men, they give themselves abortions with herbs that force stillbirths, covering their shameful parts with leaves or cotten cloth; although on the whole Indian men and women look upon total nakedness with as much casualness as we look upon a man's head or at his hands.

The Indians, Las Casas says, have no religion, at least no temples. They live in

> large communal bell-shaped buildings, housing up to 600 people at one time...made of very strong wood and roofed with palm leaves...They prize bird feathers of various colors, beads made of fishbones, and green and white stones with which they adorn their ears and lips, but they put no value on gold and other precious things. They lack all manner of commerce, neither buying nor selling, and rely exclusively on their natural environment for maintenance. They are extremely generous with their possessions and by the same token covet the possessions of their friends and expect the same degree of liberality...

In Book Two of his History of the Indies, Las Casas (who at first urged replacing Indians by black slaves, thinking they were stronger and would survive, but later relented when he saw the effects on blacks) tells about the treatment of the Indians by the Spaniards. It is a unique account and deserves to be quoted at length:

> Endless testimonies...prove the mild and pacific temperament of the natives...But our work was to exasperate, ravage, kill, mangle and destroy; small wonder, then, if they tried to kill one of us now and then...The admiral, it is true, was blind as those who came after him, and he was so anxious to please the King that he committed irreparable crimes against the Indians...

Las Casas tells how the Spaniards "grew more conceited every day" and after a while refused to walk any distance. They "rode the backs of Indians if they were in a hurry" or were carried on hammocks by Indians running in relays. "In this case they also had Indians carry large leaves to shade them from the sun and others to fan them with goose wings."

Total control led to total cruelty. The Spaniards "thought nothing of knifing Indians by tens and twenties and of cutting slices off them to test the sharpness of their blades." Las Casas tells how "two of these so-called Christians met two Indian boys one day, each carrying a parrot; they took the parrots and for fun beheaded the boys."

The Indians' attempts to defend themselves failed. And when they ran off into the hills they were found and killed. So, Las Casas reports, "they suffered and died in the mines and other labors in desperate silence, knowing not a soul in the world to whom they could turn for help." He describes their work in the mines:

> ...mountains are stripped from top to bottom and bottom to top a thousand times; they dig, split rocks, move stones, and carry dirt on their backs to wash it in the rivers, while those who wash gold stay in the water all the time with their backs bent so constantly it breaks them; and when water invades the mines, the most arduous task of all is to dry the mines by scooping up pansful of water and throwing it up outside...

After each six or eight months' work in the mines, which was the time required of each crew to dig enough gold for melting, up to a third of the men died.

While the men were sent many miles away to the mines, the wives remained to work the soil, forced into the excruciating job of digging and making thousands of hills for cassava plants.

> Thus husbands and wives were together only once every eight or ten months and when they met they were so exhausted and depressed on both sides...they ceased to procreate. As for the newly born, they died early because their mothers, overworked and famished, had no milk to nurse them, and for this reason, while I was in Cuba, 7000 children died in three months. Some mothers even drowned their babies from

> sheer desperation...In this way, husbands died in the mines, wives died at work, and children died from lack of milk...and in a short time this land which was so great, so powerful and fertile...was depopulated...My eyes have seen these acts so foreign to human nature, and now I tremble as I write...

When he arrived on Hispaniola in 1508, Las Casas says, "there were 60,000 people living on this island, including the Indians; so that from 1494 to 1508, over three million people had perished from war, slavery, and the mines. Who in future generations will believe this? I myself writing it as a knowledgeable eyewitness can hardly believe it..."

Thus began the history, five hundred years ago, of the European invasion of the Indian settlements in the Americas. That beginning, when you read Las Casas--even if his figures are exaggerations (were there 3 million Indians to begin with, as he says, or 250,000, as modern historians calculate?)--is conquest, slavery, death. When we read the history books given to children in the United States, it all starts with heroic adventure--there is no bloodshed--and Columbus Day is a celebration.

Past the elementary and high schools, there are only occasional hints of something else. Samuel Eliot Morison, the Harvard historian, was the most distinguished writer on Columbus, the author of a multi-volume biography, and was himself a sailor who retraced Columbus's route across the Atlantic. In his popular book Christopher Columbus, Mariner, written in 1954, he tells about the enslavement and the killing: "The cruel policy initiated by Columbus and pursued by his successors resulted in complete genocide."

That is on one page, buried halfway into the telling of a grand romance. In the book's last paragraph, Morison sums up his view on Columbus:

> He had his faults and his defects, but they were largely the defects of the qualities that made him great--his indomitable will, his superb faith in God and in his own mission as the Christ-bearer to lands beyond the seas, his stubborn persistence despite neglect, poverty and discouragement. But there was no flaw, no dark side to the most outstanding and essential of all his qualities--his seamanship.

One can lie outright about the past. Or one can omit facts which might lead to unacceptable conclusions. Morrison does neither. He refuses to lie about Columbus. He does not omit the story of mass murder; indeed he describes it with the harshest word one can use: genocide.

But he does something else--he mentions the truth quickly and goes on to other things more important to him. Outright lying or quiet omission takes the risk of discovery which, when made, might arouse the reader to rebel against the writer. To state the facts, however, and then to bury them in a mass of other information is to say to the reader with a certain infectious calm: yes mass murder took place, but it's not that important--it should weigh very little in our final judgments; it should affect very little what we do in the world.

It is not that the historian can avoid emphasis of some facts and not of others. This is as natural to him as to the mapmaker, who, in order to produce a usable drawing for practical purposes, must first flatten and distort the shape of the earth, then choose out of the bewildering mass of geographic information those things needed for the purpose of this or that particular map.

My argument cannot be against selection, simplification, emphasis, which are inevitable for both cartographers and historians. But the mapmaker's distortion is a technical necessity for a common purpose shared by all people who need maps. The historian's distortion is more than technical, it is ideological; it is released into a world of contending interests, where any chosen emphasis supports (whether the historian means to or not) some kind of interest, whether economic or political or racial or national or sexual.

Furthermore, this ideological interest is not openly expressed in the way a mapmaker's technical interest is obvious ("This is a Mercator projection for long-range navigation--for short-range, you'd better use a different projection"). No, it is presented as if all readers of history had a common interest which historians serve to the best of their ability. This is not intentional deception; the historian has been trained in a society in which education and knowledge are put forward as technical problems of excellence and not as tools for contending social classes, races, nations.

To emphasize the heroism of Columbus and his successors as navigators and discoverers, and to deemphasize their genocide, is not a technical necessity but an ideological choice. It serves--unwittingly--to justify what was done.

My point is not that we must, in telling history, accuse, judge, condemn Columbus in absentia. It is too late for that; it would be a useless scholarly exercise in morality. But the easy acceptance of atrocities as a deplorable but necessary price to pay for progress (Hiroshima and Vietnam, to save Western civilization; Kronstadt and Hungary, to save socialism; nuclear proliferation, to save us all)--that is still with us. One reason these atrocities are still with us is that we have learned to bury them in a mass of other facts, as radioactive wastes are buried in containers in the earth. We have learned to give them exactly the same proportion of attention that teachers and writers often give them in the most respectable of classrooms and textbooks. This learned sense of moral proportion, coming from the apparent objectivity of the scholar, is accepted more easily than when it comes from politicians at press conferences. It is therefore more deadly.

The treatment of heroes (Columbus) and their victims (the Arawaks)--the quiet acceptance of conquest and murder in the name of progress--is only one aspect of a certain approach to history, in which the past is told from the point of view of governments, conquerors, diplomats, leaders. It is as if they, like Columbus, deserve universal acceptance, as if they--the Founding Fathers, Jackson, Lincoln, Wilson, Roosevelt, Kennedy, the leading members of Congress, the famous Justices of the Supreme Court--represent the nation as a whole. The pretense is that there is really such a thing as "the United States," subject to occasional conflicts and quarrels, but fundamentally a

community of people with common interests. It is as if there really is a "national interest" represented in the Constitution, in territorial expansion, in the laws passed by Congress, the decisions of the courts, the development of capitalism, the culture of education and the mass media.

"History is the memory of states," wrote Henry Kissinger in his first book, A World Restored, in which he proceeded to tell the history of nineteenth-century Europe from the viewpoint of the leaders of Austria and England, ignoring the millions who suffered from those statesmen's policies. From his standpoint, the "peace" that Europe had before the French Revolution was "restored" by the diplomacy of a few national leaders. But for factory workers in England, farmers in France, colored people in Asia and Africa, women and children everywhere except in the upper classes, it was a world of conquest, violence, hunger, exploitation--a world not restored but disintegrated.

My viewpoint, in telling the history of the United States, is different: that we must not accept the memory of states as our own. Nations are not communities and never have been. The history of any country, presented as the history of a family, conceals fierce conflicts of interest (sometimes exploding, most often repressed) between conquerors and conquered, masters and slaves, capitalists and workers, dominators and dominated in race and sex. And in such a world of conflict, a world of victims and executioners, it is the job of thinking people, as Albert Camus suggested, not to be on the side of the executioners.

Thus, in that inevitable taking of sides which comes from selection and emphasis in history, I prefer to try to tell the story of the discovery of American from the viewpoint of the Arawaks, of the Constitution from the standpoint of the slaves, of Andrew Jackson as seen by the Cherokees, of the Civil War as seen by the New York Irish, of the Mexican war as seen by the deserting soldiers of Scott's army, of the rise of industrialism as seen by the young women in the Lowell textile mills, of the Spanish-American war as seen by the Cubans, the conquest of the Philippines as seen by black soldiers on Luzon, the Gilded Age as seen by southern farmers, the First World War as seen by socialists, the Second World War as seen by pacifists, the New Deal as seen by blacks in Harlem, the postwar American empire as seen by peons in Latin America. And so on, to the limited extent that any one person, however he or she strains, can "see" history from the standpoint of others.

My point is not to grieve for the victims and denounce the executioners. Those tears, that anger, cast into the past, deplete our moral energy for the present. And the lines are not always clear. In the long run, the oppressor is also a victim. In the short run (and so far, human history has consisted only of short runs), the victims, themselves desperate and tainted with the culture that oppresses them, turn on other victims.

Still, understanding the complexities, this book will be skeptical of governments and their attempts, through politics and culture, to ensnare

ordinary people in a giant web of nationhood pretending to a common interest. I will try not to overlook the cruelties that victims inflict on one another as they are jammed together in the boxcars of the system. I don't want to romanticize them. But I do remember (in rough paraphrase) a statement I once read: "The cry of the poor is not always just, but if you don't listen to it, you will never know what justice is."

I don't want to invent victories for peoples movements. But to think that history-writing must aim simply to recapitulate the failures that dominate the past is to make historians collaborators in an endless cycle of defeat. If history is to be creative, to anticipate a possible future without denying the past, it should, I believe, emphasize new possibilities by disclosing those hidden episodes of the past when, even if in brief flashes, people showed their ability to resist, to join together, occasionally to win. I am supposing, or perhaps only hoping, that our future may be found in the past's fugitive moments of compassion rather than in its solid centuries of warfare.

That, being as blunt as I can, is my approach to the history of the United States. The reader may as well know that before going on.

Comprehension Questions for "Columbus, the Indians, and Human Progress"

1. According to the information in Zinn's first chapter, how does Zinn characterize the indigenous tribal cultures of the New World?

   Skill: Literal Recall

   According to Zinn, the tribes of the New World were a fundamentally virtuous and amiable people. They were generous with their possessions and, from this account, lived in a sort of utopia with all aspects of material and personal worth communally held and shared. They were, in fact, so generous, according to the author, that they never refused requests and offered to share with anyone. (pages 47-50)

2. How does he characterize Western European society or culture?

   Skill: Literal Recall, Text-based Inferential Comprehension

   In contrast, Christopher Columbus and his cohorts, as representatives of the Western European culture, were an unscrupulous and amoral group, their aim being slaves and gold. Zinn specifically alludes to Columbus's expedition taking the Indians as captives, cutting their hands off, riding their backs, and

beheading boys. They were ruthless in their pursuit of power, wealth and prestige, were motivated by their individual and collective self-interest, and, in the name of Christianity, enslaved and nearly destroyed a whole generation of tribal people. One could conclude that the society which produced such a representation was one motivated by greed and power and with little concern for social justice. (pages 47-53)

3. How does this article's treatment of Columbus fit with what you have already read or heard about him?

   Skill: Reader-based Inferential Comprehension

   The article contradicts most of what I recall about Christopher Columbus. Although I was aware of the fact that Columbus sailed in three small ships, that he did not actually reach the mainland, that he was in search of gold and that he was later imprisoned, I do not recall ever hearing or reading anything about his cruel treatment of the Arawak Indians. In fact, my recollection of the history of Christopher Columbus was far more of a man who was mistreated by his superiors than of a man who used others for his own benefit. Thus, Zinn debunks the heroic and admirable Columbus and replaces that image with the description of a greedy and ruthless man.

4. What point about the nature of history is Zinn making with his discussion of the work of the Harvard historian, Samuel Eliot Morison?

   Skill: Literal Recall, Text-based Inferential Comprehension

   Historians typically present their work as an objective interpretation of past events. Usually, the historical events deemed most significant are those important to the development of political systems and their leaders — "history is the memory of states."

   In contrast to this view, Zinn suggests that historians have a great deal of power in how they "recreate" history. He sees the historian's "ideology" as a significant filter through which events may be distorted, reported inaccurately, or valued or devalued. What the historians emphasize has long-term impact on interpretation and cannot only alter one's understanding of history, but can also, as in the case of Morison, establish a justification for unacceptable acts which then become acceptable. Zinn seems to suggest that Morison's quick reference to genocide and subsequent justification of it by highlighting Columbus' seamanship is, in

fact, more problematical than if he were to have omitted reference to Columbus' malevolence altogether, as it implies that the fact of genocide is unimportant. Historians are perceived (and often perceive themselves) as objective "technicians," when, in fact, they act as spokespeople for social classes, races, and nations. In fact, Zinn suggests, historians are powerful individuals, and because of the scholar's "cloak of objectivity," can become authoritative sources for societal morality as it views past and current events and people. (pages 53-54)

5. Can you infer a definition of ideology from Zinn's use of the word "ideological" on page 53? Explain.

   Skill: Text-based Inferential Comprehension

   Zinn repeatedly uses the key word interests, "...whether economical or political or racial or national or sexual" when he speaks of ideology. One could thus infer that Zinn believes that one's ideology arises from the interest of the individual or the interests of the group with which one most closely identifies. Therefore, according to Zinn, the word ideology denotes the belief system that one has acquired because of what one has come to perceive as one's self-interest or the self-interest of one's reference group. (pages 53-54)

6. Describe Zinn's own ideological bias.

   Skill: Reader-based Inferential Comprehension

   Zinn states that history should be a retelling of the story of the common people involved, not a story of elites. Through his emphasis of the Arawak's communal lifestyle, their sharing, and their lack of arms, and his emphasis on Columbus' brutality, one can deduce that Zinn reflects a socialist ideological perspective. He thus proposes to look at such groups as the Arawaks, the slaves, the Cherokee Indians, the New York Irish, etc., and to tell the events from such people's perspectives. (pages 54-55)

7. What assumptions does Zinn make?

   Skill: Critical Reading

   Zinn assumes that history is a series of conflicts between the oppressors and the oppressed and the telling of history is not neutral. He further postulates that there is a vast difference between the self-interest of the states and the

self-interest of the states and the self-interest of the people themselves. Too, Zinn posits that the cycle continues throughout future generations. The line between the oppressed and oppressors is not always clear, however, with the oppressed sometimes becoming the oppressors and the oppressors sometimes becoming the victims. (pages 54-55)

To make his point, Zinn quotes extensively from a single observer, Las Casas, whom Zinn assumes to be a credible, if unverified, source on the life of Columbus. Zinn chooses to emphasize the atrocities reported by Las Casas, rather than the achievements recorded by other historians, because they illustrate his assumptions about what is important in human history.

8. How might the reader use study skills to better understand the story's message?

In preparing a selection such as "Columbus, the Indians, and Human Progress," the student should initially read the entire passage at a rate whereby the expository material can be comprehended. Since more than one reading is appropriate for such material, the student should then go over the article a second time, reading comprehensible chunks of the chapter, underlining and later providing marginal questions. An alternate strategy would be notetaking, with marginal questions again being appropriate.

Animal Communication

Animals ranging from insects to mammals communicate by means of chemicals, movements and sounds. Man also uses these modes of communication, but he adds his own unique kind of language

by Edward O. Wilson

The most instructive way to view the communication systems of animals is to compare these systems first with human language. With our own unique verbal system as a standard of reference we can define the limits of animal communication in terms of the properties it rarely—or never—displays. Consider the way I address you now. Each word I use has been assigned a specific meaning by a particular culture and transmitted to us down through generations by learning. What is truly unique is the very large number of such words and the potential for creating new ones to denote any number of additional objects and concepts. This potential is quite literally infinite. To take an example from mathematics, we can coin a nonsense word for any number we choose (as in the case of the googol, which designates a 1 followed by 100 zeros). Human beings utter their words sequentially in phrases and sentences that generate, according to complex rules also determined at least partly by the culture, a vastly larger array of messages than is provided by the mere summed meanings of the words themselves. With these messages it is possible to talk about the language itself, an achievement we are utilizing here. It is also possible to project an endless number of unreal images: fiction or lies, speculation or fraud, idealism or demagogy, the definition depending on whether or not the communicator informs the listener of his intention to speak falsely.

Now contrast this with one of the most sophisticated of all animal communication systems, the celebrated waggle dance of the honeybee (*Apis mellifera*), first decoded in 1945 by the German biologist Karl von Frisch. When a foraging worker bee returns from the field after discovering a food source (or, in the course of swarming, a desirable new nest site) at some distance from the hive, she indicates the location of this target to her fellow workers by performing the waggle dance. The pattern of her movement is a figure eight repeated over and over again in the midst of crowds of sister workers. The most distinctive and informative element of the dance is the straight run (the middle of the figure eight), which is given a particular emphasis by a rapid lateral vibration of the body (the waggle) that is greatest at the tip of the abdomen and least marked at the head.

The complete back-and-forth shake of the body is performed 13 to 15 times per second. At the same time the bee emits an audible buzzing sound by vibrating its wings. The straight run represents, quite simply, a miniaturized version of the flight from the hive to the target. It points directly at the target if the bee is dancing outside the hive on a horizontal surface. (The position of the sun with respect to the straight run provides the required orientation.) If the bee is on a vertical surface inside the darkened hive, the straight run points at the appropriate angle away from the vertical, so that gravity temporarily replaces the sun as the orientation cue.

The straight run also provides information on the distance of the target from the hive, by means of the following additional parameter: the farther away the goal lies, the longer the straight run lasts. In the Carniolan race of the honeybee a straight run lasting a second indicates a target about 500 meters away, and a run lasting two seconds indicates a target two kilometers away. During the dance the follower bees extend their antennae and touch the dancer repeatedly. Within minutes some begin to leave the nest and fly to the target. Their searching is respectably accurate: the great majority come down to search close to the ground within 20 percent of the correct distance.

Superficially the waggle dance of the honeybee may seem to possess some of the more advanced properties of human language. Symbolism occurs in the form of the ritualized straight run, and the communicator can generate new messages at will by means of the symbolism. Furthermore, the target is "spoken of" abstractly: it is an object removed in time and space. Nevertheless, the waggle dance, like all other forms of nonhuman communication studied so far, is severely limited in comparison with the verbal language of human beings. The straight run is after all just a reenactment of the flight the bees will take, complete with wing-buzzing to represent the actual motor activity required. The separate messages are not devised arbitrarily. The rules they follow are genetically fixed and always designate, with a one-to-one correspondence, a certain direction and distance.

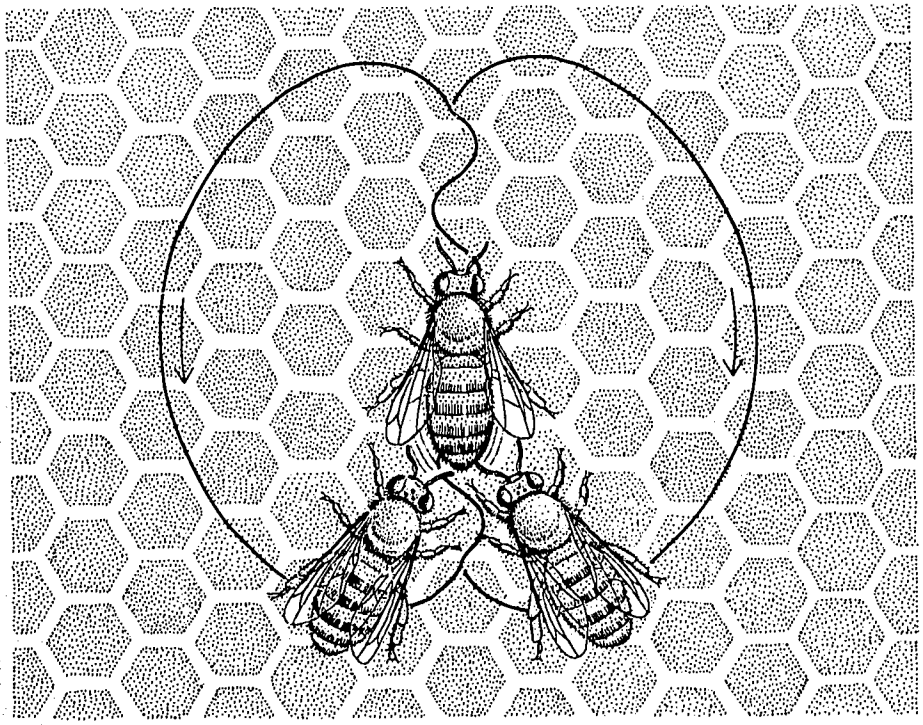
In other words, the messages cannot be manipulated to provide new classes of information. Moreover, within this

rigid context the messages are far from being infinitely divisible. Because of errors both in the dance and in the subsequent searches by the followers, only about three bits of information are transmitted with respect to distance and four bits with respect to direction. This is the equivalent of a human communication system in which distance would be gauged on a scale with eight divisions and direction would be defined in terms of a compass with 16 points. Northeast could be distinguished from north by northeast, or west from west by southwest, but no more refined indication of direction would be possible.

The waggle dance, in particular the duration of the straight run denoting distance, illustrates a simple principle that operates through much of animal communication: the greater the magnitude to be communicated, the more intense and prolonged the signal given. This graduated (or analogue) form of communication is perhaps most strikingly developed in aggressive displays among animals. In the rhesus monkey, for example, a low-intensity aggressive display is a simple stare. The hard look a human receives when he approaches a caged rhesus is not so much a sign of curiosity as it is a cautious display of hostility.

Rhesus monkeys in the wild frequently threaten one another not only with stares but also with additional displays on an ascending scale of intensity. To the human observer these displays are increasingly obvious in their meaning. The new components are added one by one or in combination: the mouth opens, the head bobs up and down, characteristic sounds are uttered and the hands slap the ground. By the time the monkey combines all these components, and perhaps begins to make little forward lunges as well, it is likely to carry through with an actual attack. Its opponent responds either by retreating or by escalating its own displays. These hostile exchanges play a key role in maintaining dominance relationships in the rhesus society.

Birds often indicate hostility by ruffling their feathers or spreading their wings, which creates the temporary illusion that they are larger than they really are. Many fishes achieve the same deception by spreading their fins or extending their gill covers. Lizards raise their crest, lower their dewlaps or flatten the sides of their body to give an impression of greater depth. In short, the more hostile the animal, the more likely it is to attack and the bigger it seems to become. Such exhibitions are often accompanied by graded changes both in color and in vocalization, and even by the release of characteristic odors.



WAGGLE DANCE of the honeybee, first decoded by Karl von Frisch in 1945, is performed by a foraging worker bee on its return to the hive after the discovery of a food source. The pattern of the dance is a repeated figure eight. During the straight run in the middle of the figure the forager waggles its abdomen rapidly and vibrates its wings. As is shown in the illustrations on the opposite page, the direction of the straight run indicates the line of flight to the food source. The duration of the straight run shows workers how far to fly.

The communication systems of insects, of other invertebrates and of the lower vertebrates (such as fishes and amphibians) are characteristically stereotyped. This means that for each signal there is only one response or very few responses, that each response can be evoked by only a very limited number of signals and that the signaling behavior and the responses are nearly constant throughout entire populations of the same species. An extreme example of this rule is seen in the phenomenon of chemical sex attraction in moths. The female silkworm moth draws males to her by emitting minute quantities of a complex alcohol from glands at the tip of her abdomen. The secretion is called bombykol (from the name of the moth, *Bombyx mori*), and its chemical structure is *trans*-10-*cis*-12-hexadecadienol.

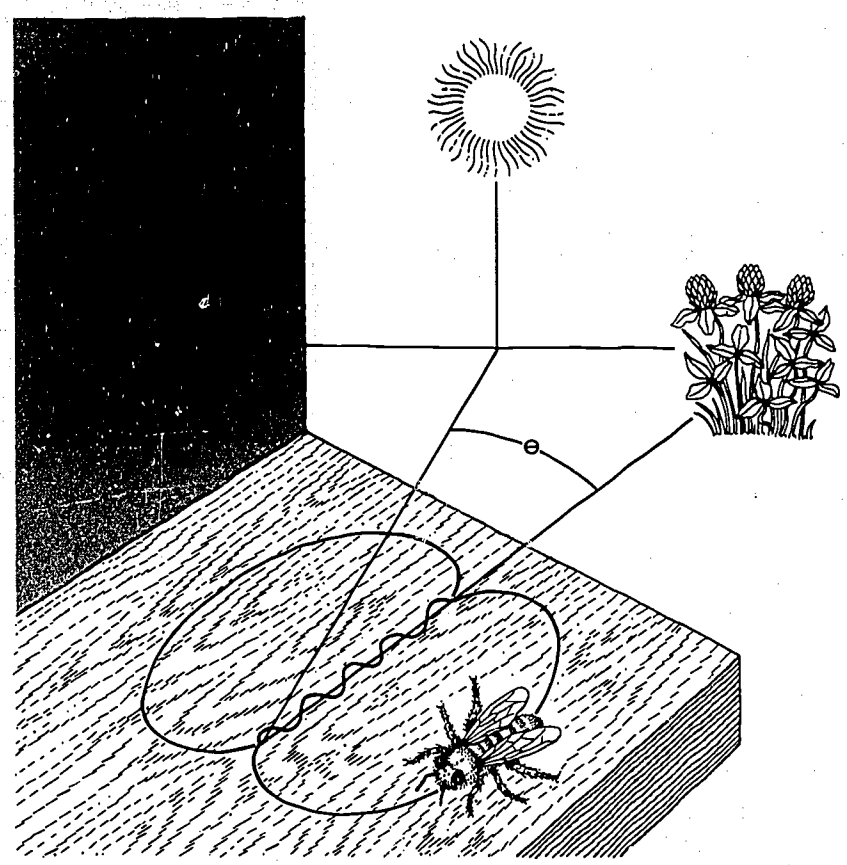
Bombykol is a remarkably powerful biological agent. According to estimates made by Dietrich Schneider and his coworkers at the Max Planck Institute for Comparative Physiology at Seewiesen in Germany, the male silkworm moths start searching for the females when they are immersed in as few as 14,000 molecules of bombykol per cubic centimeter of air. The male catches the molecules on some 10,000 distinctive sensory hairs on each of its two feathery antennae. Each hair is innervated by one or two receptor cells that lead inward to the main antennal nerve and ultimately through connecting nerve cells to centers in the brain. The extraordinary fact that emerged from the study by the Seewiesen group is that only a single molecule of bombykol is required to activate a receptor cell. Furthermore, the cell will respond to virtually no stimulus other than molecules of bombykol. When about 200 cells in each antenna are activated, the male moth starts its motor response. Tightly bound by this extreme signal specificity, the male performs as little more than a sexual guided missile, programmed to home on an increasing gradient of bombykol centered on the tip of the female's abdomen—the principal goal of the male's adult life.

Such highly stereotyped communication systems are particularly important in evolutionary theory because of the possible role the systems play in the origin of new species. Conceivably one small change in the sex-attractant molecule induced by a genetic mutation, together with a corresponding change in the antennal receptor cell, could result in the creation of a population of individuals that would be reproductively isolated from the parental stock. Persuasive

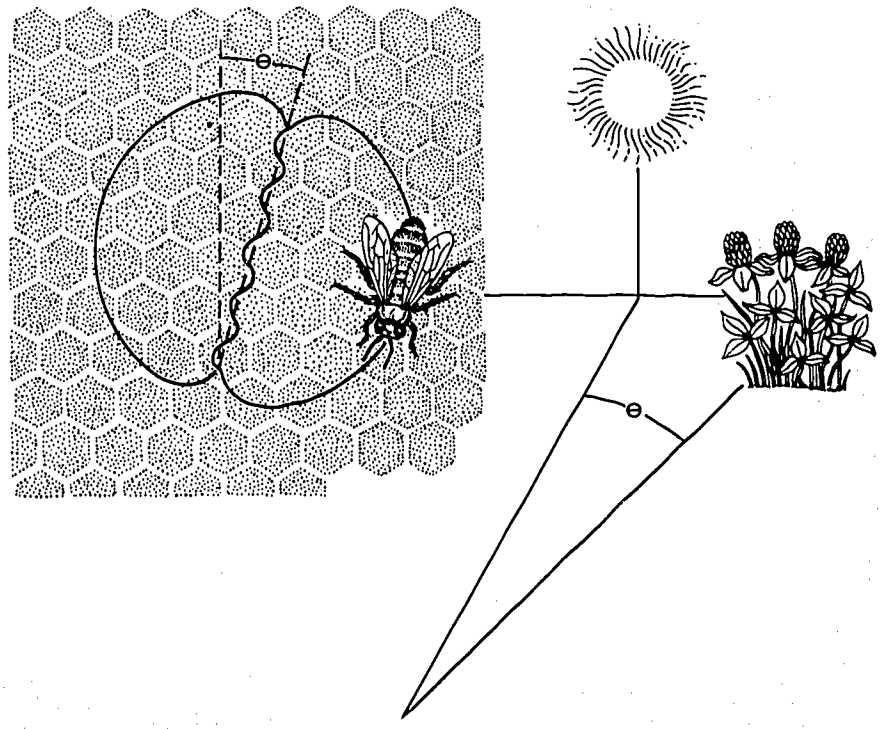
evidence for the feasibility of such a mutational change has recently been adduced by Wendell L. Roelofs and Andre Comeau of Cornell University. They found two closely related species of moths (members of the genus *Bryotopha* in the family Gelechiidae) whose females' sex attractants differ only by the configuration of a single carbon atom adjacent to a double bond. In other words, the attractants are simply different geometric isomers. Field tests showed not only that a *Bryotopha* male responds solely to the isomer of its own species but also that its response is inhibited if some of the other species' isomer is also present.

A qualitatively different kind of specificity is encountered among birds and mammals. Unlike the insects, many of these higher vertebrates are able to distinguish one another as individuals on the basis of idiosyncrasies in the way they deliver signals. Indigo buntings and certain other songbirds learn to discriminate the territorial calls of their neighbors from those of strangers that occupy territories farther away. When a recording of the song of a neighbor is played near them, they show no unusual reactions, but a recording of a stranger's song elicits an agitated aggressive response.

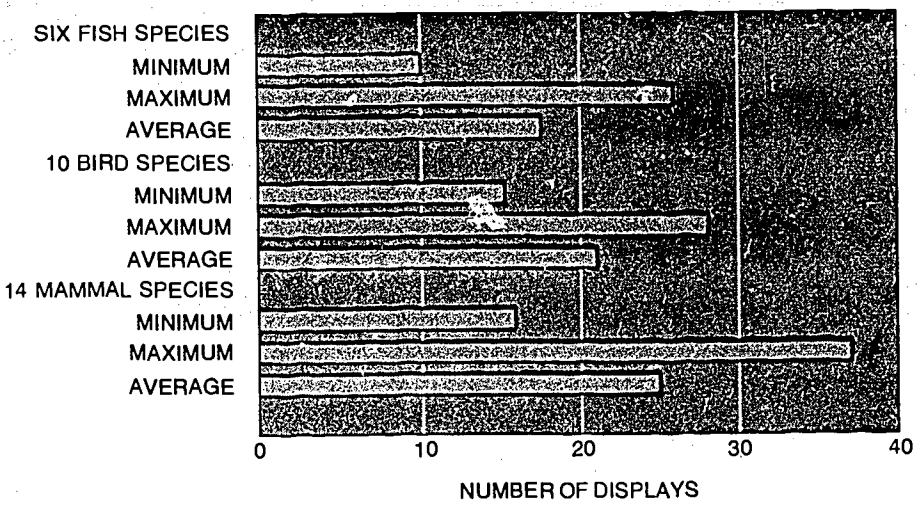
Families of seabirds depend on a similar capacity for recognition to keep together as a unit in the large, clamorous colonies where they nest. Beat Tschanz of the University of Bern has demonstrated that the young of the common murre (*Uria aalge*), a large auk, learn to react selectively to the call of their parents in the first few days of their life and that the parents also quickly learn to distinguish their own young. There is some evidence that the young murres can even learn certain aspects of the adult calls while they are still in the egg. An equally striking phenomenon is the intercommunication between African shrikes (of the genus *Laniarius*) recently analyzed by W. H. Thorpe of the University of Cambridge. Mated pairs of these birds keep in contact by calling antiphonally back and forth, the first bird vocalizing one or more notes and its mate instantly responding with a variation of the first call. So fast is the exchange, sometimes taking no more than a fraction of a second, that unless an observer stands between the two birds he does not realize that more than one bird is singing. In at least one of the species, the boubou shrike (*Laniarius aethiopicus*), the members of the pair learn to sing duets with each other. They work out combinations of phrases that are sufficiently individual



DANCING OUTSIDE THE HIVE on a horizontal surface, the forager makes the straight run of its waggle dance point directly at the source of food. In this illustration the food is located some 20 degrees to the right of the sun. The forager's fellow workers maintain the same orientation with respect to the sun as they leave for the reported source of food.



DANCING INSIDE THE HIVE on the vertical face of the honeycomb, the forager uses gravity for orientation. The straight line of the waggle dance that shows the line of flight to the source of food is oriented some 20 degrees away from the vertical. On leaving the hive, the bee's fellow workers relate the indicated orientation angle to the position of the sun.



COMMUNICATIVE DISPLAYS used by 30 species of vertebrate animals whose "languages" have been studied vary widely within each of the classes of animals represented: fishes, birds and mammals. The average differences between the classes, however, are comparatively small. The largest and smallest number of displays within each class and the average for each class are shown in this graph. Six of the fish species that have been studied use an average of some 17 displays, compared with an average of 21 displays used by 10 species of birds and an average of 25 displays among 14 species of mammals. Martin H. Moynihan of the Smithsonian Institution compiled the display data. The 30 vertebrates and the number of displays that each uses are illustrated on the opposite page and on page 58.

to enable them to recognize each other even though both are invisible in the dense vegetation the species normally inhabits.

Mammals are at least equally adept at discriminating among individuals of their own kind. A wide range of cues are employed by different species to distinguish mates, offspring and in the case of social mammals the subordinate or dominant rank of the peers ranged around them. In some species special secretions are employed to impart a personal odor signature to part of the environment or to other members in the social group. As all dog owners know, their pet urinates at regular locations within its territory at a rate that seems to exceed physiological needs. What is less well appreciated is the communicative function this compulsive behavior serves: a scent included in the urine identifies the animal and announces its presence to potential intruders of the same species.

Males of the sugar glider (*Petaurus breviceps*), a New Guinea marsupial with a striking but superficial resemblance to the flying squirrel, go even further. They mark their mate with a secretion from a gland on the front of their head. Other secretions originating in glands on the male's feet, on its chest and near its arms, together with its saliva, are used to mark its territory. In both instances the odors are distinctive enough for the male to distinguish them from those of other sugar gliders.

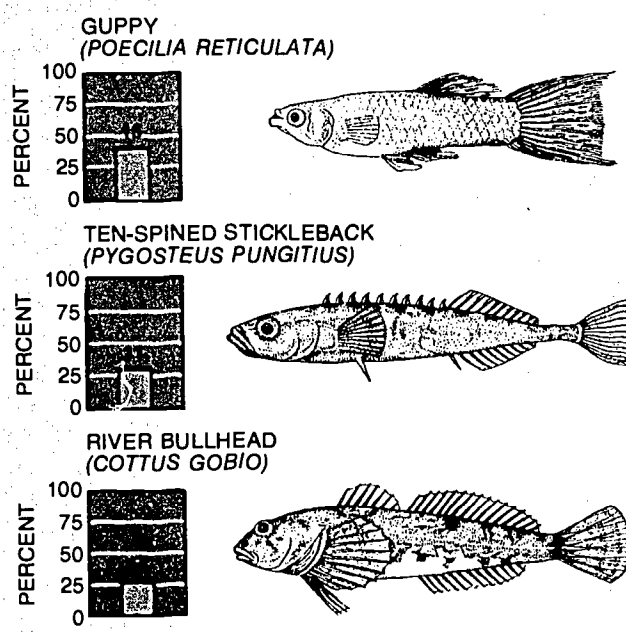
As a rule we find that the more highly social the mammal is, the more complex the communication codes are and the more the codes are utilized in establishing and maintaining individual relationships. It is no doubt significant that one of the rare examples of persistent individual recognition among the lower animals is the colony odor of the social insects: ants and termites and certain social bees and wasps. Even here, however, it is the colony as a whole that is recognized. The separate members of the colony respond automatically to certain caste distinctions, but they do not ordinarily learn to discriminate among their nestmates as individuals.

By human standards the number of signals employed by each species of animal is severely limited. One of the most curious facts revealed by recent field studies is that even the most highly social vertebrates rarely have more than 30 or 35 separate displays in their entire repertory. Data compiled by Martin H. Moynihan of the Smithsonian Institution indicate that among most vertebrates the number of displays varies by a factor of only three or four from species to species. The number ranges from a minimum of 10 in certain fishes to a maximum of 37 in the rhesus monkey, one of the primates closest to man in the complexity of their social organization. The full significance of this rule of relative inflexibility is not yet clear. It may be that the maximum number of messages any animal needs in order to be fully adaptive in any ordinary environment, even a social one, is no more than 30 or 40. Or it may be, as Moynihan has suggested, that each number represents the largest amount of signal diversity the particular animal's brain can handle efficiently in quickly changing social interactions.

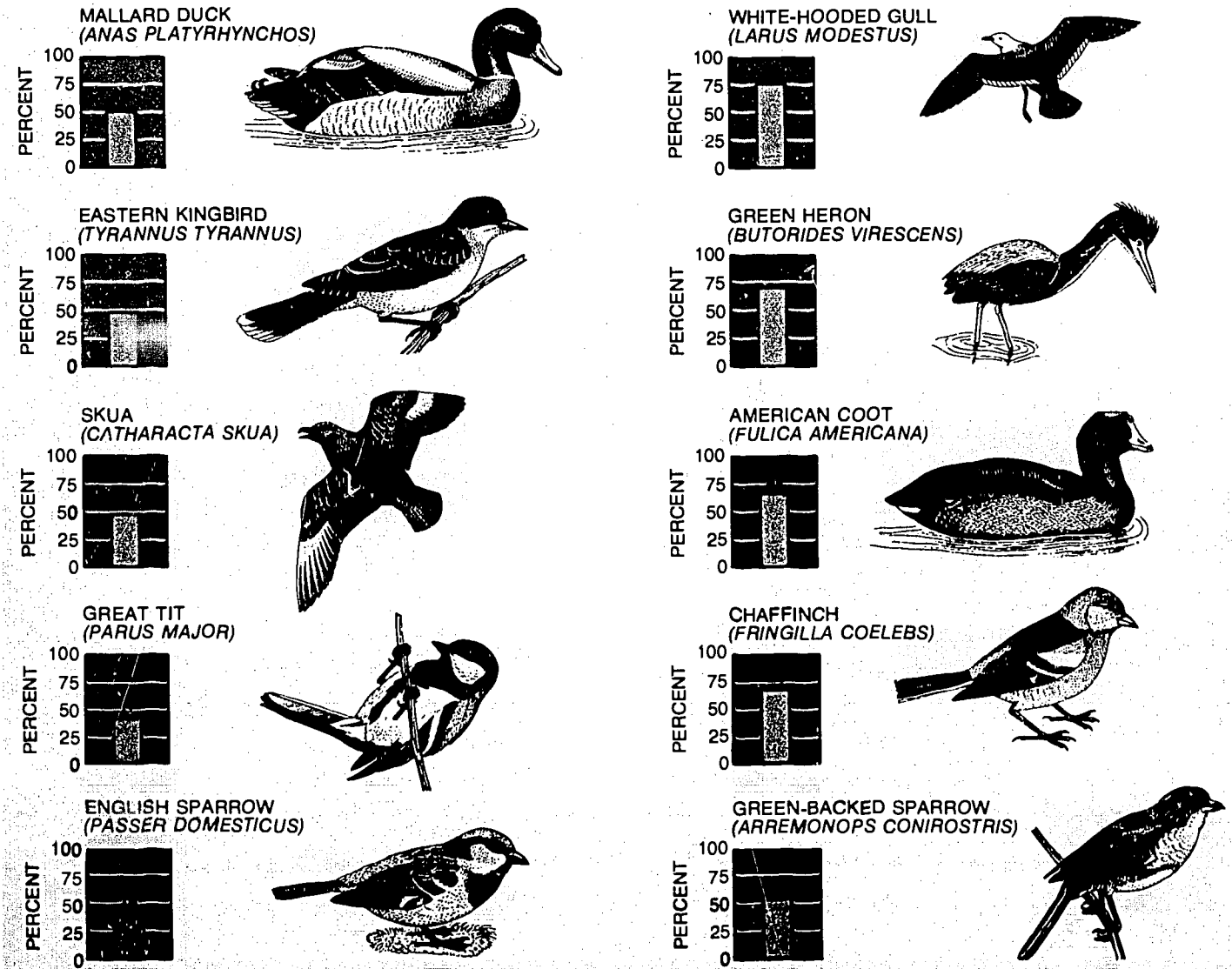
In the extent of their signal diversity the vertebrates are closely approached by social insects, particularly honeybees and ants. Analyses by Charles G. Butler at the Rothamsted Experimental Station in England, by me at Harvard University and by others have brought the number of individual known signal categories within single species of these insects to between 10 and 20. The honeybee has been the most thoroughly studied of all the social insects. Apart from the waggle dance its known communicative acts are mediated primarily by pheromones: chemical compounds transmitted to other members of the same species as signals. The glandular sources of these and other socially important substances are now largely established. Other honeybee signals include the distinctive colony odor mentioned above, tactile cues involved in food exchange and several dances that are different in form and function from the waggle dance.

Of the known honeybee pheromones the "queen substances" are outstanding in the complexity and pervasiveness of their role in social organization. They include *trans*-9-keto-2-decenoic acid, which is released from the queen's mandibular glands and evokes at least three separate effects according to the context of its presentation. The pheromone is spread through the colony when workers lick the queen's body and regurgitate the material back and forth to one another. For the substance to be effective in the colony as a whole the queen must dispense enough for each worker bee to receive approximately a tenth of a microgram per day.

The first effect of the ketodecenoic acid is to keep workers from rearing larvae in a way that would result in their becoming new queens, thus preventing the creation of potential rivals to the mother queen. The second effect is that when the worker bees eat the substance, their own ovaries fail to develop; they cannot lay eggs and as a result they too are eliminated as potential rivals. Indirect evidence indicates that ingestion of the substance affects the corpora allata, the endocrine glands that partly control the development of the ovaries, but the exact chain of events remains to be worked out. The third effect of the pheromone is that it acts as a sex attractant. When a virgin queen flies from

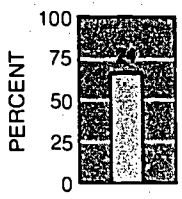


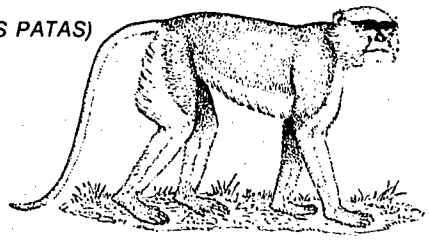
DISPLAYS BY FISHES range from a minimum of 10, used by the river bullhead (*bottom left*), to a maximum of 26, used by the badis (*top right*). The badis repertory is thus more extensive than those of eight of the 10 birds and nine of the 14 mammals studied. The bar beside each fish expresses the number of its displays in percent; 37 displays, the maximum in the study, equal 100 percent.



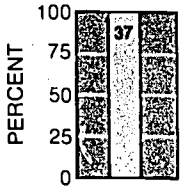
DISPLAYS BY BIRDS range from a minimum of 15, used by the English sparrow (*bottom left*), to a maximum of 28, used by the white-headed gull (*top right*). The maximum repertory among birds thus proves to be little greater than the fishes' maximum.

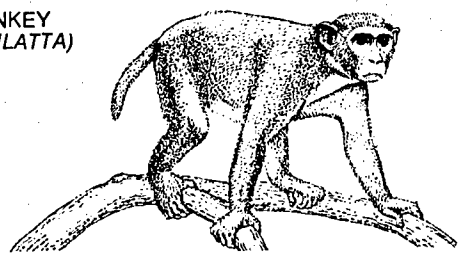
PATAS MONKEY
(ERYTHROCEBUS PATAS)



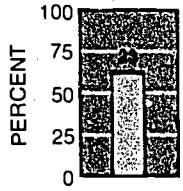


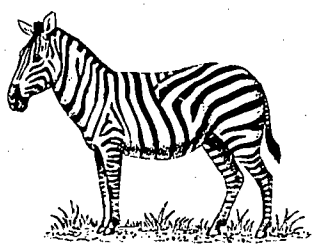
RHESUS MONKEY
(MACACA MULATTA)



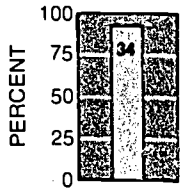


PLAINS ZEBRA
(EQUUS QUAGGA)

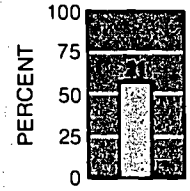


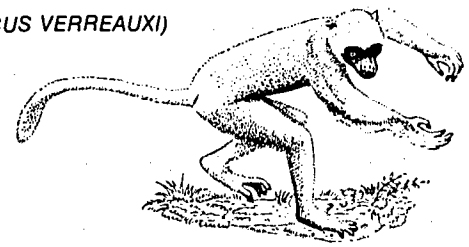


RING-TAILED LEMUR
(LEMUR CATTA)

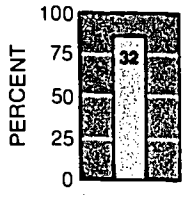


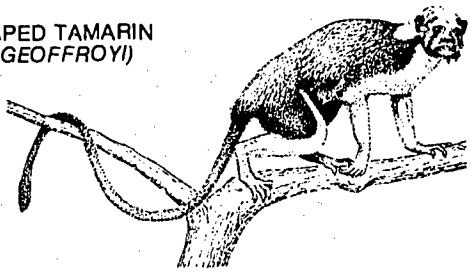
SIFAKA
(PROPITHECUS VERREAUXI)



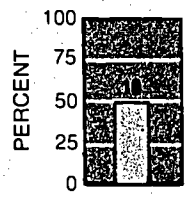


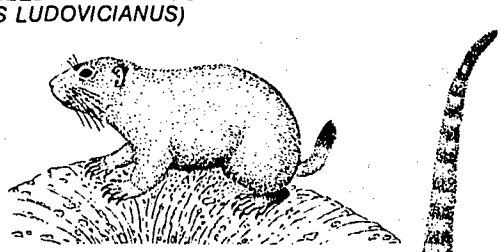
RUFOUS-NAPED TAMARIN
(SAGUINUS GEOFFROYI)



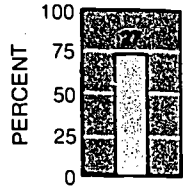


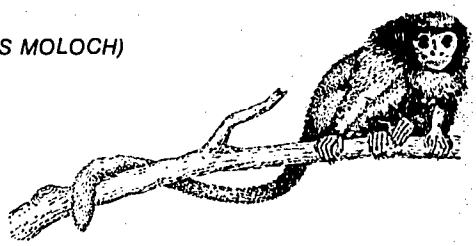
BLACK-TAILED PRAIRIE DOG
(CYNOMYS LUDOVICIANUS)



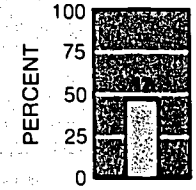


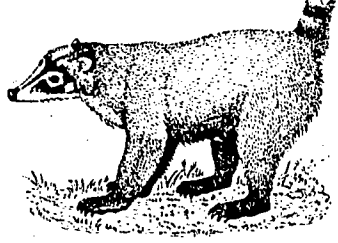
DUSKY TITI
(CALLICEBUS MOLOCH)



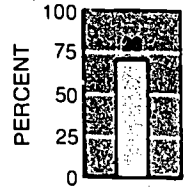


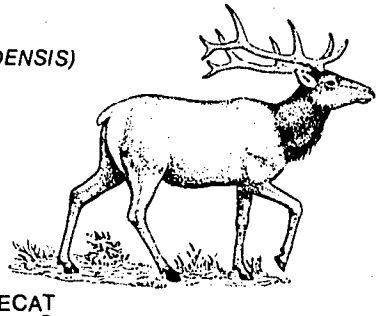
COATI
(NASUA NARICA)



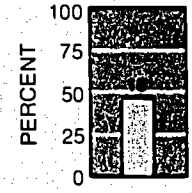


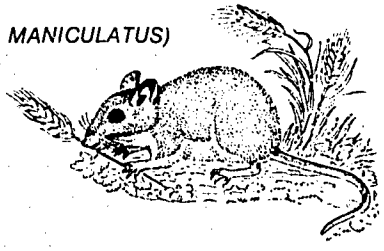
ELK
(CERVUS CANADENSIS)



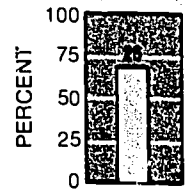


DEER MOUSE
(PEROMYSCUS MANICULATUS)

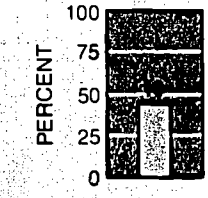


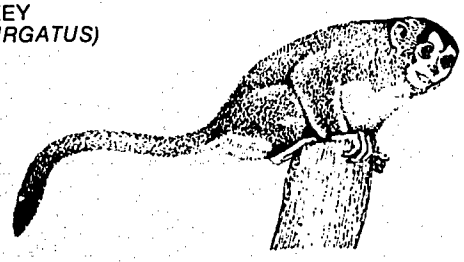


EUROPEAN POLECAT
(MUSTELA PUTORIUS)

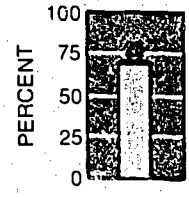


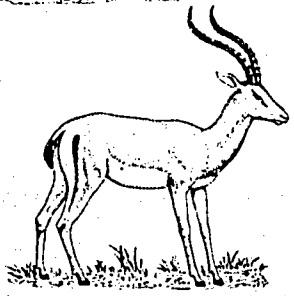
NIGHT MONKEY
(AOTUS TRIVIRGATUS)





GRANT'S GAZELLE
(GAZELLA GRANTI)





DISPLAYS BY MAMMALS range from a minimum of 16, used both by the deer mouse and by the night monkey (*left, bottom and next to bottom*), to a maximum of 37, used by the rhesus monkey (*top right*). Two other primates rank next in number of displays.

the hive on her nuptial flight, she releases a vapor trail of the ketodecenoic acid in the air. The smell of the substance not only attracts drones to the queen but also induces them to copulate with her.

Where do such communication codes come from in the first pl[illegible] comparing the signaling beha[illegible] closely related species zoologists [illegible] often able to piece together the sequence of evolutionary steps that leads to even the most bizarre communication systems. The evolutionary process by which a behavior pattern becomes increasingly effective as a signal is called "ritualization." Commonly, and perhaps invariably, the process begins when some movement, some anatomical feature or some physiological trait that is functional in quite another context acquires a secondary value as a signal. For example, one can begin by recognizing an open mouth as a threat or by interpreting the turning away of the body in the midst of conflict as an intention to flee. During ritualization such movements are altered in some way that makes their communicative function still more effective. In extreme cases the new behavior pattern may be so modified from its ancestral state that its evolutionary history is all but impossible to imagine. Like the epaulets, shako plumes and piping that garnish military dress uniforms, the practical functions that originally existed have long since been obliterated in order to maximize efficiency in display.

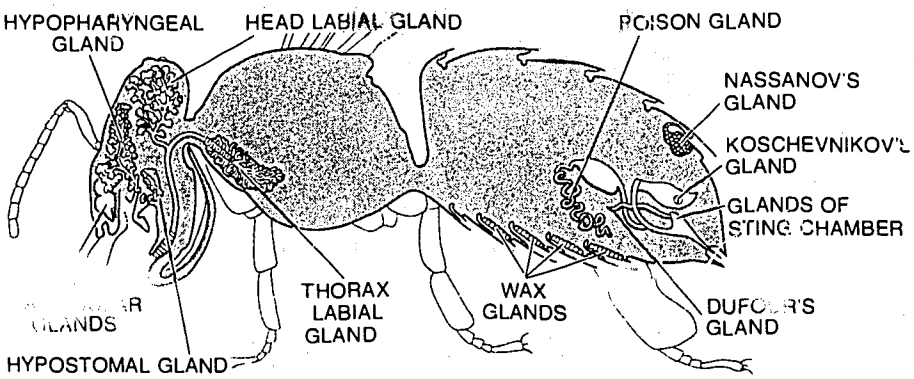
The ritualization of vertebrate behavior commonly begins in circumstances of conflict, particularly when an animal is undecided whether or not to complete an act. Hesitation in behavior communicates the animal's state of mind—or, to be more precise, its probable future course of action—to onlooking members of the same species. The advertisement may begin its evolution as a simple intention movement. Birds intending to fly, for example, typically crouch, raise their tail and spread their wings slightly just before taking off. Many species have ritualized these movements into effective signals. In some species white rump feathers produce a conspicuous flash when the tail is raised. In other species the wing tips are flicked repeatedly downward, uncovering conspicuous areas on the primary feathers of the wings. The signals serve to coordinate the movement of flock members, and also may warn of approaching predators.

Signals also evolve from the ambivalence created by the conflict between two or more behavioral tendencies. When a male faces an opponent, unable to decide whether to attack or to flee, or approaches a potential mate with strong tendencies both to threaten and to court, he may at first make neither choice. Instead he performs a third, seemingly irrelevant act. The aggression is redirected at a meaningless object nearby, such as a pebble, a blade of grass or a bystander that serves as a scapegoat. Or the animal may abruptly commence a "displacement" activity: a behavior pattern with no relevance whatever to the circumstance in which the animal finds itself. The animal may preen, start ineffectual nest-building movements or pantomime feeding or drinking.

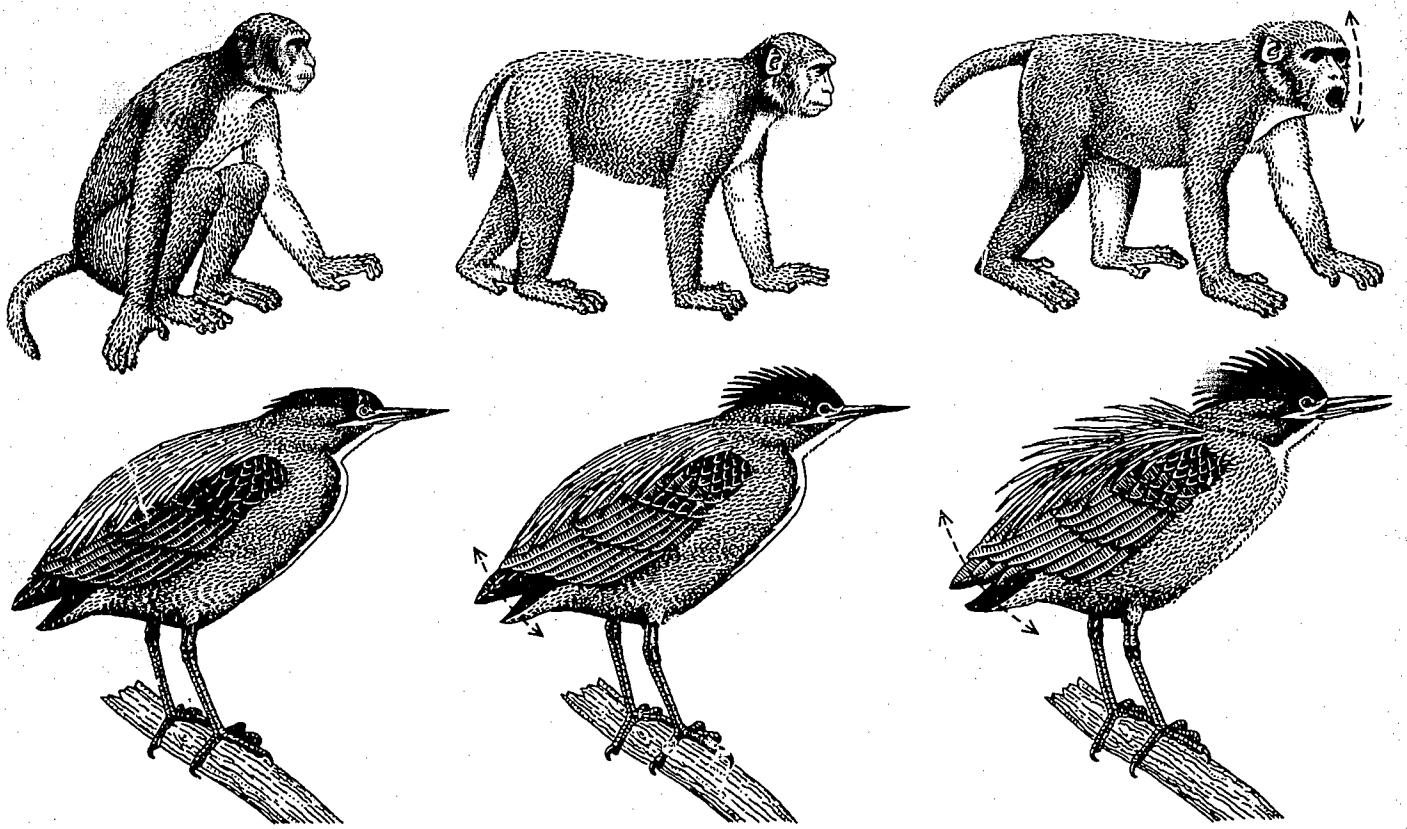
Such redirected and displacement activities have often been ritualized into strikingly clear signals. Two classic examples involve the formation of a pair bond between courting grebes. They were among the first such signals to be recognized; Julian Huxley, the originator of the concept of ritualization, analyzed the behavior among European great crested grebes in 1914. The first ritual is "mutual headshaking." It is apparently derived from more elementary movements, aimed at reducing hostility, wherein each bird simply directs its bill away from its partner. The second ritual, called by Huxley the "penguin dance," includes headshaking, diving and the mutual presentation by each partner to its mate of the waterweeds that serve as nesting material. The collection and presentation of the waterweeds may have evolved from displacement nesting behavior initially produced by the conflict between hostility and sexuality.

A perhaps even more instructive example of how ritualization proceeds is provided by the courtship behavior of the "dance flies." These insects include a large number of carnivorous species of dipterans that entomologists classify together as the family Empididae. Many of the species engage in a kind of courtship that consists in a simple approach by the male; this approach is followed by copulation. Among other species the male first captures an insect of the kind that normally falls prey to empids and presents it to the female before copulation. This act appears to reduce the chances of the male himself becoming a victim of the predatory impulses of the female. In other species the male fastens threads or globules of silk to the freshly captured offering, rendering it more distinctive in appearance, a clear step in the direction of ritualization.

Increasing degrees of ritualization can be observed among still other species of dance flies. In one of these species the male totally encloses the dead prey in a sheet of silk. In another the size of the offered prey is smaller but its silken covering remains as large as before: it is now a partly empty "balloon." The male of another species does not bother to capture any prey object but simply offers the female an empty balloon. The last display is so far removed from the original behavior pattern that its evolutionary origin in this empid species might have remained a permanent mystery if biolo-



PHEROMONES OF THE HONEYBEE are produced by the glands shown in this cutaway figure of a worker. The glands perform different functions in different castes. In workers, for example, the secretion of the mandibular glands serves as an alarm signal. In a queen, however, the mandibular secretion that is spread through the colony as a result of grooming inhibits workers from raising new queens and also prevents workers from becoming egg-layers. It is also released as a vaporous sex attractant when the new queen leaves the hive on her nuptial flight. The "royal jelly" secreted by the hypopharyngeal gland serves as a food and also acts as a caste determinant. The labial glands of head and thorax secrete a substance utilized for grooming, cleaning and dissolving. Action of the hypostomal-gland secretion is unknown, as is the action of Dufour's gland. The wax glands yield nest-building material, the poison gland is for defense and the sting-chamber glands provide an alarm signal. The secretion of Nassanov's gland assists in assembling workers in conjunction with the waggle dance; that of Koschevnikov's gland renders queens attractive to workers.



AGGRESSIVE DISPLAYS by a rhesus monkey (*top*) and a green heron (*bottom*) illustrate a major principle of animal communication: the greater the magnitude to be communicated, the more prolonged and intense the signal is. In the rhesus what begins as a display of low intensity, a hard stare (*left*), is gradually escalated as the monkey rises to a standing position (*middle*) and then, with an open mouth, bobs its head up and down (*right*) and slaps the ground with its hands. If the opponent has not retreated by now, the monkey may actually attack. A similarly graduated aggressive display is characteristic of the green heron. At first (*middle*) the heron raises the feathers that form its crest and twitches the feathers of its tail. If the opponent does not retreat, the heron opens its beak, erects its crest fully, ruffles all its plumage to give the illusion of increased size and violently twitches its tail (*right*). Thus in both animals the likelier the attack, the more intense the aggressive display. Andrew J. Meyerriecks of the University of South Florida conducted the study of heron display and Stuart A. Altmann of the University of Chicago conducted the rhesus display study.

gists had not discovered what appears to be the full story of its development preserved step by step in the behavior of related species.

One of the most important and most difficult questions raised by behavioral biology can be phrased in the evolutionary terms just introduced as follows: Can we hope to trace the origin of human language back through intermediate steps in our fellow higher primates—our closest living relatives, the apes and monkeys—in the same way that entomologists have deduced the origin of the empty-balloon display among the dance flies? The answer would seem to be a very limited and qualified yes. The most probable links to investigate exist within human paralinguistics: the extensive array of facial expressions, body postures, hand signals and vocal tones and emphases that we use to supplement verbal speech. It might be possible to match some of these auxiliary signals with the more basic displays in apes and monkeys. J. A. R. A. M. van Hooff of the State University of Utrecht, for example, has argued persuasively that laughter originated from the primitive "relaxed open-mouth display" used by the higher primates to indicate their intention to participate in mock aggression or play (as distinct from the hostile open-mouth posture described earlier as a low-intensity threat display in the rhesus monkey). Smiling, on the other hand, van Hooff derives from the primitive "silent bared-teeth display," which denotes submission or at least nonhostility.

What about verbal speech? Chimpanzees taught from infancy by human trainers are reported to be able to master the use of human words. The words are represented in some instances by sign language and in others by metal-backed plastic symbols that are pushed about on a magnetized board. The chimpanzees are also capable of learning rudimentary rules of syntax and even of inventing short questions and statements of their own. Sarah, a chimpanzee trained with plastic symbols by David Premack at the University of California at Santa Barbara, acquired a vocabulary of 128 "words," including a different "name" for each of eight individuals, both human and chimpanzee, and other signs representative of 12 verbs, six colors, 21 foods and a rich variety of miscellaneous objects, concepts, adjectives and adverbs. Although Sarah's achievement is truly remarkable, an enormous gulf still separates this most intelligent of the anthropoid apes from man. Sarah's words are given to her, and she must use them in a rigid and artificial context. No chimpanzee has demonstrated anything close to the capacity and drive to experiment with language that is possessed by a normal human child.

The difference may be quantitative rather than qualitative, but at the very least our own species must still be ranked as unique in its capacity to concatenate a large vocabulary into sentences that touch on virtually every experience and thought. Future studies of animal communication should continue to prove useful in helping us to understand the steps that led man across such a vast linguistic chasm in what was surely the central event in the evolution of the human mind.

The Author

EDWARD O. WILSON is professor of zoology at Harvard University. He was graduated from the University of Alabama in 1949, obtaining his master's degree there in 1950 and his Ph.D. from Harvard in 1955. "My original schizoid approach to biology," he writes, "in which I kept programs going in the seemingly unrelated fields of population biology and behavior, has now been healed through the happy discovery, by several researchers independently, that much of social behavior can be more deeply explained by recourse to theoretical population biology. My book *The Insect Societies* was published by Harvard University Press last year; in 1971 I also published *A Primer of Population Biology*, a short self-teaching textbook, with my colleague William H. Bossert. Earlier (1967) I coauthored *The Theory of Island Biogeography* with Robert H. MacArthur. My research continues to center on ants, with emphasis on their biogeography and social behavior." *The Insect Societies* is reviewed in the September, 1972 issue; SCIENTIFIC AMERICAN (page 193).

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Comprehension Questions for "Animal Communication"

1. The author states that "With our own unique verbal system as a standard of reference, we can define the limits of animal communication in terms of the properties it rarely — or never — displays." What is the author claiming in this statement?

   Skill: Literal Comprehension, Including Recognition and Recall

   The author claims that animals communicate in similar ways to that communication found between people. However, human beings use language that displays a large and complex series of messages that go beyond the total meanings of the words themselves. Animal communication is possible within the outer reaches of understanding men are capable of generating. What animal communication is unable to parallel in human language gives animal communication its outer limits. (page 59)

2. Using the information given in the first paragraph, formulate a definition of human language.

   Skill: Text-Based Inferential Comprehension

   Human language is the sum total of the meanings of the individual words, set in phrases and sentences determined by culture, which generate simple and complex understandings between human beings. (page 59)

3. How is the waggle dance of the honeybee similar to human language?

   Skill: Text-Based Inferential Comprehension

   The dance, like verbal communication and gestures between human beings, points to a source of food, indicates distance to the source, its repeated "waggle" and duration thereof eliminate possible confusion among peers. The waggle dance taps prior learning among honeybees just as the use of human language would stimulate understandings brought about through prior word connotation/denotation learned culturally. (pages 59-61)

4. Describe the straight run aspect of the waggle dance in relationship to the distance of the target from the communicating honeybee.

   Skill: Literal Comprehension, Including Recognition and Recall

   During the straight run of the waggle dance, the honeybee is in the middle of its figure eight, wiggling its abdomen rapidly and vibrating its wings. The length of time the honeybee "waggles" shows workers how far to fly to food. For example, in the Carniolan race of the honeybee, a straight run lasting a second means the source target is about 500 meters away, while a run that lasts two seconds indicates a target to be two kilometers away. (pages 59-60)

5. Describe an animal movement in nature, other than one described in the article, that is analogous to human language.

   Skill: Reader-Based Inferential Comprehension

A simple example would be a domestic dog spotting a person or animal near its claimed territory. Immediately, an alarming bark followed by a chase to that invading creature may well bring a fellow pet dog to that same location.

6. Does the author give enough evidence to prove is claim? Give your reasons.

Skill: Critical Reading

Yes. First, the author states that animals follow similar communication patterns to those of human beings. Then he proceeds to chronicle the movements and understanding between like creatures. Mr. Wilson clearly shows and explains communication patterns used by insects, birds, fish, and mammals. Their communication codes and signaling behaviors range from a minimum of 10 (river bullhead) to a maximum of 37 (the rhesus monkey). Each behavior is unique, yet does directly reflect the experience, action, and thought found in human language. (Entire passage)

APPENDIX B. RECOMMENDATIONS OF THE BOARD OF GOVERNORS OF THE MATHEMATICAL ASSOCIATION OF AMERICA AND THE BOARD OF DIRECTORS OF THE NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

The Board of Governors of the Mathematical Association of America and the Board of Directors of the National Council of Teachers of Mathematics make the following recommendations:

1. Proficiency in mathematics cannot be acquired without individual practice. We, therefore, endorse the common practice of making regular assignments to be completed outside of class. We recommend that parents encourage their children to set aside sufficient time each day to complete these assignments and that parents actively support the request of the teachers that homework be turned in. Students should be encouraged to develop the ability to read mathematics.

2. Homework and drill are very important pedagogical tools used to help the students gain understanding as well as proficiency in the skills of arithmetic and algebra; but students should not be burdened with excessive or meaningless drill. We, therefore, recommend that teachers and authors of textbooks step up their search for interesting problems that provide the opportunity to apply these skills. We realize that this is a difficult task, but we believe that providing problems that reinforce manipulative skills as a byproduct should have high priority, especially those that show that mathematics helps solve problems in the real world.

3. We are aware that teachers must struggle to maintain standards of performance in courses at all levels from kindergarten through college and that serious grade inflation has been observed. An apparent growing trend to reward effort or attendance rather than achievement has been making it increasingly difficult for mathematics teachers to maintain standards. We recommend that mathematics departments review evaluation procedures to ensure that grades reflect student achievement. Further, we urge administrators to support teachers in this endeavor.

4. In light of 3 above, we also recognize that advancement of students without appropriate achievement has a detrimental effect on the individual student and on the entire class. We, therefore, recommend that school districts make special provisions to assist students when deficiencies are first noted.

5. We recommend that cumulative evaluations be given throughout each course, as well as at its completion to all students. We believe that the absence of cumulative evaluation promotes short-term learning. We strongly oppose the practice of exempting students from evaluations.

6. We recommend that computers and hand calculators be used in imaginative ways to reinforce learning and to motivate the student as proficiency in mathematics is gained. Calculators should be used to supplement rather than to supplant the study of necessary computational skills.

7. We recommend that colleges and universities administer placement examinations in mathematics prior to final registration to aid students in selecting appropriate college courses.

8. We encourage the continuation or initiation of joint meetings of colleges and secondary school mathematics instructors and counselors in order to improve communication concerning mathematics prerequisites for careers, preparation of students for collegiate mathematics courses, joint curriculum coordination, remedial programs in schools and colleges, and exchange of successful instructional strategies, planning of in-service programs, and other related topics.

9. Schools should frequently review their mathematics curricula to see that they meet the needs of their students in preparing them for college mathematics. School districts that have not conducted a curriculum analysis recently should do so now, primarily to identify topics in the curriculum which could be either omitted or de-emphasized, if necessary, in order to provide sufficient time for the topics included in the above statement. We suggest that, for example, the following could be de-emphasized or omitted if now in the curriculum:

(A) logarithmic calculations that can better be handled by calculators or computers,

(B) extensive solving of triangles in trigonometry,

(C) proofs of superfluous or trivial theorems in geometry.

10. We recommend that algebraic concepts and skills be incorporated whenever possible into geometry and other courses beyond algebra to help students retain these concepts and skills.

APPENDIX C. CHAIRMAN'S SUMMARY, RECOMMENDATIONS FROM "SCHOOL MATHEMATICS: OPTIONS FOR THE 1990s," MADISON, WISCONSIN, DECEMBER 5-8, 1983

A requirement of the conference participants was to consider evidence of the need to improve school mathematics, to develop recommendations about the nature of the needed changes, and to prepare strategies or next steps for accomplishing these changes. Participants studied the recommendations made during the past two years by the many commissions and groups critical of current practices and provided additional evidence and recommendations of their own.

Serious problems exist with respect to the opportunity most students have to learn the mathematical concepts and skills they need for college, for future employment, and for responsible citizenship. The consensus of the participants was that more than marginal improvement is needed. Sharp improvement in the nature of reform is needed, and the mathematics education community should play its part in defining the shape of school mathematics for the 1990s. The primary concerns addressed at the meeting were that most students need to learn more, and often different, mathematical topics in school and that the teaching of mathematics can be and must be significantly improved.

To provide all students with an opportunity to learn the mathematics they will need, the topics and emphases of current courses should be changed, new courses should be developed, and students should be required to enroll in more courses. To assist schools in making these changes, new curriculum materials and instructional strategies must be developed. In particular, these materials should require the use of calculators and computers when appropriate, reduce the amount of time spent on elementary arithmetic skills instruction, and add many new topics now deemed important in data collection and summarization, in statistics, and in discrete mathematics. Three recommendations for action designed to assist in the development of critically needed new materials are:

RECOMMENDATION 1: A task force should be organized to propose guidelines for a K-8 mathematics curriculum.

RECOMMENDATION 2: A task force should be organized to propose guidelines for a 7-14 mathematics curriculum.

RECOMMENDATION 3: A task force should be organized to propose standards for computer courseware so that they are compatible with the curriculum guidelines.

The second area of concern was the current average quality of classroom teaching. We find that too few teachers are qualified to teach mathematics. We believe that the current conditions for teaching in which too many teachers are underprepared, are isolated in their own classrooms, are overworked and unsupported make it impossible to remedy the quality of teaching without changing the existing staffing pattern. We therefore recommend:

RECOMMENDATION 4: In elementary schools, specialist teachers of mathematics should teach all mathematics beginning no later than grade 4 and supervise mathematics instruction at earlier grade levels.

RECOMMENDATION 5: In secondary schools, master teachers of mathematics should teach or supervise all mathematics instruction.

RECOMMENDATION 6: A task force should be organized to propose certification standards for both elementary school specialist teachers of mathematics and secondary school master teachers of mathematics.

The intent of this group of six recommendations is to assure better prepared teachers working in a more professional environment instructing students with new curricular materials. As conference participants considered how best to realize this intent, related concerns arose about teacher education and about the relevance and use of research-based knowledge in teaching and learning mathematics. The following recommendations were developed to address these concerns.

RECOMMENDATION 7: A task force should be organized to prepare model programs for the preservice and inservice education of all mathematics teachers K-12.

RECOMMENDATION 8: Research on the learning and teaching of mathematics should be actively encouraged, and research-based knowledge should be incorporated into recommended guidelines and standards.

These eight recommendations require persons or groups carrying them out. Conference participants agreed that substantial improvement requires conviction and action at the local school level, assisted by national coordination and leadership. Two final recommendations reflect this view:

RECOMMENDATION 9: In each school or school district, a school mathematics committee should use the curriculum guidelines and staffing recommendations to outline the curriculum and provide support for the mathematics program.

RECOMMENDATION 10: Professional organizations concerned with mathematics education should establish a continuing national steering committee for mathematics education to survey efforts of federal, state, and local agencies to reform school mathematics and to report on progress of the reform effort.

These ten recommendations are the steps that must be taken to assure necessary reform of school mathematics. There are barriers to the implementation of these recommendations that are discussed in the body of this report. But, with commitment, hard work, adequate resources, and the leadership of the mathematics education community, all students will have the opportunity they deserve to learn the mathematics we judge necessary for the 1990s.