

**ARTHUR LLEWELYN HUGHES:
EMBODIMENT OF THE GREATNESS OF WASHINGTON UNIVERSITY**

Robert N. Varney, WU faculty 1938-1964

Arthur Llewelyn Hughes was called to Washington University in 1923 to serve as professor of Physics and chair of the department. When he came the department was housed in Eads Hall; by the time he died in 1978 at age 94, the department had Wayman Crow Hall, Arthur Holly Compton Hall, and the Cyclotron Building. When he came the department had never awarded a Ph.D. degree; when he died it had awarded 125 doctorates. When he came the department had five faculty members; by the time he died the department had twenty-five.

Hughes retired and became professor emeritus in 1952, after nearly 30 years. Despite the chores of the chairmanship, which grew enormously after 1945, he never relinquished or even diminished his activity in physics, sustaining a standard teaching load and directing graduate and post-doctoral research. At one point he might have become dean of the graduate school of arts and sciences but declined to prevent any, even minor, estrangement from physics. He received honors for his work, including an LL.D. degree from Washington University in 1963 although possibly his greatest honors were the successes of his students and coworkers which on the one hand were attributable to their earlier contacts with him but on the other failed to redound so visibly to his credit. But over and above all of these more or less visible details was a subtle element of leadership, a warmth, a humor, and a deep wisdom that penetrated all of his activities.

The late Professor Hagenow used to give a delightful illustration of Hughes's leadership. At a physics faculty meeting Hughes would propose an item for consideration and then sit back while it was argued from all sides, possibly for as long as half an hour, at which point Hughes would for the first time enter the discussion with the comment, "I take it that the consensus is then ..." which he would then state, and the faculty being so dumbfounded that he had seen any consensus whatsoever in their discussions, would gladly vote their agreement.

A feature of Hughes's day-to-day work was his diplomacy, essential in many ways to his success as well as to that of the department and the university. In some sense, it wasn't an educated and trained diplomacy; it was rather that there was no trace of acrimony, belligerence, or controversy in his make-up. Nor was there any trace of recrimination or vengeance, as will be seen in the story of his son's heroic death in WWII.

At the same time he sustained a quiet sort of administrative discipline: If the scheduled time for an oral examination was reached, and if he and the candidate were in the room, the examination began regardless of which or how many committee members might still be missing.

How Professor Hughes achieved these enormous developments and how they served the interests of Washington University is the topic of this report.

Arriving at Washington University in 1923, he had a promise of a new physics building in hand, and he started the design immediately, in cooperation with architects. Five years later, with the onset of the great depression, the blue prints were rolled up and all but hidden on a closet shelf, until, five more years had elapsed, in 1933, when an anonymous

donor, declaring that he thought building prices had hit their ultimate bottom, came forth with three-fourths of a million dollars for a new physics building. One month later, ground was broken for Wayman Crow Hall; architects' and physicists' plans were ready in detail. It would be possible for the benefit of technically minded readers to elaborate on Hughes's designs; let it rest with the comment of the secretary of the American Physical Society that it was "the best physics building in the country." The building was completed for \$390,000, and it was so complete and even munificent that even with the enormous expansion of physics after 1945, the building only became filled to capacity twenty years later.

A line concerning Hughes's tact at this point: During construction of Crow Hall, the chancellor discovered that the plans included an elevator, and he planted a firm foot against such extravagance. The building would have been nearly useless without an elevator, but Hughes mollified the chancellor by promising that the elevator would be so slow that no one would use it for the ride.

But what the department was going to need at once, in 1923, was a research program and graduate students. Hughes proceeded to pay visits to all of the various four-year colleges throughout the state in order to become acquainted with their physics faculty and to establish a rapport between them and Washington University. As a result, perhaps only once in three years, one or another of these college professors would write to Hughes to tell him that there was an unusually outstanding young student that was a potential graduate student of physics, and from this source, Hughes derived his graduate student aggregation. Hughes knew very well that MIT, Caltech, Chicago, and Harvard would never send him their best prospects. He also knew that the local students that he was getting might not know as much physics, but if they had the talent, they could be taught what they needed to know.

Hughes then started each graduate student on a research project almost literally the day the student set foot in the department. Hughes knew very well that ten years after having a Ph.D., no prospective employer would ever ask the student what grade he had gotten in quantum mechanics, but the employer might very well ask for a list of the student's research publications. No course in theory of relativity was even offered. After 12 years of this course of action, two of Hughes's Ph.D.s were on the faculty at MIT, several had major industrial positions, and all were performing successfully. And the Department could boast of a list of research journal articles far in excess of the expectation for a department of 5 faculty and 8 graduate students.

Hughes also slowly but surely staffed the faculty with capable younger men. He reserved an instructorship for a theoretical physicist and an assistant professorship for an experimentalist. It was clearly understood with each such appointee that Washington University did not have room for promotion, but each such staff member in due course received a flattering promotion from some other institution. It may be of interest to note that an early instructor was Clarence Zener and an early assistant professor was Lee DuBridge. Zener became an outstanding solid-state physicist, and DuBridge enjoyed a career as a dean, chancellor of Caltech, and the President's science advisor.

Every Friday the entire staff, all thirteen, assembled for a brown-bag lunch in the seminar room. By decree, discussion of physics was banned during the first half hour, and the second half hour was devoted to a talk by a graduate student on a physics topic, often assigned to him by his research professor. The consequent maturing process was noteworthy.

Once each semester, without advance warning, four faculty members were ensconced each in a separate class room, and four graduate students were sent, each to a room. The remaining four were ordered to stand by in half an hour's time. Each student was then subjected to a half-hour long oral examination, each examination being oriented to test the candidate's ambient knowledge of physics, what he might be carrying in his head without previous studying or cramming. Candidates did not pass or fail these quizzes; they were advised in due course what they might do to improve for the next one. Thanks to this procedure, each student had attended seven oral exams before his final oral occurred, and in most cases the practice had served well.

These diverse responsibilities did not deter Hughes from active participation in physics. His program for the staff gave each faculty member one beginning course and one advanced course to teach, as well as a minimum of one research student. Hughes himself shared equally in the teaching load, giving as his advanced course the introductory graduate course in modern physics. His lecture notes, mimeographed or dittoed, were a valuable text for the students; they were revised each year to the extent that after three years they were entirely new. He seems always to have had a full share of research students and in fact usually had one post-doctoral fellow under him (financed by Hughes's own initiative).

In 1939, the Washington University School of Medicine asked Hughes to build it a Cyclotron, primarily for research in nuclear medicine. The complexities of this assignment could occupy another full article, such details as to where the Cyclotron was to be located alone constituting a major problem. Hughes was eminently successful in carrying out this project including selecting Robert Thornton to direct the operation. This was to be Thornton's fourth Cyclotron construction project. It was surely the most expertly engineered Cyclotron of its time, and in a bare two years was commandeered by the Army Manhattan project for wartime work. The Cyclotron was able to run 24 hours a day and to produce the then unheard of beam strength of 480 microamperes of 10 MEV deuterons. With it, the first plutonium was produced in quantities that enabled Seaborg by microchemical means to establish the chemical properties of plutonium.

The end of the war in 1945 precipitated a whole new array of problems onto Professor Hughes. The undergraduate enrollment was clearly going to quadruple by the fall of 1946. The graduate enrollment would doubtless do likewise. Three of the five faculty members were either leaving, unwell, or already beyond retirement age. Four more would have to be found by fall of 1946. In his first foray into the job market, Hughes found that the prewar salary scale was utterly outdated, and he had to return home to orient the administration on the scale of the new costs. He met this crisis with four new staff members, plus one visiting member, in good time, but two years later had to repeat the task to bring in four other new appointees. In the fall of 1946, fifty new graduate students were admitted. And now, in addition to the much augmented number of teaching assistantships, a new source of graduate student financing became necessary, taking the shape of Office of Naval Research research grants.

By June of 1950, the first 15 of the newer postwar students were due to finish doctorates. Only nine had completed their dissertations by the deadline, creating still another crisis. By the old rules, a graduate student had exactly four years in which to finish his work; now a formal motion had to be entertained to allow the six laggards to carry on through the summer of 1950 and complete their degrees by September. The smooth hand of Professor Hughes ironed out all ruffles.

By June of 1952, it came time for Hughes to retire, at age 68. An amazing feature of his long tenure is that he never seems to have grown old. With each new challenge he

rose to meet it with all the vitality of youth. He had had to face dreadful tragedies in his life, not the least being the loss of son David in World War II, the winner of three Navy Crosses and a Distinguished Flying Cross but at the loss of his life, yet he faced the loss without loss of his own stamina. He continued to enjoy his emeritus status for many years, living to the ripe age of 94. During his active tenure, Washington University had promoted its department of physics from a minor service facility into a top notch institution with a worldwide reputation.

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