

WELCOME TO W. W. MORGAN

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It is a great privilege to have the opportunity to welcome William Morgan to the IAU Symposium that has been opened today.

All those present are familiar in a general way with William Morgan's outstanding contributions to modern Astronomy and Astrophysics. During the last several weeks I have reread a number of his papers, recalling the situation in Astronomy at the time when they were written, and also reconsidering them in the light of what we know today. It has been a most rewarding experience, and I should like to share my impressions with you.

William Morgan's first papers appeared during the years 1927–1931, and from 1932 on the *Astrophysical Journal* contains a large number of articles and notes by Morgan, mostly containing spectroscopic results pertaining to peculiar stars and spectrum variables. In 1933 the *Astrophysical Journal* contained two important papers by Morgan on problems of spectral classification. I wish to quote the titles, namely, 'Some Effects of Changes in Stellar Temperature and Absolute Magnitude', and 'Some Evidence for the Existence of a Peculiar Branch of the Spectral Sequence in the Interval B8–F0'. Already at this time William Morgan was contributing significantly to the field with which this IAU Symposium is concerned.

In 1935 followed his monumental detailed investigation of A stars, 'A Descriptive Study of the Spectra of the A-Type Stars'. This publication contained estimated intensities for ten important absorption lines in the spectra of 125 stars brighter than magnitude 5.5 as well as detailed spectroscopic information, including estimated intensities, on several hundred absorption lines in the spectra of thirteen selected A stars. The material published in this work greatly furthered the understanding of the problem of A stars, and the deep familiarity with spectroscopic material that Morgan had gained through this research must have been an invaluable asset in his later investigations. One of the selected thirteen stars was 15 UMa, described as being composite in the Henry Draper Catalogue. Morgan demonstrated quite clearly that the peculiarities could not be explained through this assumption, and his analysis foreshadows his later highly important work on metallic line stars.

Before referring to Morgan's following papers on spectral classification I wish to mention a note in the *Astrophysical Journal* entitled 'A useful Fine-Grain Developer for Spectrographic Photography'. In all his spectroscopic work William Morgan took great pains to secure the highest possible quality of the observational material, attending to every detail of the process of obtaining the stellar spectra.

There followed in 1937 the paper, 'On the Spectral Classification of the Stars of Types A to K', and in 1938 'On the Spectral Types and Luminosities of the M Dwarfs', and 'On

the Determination of Color Indices of Stars from a Classification of Their Spectra'. With J. Titus, Morgan published in 1940 a paper on the spectral types of the brighter members of the Hyades cluster, and in the same year with P. C. Keenan an article entitled 'The Classification of the Red Carbon Stars'.

By this time the essential features of MK classification must have already been almost completely clear. The system of MK classification was definitely established in 1943 with the publication of the classical contribution by W. W. Morgan, P. C. Keenan and E. Kellman, 'An Atlas of Stellar Spectra with an Outline of Spectral Classification'. Few publications have had a comparable influence, and in few cases has similar definitiveness been achieved in the first great attempt.

It is of interest to consider the background in the field of stellar classification. The one-dimensional Harvard classification had been of great importance in stellar astrophysics and in galactic research, and the Mount Wilson work on determination of absolute magnitudes and stellar distances from spectra, initiated by Adam and Kohlschütter, had had a great impact, although at the time considered there had also been some disappointments.

A number of features of the MK system of two-dimensional classification contributed to its success. Suffice it to emphasize the importance of the introduction of classification based on comparison spectra of standard stars, selected with great care and on the basis of extensive experience; and the fortunate choice of luminosity classes, the M_V -calibration of which was to follow and to be improved through continued research.

Friends of William Morgan, who over the years have been privileged to discuss problems of stellar classification with him have been greatly impressed by the enormous amount of information on stellar spectra that he carried in his head. I have myself also been particularly struck by the fine balance in his whole approach, with proper emphasis on the importance – in stellar astrophysics as well as in galactic research – of classification of the great bulk of normal stars, as well as on the importance of segregation, and further intensive study, of deviating, or peculiar stars.

The subject of deviating stars was pursued in the important paper by N. G. Roman, W. W. Morgan and O. J. Eggen, 'The Classification of Metallic Line Stars', published in 1948. Let me also mention here the article by P. C. Keenan, W. W. Morgan and G. Münch, 'Spectra of High-Velocity Giants'.

I now wish to turn to William Morgan's investigations in galactic research, based on the use of MK classification, and on further developments with a particular view to high-luminosity stars.

In 1949 Morgan, with J. J. Nassau, published an investigation based on the use of Schmidt astrograph plates entitled 'A Survey of Stars of High Luminosity in the Galaxy'. This was followed in 1951 by the paper by J. J. Nassau and W. W. Morgan, 'A Finding List of O and B Stars of High Luminosity', and in 1952 by 'A Finding List of F Stars of High Luminosity', by the same authors; and William Morgan described his method of classification of natural groups, so useful in selecting candidates for further detailed spectroscopic studies, in *Publ. Obs. Univ. Michigan*, Vol. 10.

The application of the new methods of galactic research led to a striking result in

1952. W. W. Morgan, S. Sharpless and D. Osterbrock published the paper 'Some Features of Galactic Structure in the Neighborhood of the Sun'. Through judicious selection of galactic objects, namely very young clusters and associations, and careful determination of spectroscopic distances, the existence of spiral arm structure in our Galaxy was established. Later work in optical astronomy, notably by Wilhelm Becker and his collaborators, confirmed and enlarged these findings, and fully confirmed the soundness of the approach by Morgan and his collaborators.

Radio-astronomical investigations of the spiral structure of our Galaxy have contributed greatly, but the problem is complex, and more and more it has become clear that these investigations should be combined with those of optical astronomy. The 1952 investigation on spiral structure of Morgan and his collaborators is certainly pioneer work of the highest importance.

In collaboration with A. D. Code and A. E. Whitford, W. W. Morgan continued work in galactic research. Photoelectric photometry was combined with MK classification to yield most valuable results on the distribution of early-type stars, with a particular view to associations.

Fundamental work in stellar astrophysics was carried out by William Morgan in collaboration with H. L. Johnson. The powerful methods of MK classification and *UBV* photometry were combined in an investigation on standard stars defining spectral types, published in 1953. The paper in question became a standard reference work of great importance in subsequent research.

In numerous papers, mostly based on joint investigations with other astronomers, Morgan has continued galactic research.

In more recent years William Morgan has turned his attention to problems of external galaxies. His vast experience in the field of stellar classification was brought to bear on questions of classification of the highly composite spectra of, first globular clusters, and then external galaxies. The results have been of great importance in the analysis of problems of external galaxies. In particular, parallel investigations of the morphology of external galaxies have led to a considerably deepened understanding of the problems of galaxy classification.

Of particular importance to the astrophysical discussion of today is William Morgan's research on the classification of compact galaxies. Results of studies of morphology and spectra of compact galaxies have led to important new insights, and again William Morgan's power of combination of great amounts of observational information has been the basis of success.

Quite recently William Morgan has tackled a problem characterized by still larger dimensions, namely, the classification of clusters of galaxies, and already significant results have been published.

I have dwelt particularly on William Morgan's contributions in the field of stellar classification; for it is above all these contributions that come to mind in connection with the subject of this IAU Symposium.

I am sure that you agree that it was a wonderfully justifiable decision to honour him by calling it: The William Morgan Symposium of the IAU.