pressure on secondary students must be shared by many agencies. . . . In my research on "student class loads" 17 years ago ("Incompatibility between class load and study time in the typical American minor seminary," Fordham University, 1950), I detected the beginnings of this academic pressure in widely divergent areas of study. It would be useful to learn to what extent the pressures of education are contributing factors in the mounting disorders on the college and university campus. Is the student actually rebelling against a mechanistic structuring of American education rather than the American philosophy of life?

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Crafts: Forerunners of Science

There is an analogy between the model for the geographical expansion of science into "colonial" areas which Basalla has described ("The spread of Western science," 5 May, p. 611) and the intellectual expansion of science into traditional areas of technology. Just as geographically outlying areas provided new facts and observations about nature that stimulated the growing biological and geological sciences, so did the established crafts provide a veritable museum of mechanical effects and chemical reactions to test theoretical notions and suggest new areas for research in the physical sciences. The works of Hooke and Boyle are full of references to artisans' "secrets." The intimate concern with crafts in 18th-century France exemplified by the *Encyclopédie*; the reexamination of the smelters' and assayers' quantitative separatory operations by chemists in Sweden and Germany; and the extension of analysis from metallic minerals to rocks in general impelled by the desire to duplicate imported Chinese porcelain—all these were essential preliminaries to the "Chemical Revolution." A century and a half later, practical knowledge of the alloying, crystallization, and deformation of metals assisted the birth of a physics of solids. Like the colonial, the craftsman was close to a rich and varied nature and, at first, did not philosophize too much.

Basalla's second phase too was matched (at least in the field with which I am most familiar—metallurgy), by a period in which the colonial tech-

nologists developed a derived but useful science. However, metallurgists in the 19th century not only used the methods derived from analytical chemistry to select their raw materials and control their operations, but they also kept alive an interest in structure and structure-sensitive properties that were utterly beyond the pale until the 1950's, as far as physicists were concerned. Eventually, however, the local science grew in stature to meet a parental science of ever-widening significance, and boundaries disappeared. Ferrous and nonferrous metallurgy merged within the framework of chemical thermodynamics; then ceramics and other inorganic materials joined them within a new branch of physics, that of the solid state.

Perhaps the next stage will be to treat biological and synthetic organic materials along with inorganic ones, within a broad science that relates everything to hierarchical arrays of electrons, photons, and atomic nuclei, partially disordered and marvellously interwoven.

In both geographical and technological colonies, it is not the development of local independent and competitive systems that marks maturity; rather, it is the merging of all into a worldwide scheme that has regions but little regionalism.

Where are the colonial regions to serve science today? Where they have always been, I think—in the arts, both fine and practical. Where else do psychology, biology, and information theory meet with the physics and chemistry of materials to exploit and so to reveal the nature of complex structure?

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More on the Stoical Cat

Pittenger's cats were not imperturbable, as your caption suggested, but merely unperturbed (Letters, 12 May). Domesticated cats do not twitch at familiar sounds, from which I infer that his subjects lived in very interesting households.

But let him invent a new sound, and he will spot a twitch. Or, of course, an old sound that means danger or food.

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