TABLE I. Observed solar wavelengths and their identifications.

Wavelength, in A		
Observed	Predicted from energy levels	Identification[a]
31507.7	31507.7	⊙Si*I*3*d* $^1F_3{}^\circ-4p\ ^1D_2$, in the wing of ⊕31505.6
33646.5	33646.5	⊙Si*I*5*d* $^1D_2-5p\ ^3P_1$, masked by ⊕33646.5
33961.7	33964	⊙Mg*I*3*d* $^1D_2-4p\ ^1P_1{}^\circ$, blended with weaker ⊕33960.0
33976.0	33975.8	⊙Si*I*3*d* $^3D_3{}^\circ-4p\ ^3D_3$

[a] ⊙ =lines of solar origin.
⊕ =lines of terrestrial origin.

33964, 33977, and also show that λ33654 is masked by a group of terrestrial lines. The new tracings have also made possible some improvement in the scale of wavelengths originally published, so that the coincidences between the observed solar wavelengths and those predicted from known atomic energy levels are more firmly established. The lines in question are listed in Table I.

In addition to the excellent coincidence in wavelength, two different types of observation made at Mount Wilson support the identifications in column three above. The first consists of a number of pairs of tracings of the spectra of the sun's east and west limbs. The wavelengths of all solar lines will be shifted on the east-west limb pairs of tracings by the Doppler effect of the solar rotation; the wavelengths of terrestrial lines will not change. The differential Doppler displacement is about 4 km/sec, or 0.4A at λ33000. The scale of the Mount Wilson tracings is 13 mm/A so that the rotational shift of approximately 5 millimeters is very easily measured. The first and third listed lines, although they have telluric components, exhibit a Doppler shift that is correct both in sense and amount for lines of solar origin. Figure 1 shows the measured shift for λ31507. The fourth line is unblended, but it is very weak. It shows a change of wavelength, correct in sign, on four pairs of tracings, but measures of the amount of shift do not give consistent values.

The second type of supporting observations consists of tracings of the center of the sun's disk, with the sun at a high altitude in the sky and with the sun near the horizon. None of the three unmasked lines increases its intensity near the horizon as it should if it were of telluric origin. This observation is especially convincing for the unblended line, λ33976 Si*I*. It is suggested that the claim of Benesch, Elby, and Elder, that this line is not of solar origin, is based upon observation of λ33967.0, ⊕CH_4, rather than the line in question.

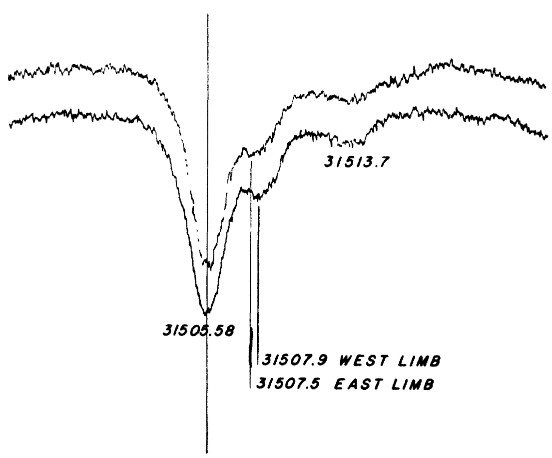

FIG. 1. Shift in wavelength of 31507, Si*I*, produced by the rotation of the sun.

Consideration of the well-known facts that the excitation potentials are high for all lines expected to appear in the infrared, and that the opacity of the sun's atmosphere is increasing rapidly with wavelength in this region of the spectrum, makes it appear unlikely that many atomic lines will be found at wavelengths greater than 3μ. Among the lines to be expected, those listed above are probably the strongest, and they all appear with rather low intensity. A series of east-west limb and high-low sun tracings now being obtained will be searched in an attempt to identify additional solar atomic lines.

Mr. Dale Vrabec made the observations at Mount Wilson reported above. The continued loan of the observing facilities of the Snow Telescope on Mount Wilson by the Mount Wilson and Palomar Observatories to the McMath-Hulbert Observatory is gratefully acknowledged.

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An Absolute Determination of the *F*, *I*, and *L* Lines of Th(B+C+C″)

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THE *F*, *I*, and *L* lines of Th(B+C+C″) (Ellis notation) have been measured with two different methods in a semicircular β-spectrograph. The first method consists of determining the magnetic field and the radius in a homogeneous magnetic field. The field was measured along the path after each run with a proton probe. Different types of slits and samples were used. The samples consisted of tungsten wires with diameters varying from 12μ to 36μ, which had been prepared by collecting Th-active deposit on them. The lines were measured with two G-M tubes in coincidence, and the slits were varied from 50μ to 300μ. Other slits were also used to get different line-widths between 0.5 percent and 0.075 percent measured at the half-maximum. The total width of the high energy side was about 0.03 percent. The radius of curvature used was about 47 mm. The experimental line shape is in excellent agreement with the one predicted from theory.

All the values taken with different samples, slits, and line widths agree among themselves; and the errors given in Table I correspond to a conservative estimate of the uncertainty in localizing the high energy part of the lines. It seems possible to give the values with higher accuracy later on.

The values can also be measured without using the absolute value of γ_p by the method used earlier by Siegbahn,[1] who gave the following relation for the $(H\rho)$ value:

$$(H\rho)^2=A+(A^2+B^2)^{\frac{1}{2}},$$
$$A=[(a^2+1)/(a^2-1)^2](Smc/e)^2,\quad B=[(4-S^2)/(a^2-1)^2](cm/e)^2S^2,$$
$$S=(E_k-E_L)/mc^2,$$

where a is the ratio between the fields at equal points on the *F* and *I* line at the same radius. The advantages of this method are that all points on the lines can be used in determining the ratio, and that one need not know the field in absolute units.

In both cases a Hartree correction[2] was applied for the gradient of the field along the path. The total field correction was of the order of 0.05 percent.

TABLE I. Results for the *F*, *I*, and *L* lines of Th(B+C+C)″.

Line	$\rho\nu_0$ Mc-cm	Probable error	$H\rho$ gauss cm	Estimated error
F	5.91212	±0.00015	1388.55	±0.20
I	7.46816	±0.00020	1754.01	±0.25
L	11.10076	±0.00025	2607.18	±0.35

The numerical value for the F line obtained by this method was $H\rho=1388.52$, with a probable experimental error of ± 0.06. The results from this and the previous method are in good agreement.

If the value 5.91212 Mc-cm for the F line given above is combined with the $H\rho$-value calculated from the field ratio, one obtains $\gamma_p=(2.67517\pm 0.00020)\times 10^4$ sec^{-1} gauss^{-1}, which is in excellent agreement with the value $\gamma_p=(2.67523\pm 0.00006)\times 10^4$ given by Thomas, Driscoll, and Hipple.[3] It is possible that a better interpretation of the lines can give a higher accuracy and that one can, therefore, in this way check the γ_p or the h/m value with good accuracy.

Hedgran and Lind[4,5] have measured the ratio between the annihilation radiation and the L line. Assuming equal electron and positron mass, this ratio would give $(H\rho)_L=2607.2\pm 0.5$, i.e., in excellent agreement with the value given above. They have also measured the ratio of the L line and the Au^{198} γ-line. Using the Au^{198} value as determined with the crystal spectrometer by DuMond *et al.*,[6] one would obtain $(H\rho)_L=2604.5\pm 0.5$, which indicates that the crystal value may be about 0.1 percent too low. The present investigation thus indicates that the β^- and β^+ masses are the same, within the given limits of error.

I am greatly indebted to Dr. Kai Siegbahn for suggesting this investigation.

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Photoprotons from Argon under the Action of Gamma-Rays of 17.6 Mev

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SINCE the discovery by Hirzel and Wäffler[1] of the anomalously large (γ, p) cross sections in many elements there has been much speculation as to the mechanism of the interaction of high energy gamma-rays with nuclei. Two theories have been put forward to explain the large cross section. In one[2] the individual level properties are chosen to vary in such a way as to favor the emission of high energy particles while retaining the idea of the initial formation of a compound nucleus: in the other,[3] the process is imagined as a surface photoelectric effect in which a proton lying near the surface of the nucleus is simply ejected on absorbing a gamma-quantum, no compound nucleus being formed in the ordinary sense.

We have sought to elucidate the mechanism of this interaction by determining the energy distribution of the photoprotons ejected from A^{40} by gamma-rays of 17.6 Mev produced in the reaction $Li^7(p, \gamma)Be^8$. Argon at 11 atmospheres was contained in a carbon-lined proportional counter of sensitive volume 1220 cc. The energy distribution of the photoprotons is shown in Fig. 1; the analysis was made with a ninety-nine-channel kicksorter.[4] A very weak polonium source within the counter provided the energy scale. We made irradiations at various proton energies from 450 to 1150 kev, over which range the relative proportion of 14.8- to 17.6-Mev lines increases by 3 : 1.[5] There was no detectable change in the distribution; this must be due almost entirely to the 17.6-Mev line.

The tail above group A is probably due to the reaction $A^{40}(\gamma, \alpha)S^{36}$. These alpha-particles would contribute little in the bulk of the distribution owing to the relatively great importance of the barrier at lower energies and can probably be ignored.

It is immediately apparent that the bulk of the disintegration cannot be the result of a surface photoelectric effect, as this would give the main group at high energy. Group A we identify with the ground state transition: if it were due to a surface effect, it would be difficult to understand the strength of group B, which

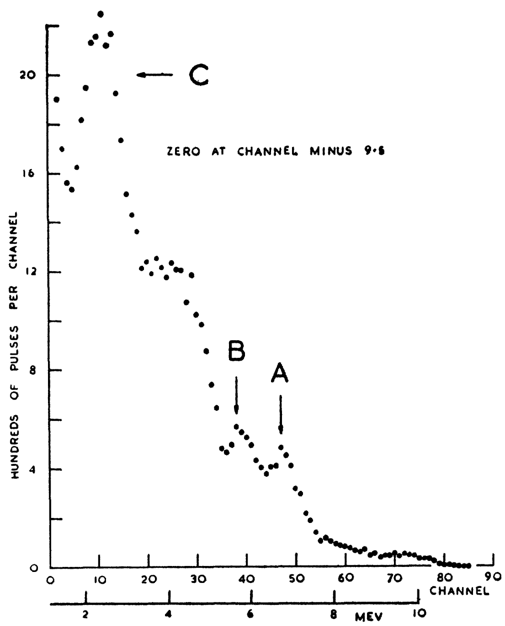

FIG. 1. Proton energy distribution from the photodisintegration of argon. (This is the experimental distribution, which must suffer a small correction for the wall-effect. The rise at low energy is due to electron build-ups.)

has about the right spacing from A to correspond to the first excited state in Cl^{39}.

It is also difficult to adopt the suggestion of Schiff[2] that high energies are favored, as the peak C lies at an even lower energy than would be expected on a model using an exponentially increasing level density of characteristic temperature 1 Mev such as seems appropriate from the work of Gugelot.[6] Using correct coulomb wave functions[7] through $l=5$ we have computed the expected distribution, which has a maximum at 3.0 Mev, and an intensity ratio of 7.7 : 1 from peak to 7 Mev. (This procedure must be rather crude for argon.) The same model predicts a ratio of 25 between (γ, n) and (γ, p) cross sections (neglecting all differences but the barrier). We may infer a (γ, n) cross section of about 15 mb:[8] our (γ, p) cross section is 5.4 mb. So the difficulty of the cross-section ratio remains without any apparent possibility of explanation by the two methods so far suggested. The answer may lie in a drastic modification of the shape of the barrier—a great change in the nuclear radius cannot be permitted.

A fuller discussion and other results will be published later.

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The Mass of Cl^{39}

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THE results of an earlier communication[1] on the photodisintegration of A^{40} by gamma-rays of 17.6 Mev enable the mass of Cl^{39} to be determined with some accuracy. We associate group A of 6.8 ± 0.1 Mev with the transition to the ground state of Cl^{39}. It is very probably due to A^{40}, as A^{36} has a relative abun-