checked to better than a part in 10^{12} by Hellwig *et al.* (**2**) Its wavelength relative to the kyrpton-86 standard has been measured by Barger and Hall (**3**). That comparison yielded a value of 33922·3376 ±0.00012 Å relative to the centre of gravity of the Kr^{86} line. Measurements on this same line by Giacomo (**4**) at BIPM gave identical results for the wavelength relative to the centre of gravity of ^{86}Kr. Another molecularly stabilized laser system that has been investigated is that involving a coincidence of the 6328 Å line of the helium-neon laser with absorption lines of iodine. This combination was first explored at NRC in Ottawa, and further developed at NBS Washington. There, Deslattes, Layer and Schweitzer utilizing the absorption by ^{129}I, have measured its wavelength relative to both ^{86}Kr and the methane absorption stablized laser (**5**).

At NRC in Ottawa, Baird and his associates have measured the wavelength of the CO_2 line at 10·6μm relative to ^{86}Kr and have also used a 10·6μm laser stabilized to the absorption line in CO_2 (**6**). Additional work with molecularly stabilized laser systems is also underway at PTB in Braunschweig (**7**) and at NPL in Teddington (**8**).

The result of these various developments will be to supply a variety of new wavelength standards in the visible and infrared, tied together to an accuracy of better than $1/10^{10}$, and all of them superior to the present standard.

Other recent work has resulted in new knowledge of the ratio of optical frequencies to the frequency of a caesium beam oscillator which realises the present definition of time interval. In one measurement, Bay and Luther (**9**) have completed a differential measurement using microwave modulation to obtain a frequency for a Lamb dip laser. Combining this measurement with an interferometric wavelength comparison to ^{86}Kr gives their value for the speed of light, namely 299792·47±0·018 kms^{-1}.

Evenson and co-workers (**10**) have made a direct frequency chain connecting a methane stablized laser (3·39μm) with a caesium beam oscillator embodying the standard frequency. When their result is combined with the Barger and Hall (**3**) wavelength measurement, a value for the speed of light of 299792·4562±0·0011 kms^{-1} is obtained (**11**).

On the basis of the results described above, we are approaching a situation in which error statements on the speed of light are dominated by the fuzziness of the present standard of wavelength. Such a situation cannot long be tolerated.

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K. G. KESSLER

COMMITTEE 2: TRANSITION PROBABILITIES

A vast amount of work on transition probabilities has been accomplished during the last three years. Wiese and his staff at the National Bureau of Standards, Washington, have continued to collect all numerical results, and they can supply information as to what is available for any particular atom. They published (**1**) a first supplement to their bibliography on transition probabilities, covering up to June 1971. At the time of writing a further supplement is in preparation which will cover the period July 1971–December 1972. Work is continuing on the next compilation, forbidden lines of the iron group atoms from scandium to nickel, with heavy emphasis on iron in its many stages of ionization. This compilation is expected to appear in the new Journal of Physical and Chemical Reference Data. Important review articles include Crossley (**2**) on all aspects of the theoretical determination of oscillator strengths, Corney (**3**) on the measurement of atomic lifetimes, Wiese (**4**) on the general status of our knowledge of transition probabilities, and Weiss (**5**) on theoretical developments. The second beam-foil spectroscopy conference report (**6**) contains many papers on lifetimes obtained both by beam-foil spectroscopy and by other methods. Garstang reviewed relativistic transitions (**7**) and magnetic multipole transitions (**8**). In the following we shall confine ourselves to mentioning a few areas of particular interest; detailed references can be traced through the bibliographies, reviews and abstracting journals.

On the experimental side there has been a veritable flood of papers on beam-foil spectroscopy. The method has the advantage of being universal in that almost any ion can be excited, and the disadvantage that the excitation is non-selective, many stages of ionization and excitation can be produced simultaneously. The earlier papers were of low reliability, it had not been realized how difficult the results were to interpret. There are always difficulties in interpreting the observed decay curves and in making proper allowance for cascading effects. Problems arise if the characteristics of the foil change as a result of bombardment during the course of an experiment. Of particular interest has been excitation of many doubly-excited states of helium and the measurement of some of their lifetimes. These doubly excited levels have been calculated successfully by Drake and Dalgarno. More related to astrophysical needs have been the many papers on the lifetimes of heavier (i.e. iron group) elements, in contrast to earlier years when the emphasis was on the lighter elements. Whaling and Lennard have completed the measurement of the lifetimes of eight levels in Ni I, and branching ratios have been determined. The new data give a solar nickel abundance agreeing with the coronal value. Whaling plans to study Ni II. Brand, Cocke and Curnutte at Kansas State University have also made a study of Ni I. Curtis, Martinson and Buchta have studied Mn I and Mn II. Roberts, Andersen and Sørensen used beam-foil lifetimes and branching ratios from a stabilized arc to obtain 286 absolute transition probabilities in Ti II. Cocke, Curnutte and Brand published data on Cr I. From the large number of papers on lighter elements we mention the work of Berry, Bickel, Martinson and their co-workers on the spectra N I–N V, O I–O VI, and S II–S VI, and the work of Poulizac and Buchet on C II–C V. Irwin, Livingston and Kernahan obtained lifetimes of a number of levels in various ions, including O I–O V, Ne I, Ne VI and Si II–Si IV.

Work has continued using older methods. Stabilized arcs have been used by Foster in work on C I and S II and by Schulz-Gulde on S I and S II. Bridges has completed a comprehensive set of measurements in a stabilized arc on about 800 lines of Fe I. The Kiel group (Richter, Garz, Heise, Holweger) have continued their arc work, having completed Ni I, Ni II, Si I and V I, and work is in progress on Co I. Marek has made lifetime measurements on Ni I. Wolnik, Berthel and Wares used shock-tube emission spectroscopy for 97 Ti I and 30 Ti II lines, their work is soon to be published.

Renewed attempts have been made by Blackwell to improve the King furnace. Blackwell has used a larger furnace, which allows fainter lines to be observed and reduces end effects, had a better quality grating, and achieved a much lower noise level. His first studies on the iron group differed from the work of Garz and Koch by a factor of 2 or 3. He is working on Mn I. There have been a few applications of the hook method. Huber and Parkinson determined oscillator strengths of 82 lines of Fe I in shock-heated iron carbonyl. Important applications of the hook method to molecular oscillator strengths have been made by Pery-Thorne and by Nicholls and their colleagues.

In addition to the papers already mentioned several other authors have worked on lifetimes and oscillator strengths in Fe I. Klose measured the lifetimes of three levels by electronic excitation and delayed coincidence. Bell and Tubbs used atomic beam absorption. Bridges and Wiese used a stabilized arc, Martinez-Garcia, Wahling, Mickey and Lawrence used beam-foil spectroscopy and branching ration from a hollow cathode spectrum, Assousa and Smith used a phase-shift apparatus

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for a number of lines of both Fe I and Fe II, Wolnick, Berthel and Wares used shock-tube emission spectroscopy on Fe I and Fe II and Andersen and Sørensen used beam-foil spectroscopy on Fe I. The result of all these investigations has been to confirm the revision of the absolute scale of the iron oscillator strengths and the increase of the solar photospheric iron abundance to a value in agreement with that obtained from the solar corona. Further work on weak Fe I lines is desirable; most of the laboratory measurements are on lines which are very strong in the solar spectrum.

On the theoretical side mention must be made of the work of Schiff, Pekeris and Accad, who obtained oscillator strengths for a large number of transitions between low-lying S and P states in all the ions from He I to Ne IX. Their data are believed to be exceptionally accurate. Starace considered the use of the dipole length and dipole velocity formulae for oscillator strengths, and showed that for model atoms which involve non-local potentials (such as the Hartree-Fock method) the dipole length formula is the correct one to use. Klapisch proposed a new potential function which contained several parameters and which could be determined by fitting to experimental energy levels. His method was applied by himself, Aymar, Koenig and others to transitions in noble gas spectra.

Smith and Wiese (9) published a very important study of the systematic trends of oscillator strengths along isoelectronic sequences. They used the charge expansion method, in which wave functions, oscillator strengths, and other properties are expanded in a series of powers of Z^{-1}, where Z is the nuclear charge, to establish the expected behaviour of the oscillator strengths as Z tends to infinity. They studied many individual transitions, and showed that existing data and the predicted infinite limits were together sufficient to interpolate the behaviour of the transitions for any member of the isoelectronic sequence. In several cases it was possible to explain apparently discrepant results as being due to perturbations by other configurations. This method has subsequently been extended by Smith, Martin and Weise.

Recent work on forbidden lines includes that of Corney and Williams on [O I], using a stationary afterglow decay. Their experimental result is in excellent agreement with the latest theoretical work by Nicolaides, Sinanoglu and Westhaus. Derwent and Thrush measured the lifetime of the metastable $^2P_{\frac{1}{2}}$ state of I I, confirming the theoretical value. Nussbaumer, Swings and Grevesse worked on various ions; their results for the stronger [Fe II] transitions agreed with earlier estimates, and they published results for [Fe I], [Mn I] and [Cr II]. Nussbaumer also made an improved study of forbidden lines in the C I isoelectronic sequence. The transition 2^3S_1–1^1S_0 in the helium isoelectronic sequence, which is due to relativistic magnetic dipole radiation, was studied by Feinberg and Sucher, and by Drake. It has been identified in several ions (e.g. O VII) in the solar ultraviolet spectrum. Marrus and Schmeider measured the decay rates of the same transition in Ar XVII, together with the two-photon decay 2^1S_0–1^1S_0 and the magnetic quadropole decay 2^3P_2–1^1S_0 in Ar XVII and the two-photon decay $2^2S_{\frac{1}{2}}$–$1^2S_{\frac{1}{2}}$ in Ar XVIII. The measured lifetimes are in excellent agreement with theory, fully confirming the latter. Important work on the two-photon 2^1S_0–1^1S_0 in He I was also done by Pearl, by Jacobs, and by Van Dyck, Johnson and Shugart. Johnson measured the lifetime of the ^5S metastable state of O I, and Nicolaides calculated a lifetime in agreement with the experimental result.

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