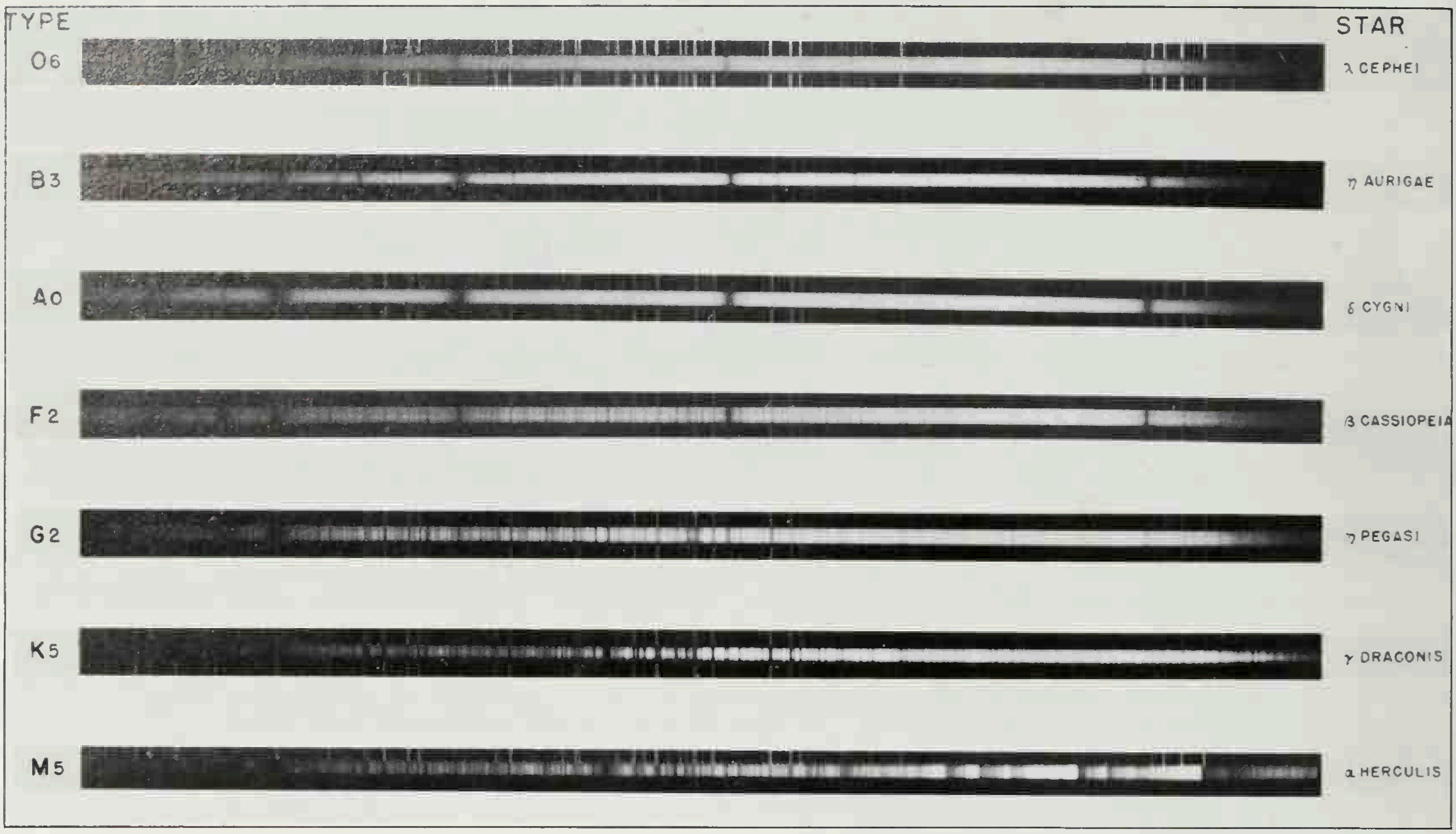

Examples of stellar spectra which illustrate the main features which typify the spectral classification from class O to M.

production of the Henry Draper catalogue containing nearly a quarter of a million stellar spectra. The stars were originally classified on the basis of the strength of the hydrogen absorption lines, beginning at class A and continuing alphabetically. With the discovery of some stars having emission lines class O was added to precede A and finally, as our knowledge of stellar spectroscopy improved, the entire sequence was re-classified. There are now seven main classes. They are from hottest to coolest O, B, A, F, G, K, M. A well-known mnemonic ensures that this sequence, once learned, is never forgotten. This is 'O Be A Fine Girl, Kiss Me'. Each class is further divided into ten sub-classes ranging from zero to 9 in decreasing temperature, except O which goes from 5 to 9·5. Additional cool classes of R, N (carbon stars) and S (zirconium oxide stars) have now been added, named because of the presence of these elements in their stellar atmospheres.

How are the actual spectra classified? This depends on the absence or presence of certain spectral lines along with the ratios of intensities of particular lines. It should be remembered at this point that the absence of lines from a particular element does not necessarily mean it is not present in the stellar atmosphere. It could be that conditions are not suitable for its emission at wavelengths which may be observed from the surface of the Earth. The classification scheme listed below was devised by William Morgan and Philip Keenan.

Astronomers like to have their little differences from other scientists, especially in the labelling of ionized atoms. Physicists label ionized atoms by indices of n+ where n denotes the number of electrons lost by the atoms, for example, C^{2+} indicates a carbon atom which has lost two electrons and is thus left with a positive charge of 2 units. Astronomers use roman numerals to describe the state of the atom with the important difference that the neutral atom, one that has neither lost nor gained electrons, is designated I – for example, C I is neutral carbon (C or C^0 to the physicist). For the above example C^{2+} becomes to the astronomer CIII. An example of the spectra of each class is shown above.

O 'Ionized helium stars'; lines of ionized helium (He II) appear in the spectra. They are very rare in the Galaxy and possess $T_{eff} \sim$ 40 000 K. An example is Alnitak (ζ Orionis) at O9·5.

B In general, neutral helium stars. He II disappears after B5. Singly ionized oxygen, nitrogen, and so on, replace the more highly ionized forms; the intensity of these decreases rapidly from B5 as the lines of neutral hydrogen (HI) strengthen. $T_{eff} \sim$ 16 000 K and examples are Bellatrix (γ Orionis) at B2 and Rigel (β Orionis) at B8.

A Hydrogen dominated spectra; neutral helium is replaced by very strong lines of HI which attain their maximum strength about A2. Ionized metal lines of calcium (Ca II), iron (Fe II), chromium (Cr II) and titanium (Ti II). Neutral metal lines increase in strength through the class. $T_{eff} \sim$ 8 500 K and examples are Vega (α Lyrae) at A0, Sirius (α Canis Majoris) at A1 and Altair (α Aquilae) at A7.

F 'Ionized calcium stars' because these lines become very intense as the class progresses. Neutral hydrogen lines continue to fade but are still strong. Fine and very numerous lines of neutral and singly ionized metals proliferate in the spectra. $T_{eff} \sim$ 6 500 K and examples are Canopus (α Carinae) at F0 and Procyon (α Canis Minoris) at F5.

G 'Solar type stars'; spectrum dominated by lines of Ca II and neutral metals. Iron is very abundant. H I continues to fade and Ca I appears as class progresses when the molecular bands of CN and