of homology have not stimulated anatomical research to any noticeable degree (*6, 10*); indeed, the idea largely disintegrated when faced with the results of experimental morphology (*9*). Some of the defenders of the primacy of homology corroborated rather than refuted this fact (*8*).

In view of the sterility of an anatomy interested only in the historical aspects of structure, it would seem worth while to examine the potentialities inherent in the study of that neglected concept, analogy, *i.e.* the functional correspondence of organs.

The study of analogy offers a wide perspective, inasmuch as it permits the analysis of structures as they represent solutions of functional problems. Böker (*2*) has demonstrated how fruitful this approach is, although he restricted his "Biological Anatomy" to the vertebrates. Actually, the field is much larger, for without the dominating presence of the concept of homology the barrier between vertebrates and invertebrates disappears. This barrier has been magnified out of proportion to its true significance and has rendered anatomy no service other than to limit the study of many problems to the vertebrates. But in spite of their great variety, animals with and without vertebrae are faced with basically similar functional problems—orientation in space, conservation of water, disposal of waste materials, to name only a few. The interest lies in discovering how many different fundamental structural solutions of the same problem have been "invented" by different organisms. The broader the basis on which such inquiries are conducted, the more valuable will be the insight gained with respect to the functional significance of anatomical structures.

The great promise of a reorientation of comparative anatomy along such lines is not hypothetical; it can easily be estimated by glancing through Meisenheimer's (*5*) monumental study of reproduction, Krogh's (*4*) analysis of the mechanisms of respiration, or Baldwin's (*1*) delightful essays on comparative biochemistry. It is difficult to see why this type of investigation should not come within the province of comparative anatomy, even if it is in one way or another based on the concept of analogy. The value of concepts is measured by their influence on research. By this standard the concept of analogy will probably not forever hold the subordinate place which is still assigned to it in comparative anatomy.

### References


1. BALDWIN, E. *An introduction to comparative biochemistry.* Cambridge, Engl.: Cambridge Univ. Press, 1937.
2. BÖKER, H. *Einführung in die vergleichende biologische Anatomie der Wirbeltiere.* Jena: Gustav Fischer, 1935, 1937; DAVIS, D. D. *Turtox News,* 1939, **17**, 93–96.
3. BOYDEN, A. *Quart. Rev. Biol.,* 1943, **18**, 228–241.
4. KROGH, A. *The comparative physiology of respiratory mechanisms.* Philadelphia: Univ. Pennsylvania Press, 1941.
5. MEISENHEIMER, J. *Geschlecht und Geschlechter.* Jena: Gustav Fischer, 1921, 1930.
6. NAEF, A. *Handb. vergl. Anat. Wirbelt.,* 1931, **1**, 77–118.
7. NOWIKOFF, M. *Anat. Anz.,* 1935, **80**, 388–392.
8. SÖDERSTRÖM, A. *Homologie, Homogenie und Homoplasie.* Upsala: 1925.
9. SPEMANN, H. Zur Geschichte und Kritik des Begriffs der Homologie. In *Die Kultur der Gegenwart,* Teil III, Abt. IV/1, Allg. Biol., 1915, 63–86.
10. WESTENBERG, J. *Acta biotheor.,* 1938–39, **4**, 33–50.


# Universal Military Service in Peacetime

## A Statement by the American Mathematical Society and the Mathematical Association of America

THE WAR POLICY COMMITTEE of the two mathematical organizations was formed to study the many questions of professional and scientific policy arising out of the war. No subject has been of greater interest or more vital concern to the Committee than the relations between scientific effectiveness, on the one hand, and the military requirements of the Nation, on the other. A most important aspect of this subject is treated in the report on "Universal Military Service in Peacetime," recently made public. This report is directed in the main at points upon which mathematicians, as such, are particularly qualified to express informed opinions. Whatever view may ultimately prevail—and it should be emphasized that there are many citizens, mathematicians included, who doubt the wisdom of introducing

*In July 1945 a report on this topic was prepared* by a subcommittee of the War Policy Committee which consisted of W. L. Hart (Chairman), Saunders MacLane, and C. B. Morrey, Jr. The report, which was approved by the War Policy Committee, the Council of the American Mathematical Society, and the Board of Governors of the Mathematical Association of America, was published in full in the *Bulletin* of the American Mathematical Society. Chairman Marshall H. Stone, of the War Policy Committee, has furnished this summary statement.

universal, compulsory military training in time of peace—it is clearly of the first importance that no program detrimental to the scientific and technological vigor of the Nation should be adopted. The report deals frankly and in detail with this vital segment of the problem now before Congress. In offering the recommendations of the report as a professional contribution to the current discussion, the War Policy Committee hopes to render a modest public service within the natural sphere of its activity.

### Introduction

Congress is currently considering legislation to establish universal military service in peacetime. It is the purpose of this report to examine the implications of such legislation for those phases of our national life about which mathematicians may speak with special knowledge. It is natural, however, that some of the statements made should reflect a broad educational concern rather than a strictly professional one.

### General Recommendations

This report does not deal directly with the basic question: "Should the United States have universal military training in peacetime?" We believe, however, that this question should be decided only in the light of a thorough study by a Presidential commission representing not only the armed services but also other important national activities, including science, industry, and technology.

### Specific Recommendations

The report concerns itself chiefly with the equally important question: "If Congress is to pass a universal military service act, what provisions should be included in order that the greatest benefit should be obtained for the Nation as a whole and for the young men who will perform the service?" From our recent experiences with the development of new weapons and tactics, it is clear that science is a fundamental factor in the military power of the Nation; and that, as a result, long-range military planning requires that young men be encouraged to prepare themselves in basic scientific and mathematical knowledge and to acquaint themselves with the ways in which this knowledge can be applied in time of war or national emergency. Furthermore, it is equally important that the peacetime military program should not interfere with plans to overcome the present dangerous shortage of scientists and technologists and to provide for a continuous generous supply in such essential categories of trained citizens in the future. Our democratic principles bring out clearly the unwisdom of granting individual exemptions as a means of safeguarding the development of science and technology. It is therefore recommended at the outset that:

(1) No outright exemptions from universal military service should be requested.

The appropriate way to harmonize military training with our scientific and technological needs lies rather in the direction of recognizing frankly that military training includes not only the usual routine military activities but also various other highly technical forms of training equally essential for the development of military strength. In particular, a program of military training could, with great advantage, include appropriate advanced types of service in which the special aptitudes of the small but important group with a bent for mathematics, the physical sciences, or engineering are employed and developed. Accordingly, the next recommendation reads:

(2) The required military service should be highly differentiated in accordance with the aptitudes and training of the young men involved, with emphasis on exceptional differentiation for those with the greatest technical abilities.

In order that young men with the prerequisite aptitudes should have opportunities to prepare themselves for such differentiated service, the possibility of deferments must be considered. More important still is the problem of preventing the atrophy or diversion of the scientific talents of any appreciable proportion of the Nation's youth on account of ill-timed interruptions in scientific training occasioned by the military program. This problem, too, would be met most easily and directly by a policy of deferments. It has been estimated that the small but significant body of scientists and engineers must be recruited annually from a group of high school graduates including around 20,000 boys of high mathematical and scientific aptitude. In order to safeguard the training and development of these essential young men, it is therefore recommended that:

(3) A system for deferring the term of military service should be instituted so that gifted young men might prepare themselves for advanced varieties of differentiated service before entering the armed forces.

(4) The possibilities for technical varieties of differentiated service should be canvassed by a joint civilian and military board. The resulting training programs with the corresponding academic prerequisites should be well advertised among high school boys, their parents, and the teachers and administrators in the secondary field.

Indeed, a deferment policy so liberal as to permit continued postponement of the term of military service until completion of work for the Ph.D. would

be entirely justifiable, it is thought, in the case of extremely gifted young men, who could then perform their service in the various laboratories, research divisions, arsenals, and other technical agencies of the armed forces. In addition to a wise policy of deferment, the encouragement and development of youthful scientific talent under the circumstances which would be produced by universal compulsory military training make necessary a policy of strengthening scientific training both before and during the term of service. To this end, added efforts should be made in the field of secondary education to teach the better students as much mathematics and physical science as possible; and young men in military service should be given every encouragement, including the payment by government of the necessary fees, to extend their formal education by pursuing correspondence courses, including courses at college level. The report therefore recommends that:

(5) If universal military service is adopted, in the field of secondary education particular attention should be paid to increasing the efficiency and quantity of instruction given in mathematics and physical science to the students of better than average ability.

(6) The armed forces should encourage young men to continue their education during military service by taking correspondence work through regular school channels, and should pay the costs of such study if a man carries it through diligently.

# Technical Papers

## Synthesis of Biologically Active Vitamin A Substances[1]

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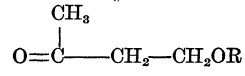
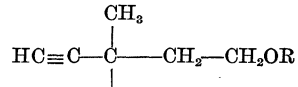
The structure of vitamin A was definitely established from degradation and other experiments as far back as 1931 by Karrer (*4*) and was later confirmed by Heilbron (*2*) and others. On the basis of this knowledge, several synthetic methods, claiming the synthesis of vitamin A itself and some of its derivatives, have been published in various countries during the last decade. Of these, only one—that published in Germany in 1937 by Kuhn and Morris (*6*)—claims to have produced a biologically active product. Subsequent attempts to reproduce this synthesis in other countries (*5*) as well as in Germany (*8*) have been entirely unsuccessful.

The German method was one of the first we investigated, but our failure to obtain one of the key intermediates, β-ionylidene acetaldehyde, forced us to abandon this method early in 1940. Since then, we have investigated several alternative syntheses (*7*). In one of these syntheses, which led to biologically active vitamin A substances, the aldehyde (I), originally prepared by Ishikawa and Matsuura (*3*) from β-ionone and ethyl chloroacetate, was condensed with lithium acetylide in liquid ammonia at −60 to −70° C. to give the acetylene carbinol (II) in about 65 to 70 per cent yields. A condensation of this product, via the Grignard reaction, with the ketone (III), in which R may be either an alkyl or an acyl group



(III)

depending upon whether an ether or an ester of vitamin A is wanted, produced the acetylene glycol (IV) in about 70 to 80 per cent yields. The acetylene glycol ethers have also been synthesized in higher yields by condensing, again via the Grignard reaction, 3-methyl 3-hydroxy 5-alkoxy pentyne-1 (V) with the aldehyde (I). Unfortunately, the corresponding acetylene glycol esters cannot be obtained easily by this reaction. In the next step of the synthesis, the



(V)

acetylene glycol was dehydrated, using *p*-toluene sulfonic acid as the dehydrating agent, to produce the polyvinyl acetylene (VI), which, when selectively hydrogenated, yielded biologically active ethers or esters of vitamin A (VII), depending upon whether R was an alkyl or an acyl group.

[1] Presented in part before the North Jersey Section of the American Chemical Society, 9 April 1945; the AAAS-Gibson Island Conferences, 23 July 1945; and in a Vitamin A Symposium sponsored by the Northeastern Section of the American Chemical Society, 10 January 1946.

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