implies the unreasonably low temperature, 500°K , particularly since the hyperfine structure amounting to a separation of components of $0.12\text{\AA}$ should appear. Hence its interpretation as hydrogen absorption is uncertain. The absorption feature and the asymmetry of the line disappear at the limb.

The general asymmetry of the line can be explained if we assume a complex emission core produced by jets or small prominences, some having a radial velocity of 5 km/sec toward the sun and others with a velocity of 8 km/sec outward from the sun. In a general way this agrees with the H_2 , K_2 emission in *Ca. T.* Royds observed on $\text{H}\alpha$ spectroheliograms that dark markings and the bright emission markings accompanying spot disturbances showed best when the second slit of the spectroheliograph was set $0.2\text{\AA}$ to the violet.¹ When the slit was set to the red it was observed that the markings disappear and the image is much less contrasty. Further observations will be made on the relationship of the line profile to spectroheliograms.

1. *M. N.* 71, 723, 1911.

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Rabe, Eugene K. Escaping satellites of Jupiter.

The transfer between satellite and planetary motion, in view of G. P. Kuiper's conception of a decreasing mass of the original Proto-Jupiter due to evaporation, has been studied by numerical integrations for one selected hypothetical case of an intermediate motion. The orbit that Hill considered the orbit of maximum lunation, properly adjusted for the assumed large mass of Jupiter in our case, has been chosen for the starting conditions. Since Hill's orbit was computed on the basis of approximate differential equations, some deviation from actual periodicity had to be expected for the result of my own computations for an original Jupiter mass of 0.020 solar masses. Due to its non-periodicity, the resulting oscillating satellite-type motion is unstable. The small body escapes from Jupiter even without the additional effect of Jupiter's mass decrease. The orbital curve resembles, with its loops and with a close passage of Jupiter before the final ejection, the ejection orbits which have been computed by Darwin and at the Copenhagen Observatory. For almost a whole synodic revolution, including the backwards integration, the small body of my investigation moves

in reasonably close agreement with the synodic period of Hill's approximating solution, but then a close approach to Jupiter and the following ejection put an end to this similarity, even for a constant mass of Jupiter. By comparison of my two computed orbits, one for a constant mass and one for a rapidly decreasing mass of Jupiter, the effect of Jupiter's mass decrease on this type of periodic or near-periodic motion could easily be shown.

Both integrations were started with the satellite in opposition to the sun. In both cases the small body is soon ejected towards increasing solar distances. The planetary orbit thus produced by some deviation from the selected periodic orbit of the satellite type resembles most the Hidalgo-type of planetary orbits, with an eccentricity very close to that of the actual planet Hidalgo. This result gives some support to Kuiper's suggested origin of Hidalgo as an escaped satellite of Jupiter. For an original mass of Jupiter of the order of the adopted value, there seems to be a natural connection between the limiting ejection-type periodic satellite orbits and planetary orbits of the Hidalgo type. Such a transition appears likely if we may assume that in the last stages of its satellite existence such a small body actually moves in an orbit somewhat similar to the very special type of an intermediate orbit here considered. Further computational evidence would be desirable to justify such an assumption.

My integrations further revealed a systematic decrease of the value of the Jacobi integral, C , in consequence of Jupiter's mass decrease, in agreement with the conclusion that I had previously obtained by analytical considerations of the effect of a changing planetary mass on the classical restricted problem of three bodies. It is my intention to continue and extend these numerical investigations at some later time, mainly with regard to the Trojan planets, for which an origin as escaped satellites of Jupiter has also been suggested by Kuiper. Details about the method of integration and the numerical results will then be presented together.

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Roberts, Morton and Allan Sandage. Group characteristics of the RR Lyrae stars in M 3.

The purpose of this investigation was to determine the region occupied by the RR Lyrae stars in the color-magnitude diagram of M 3. Twenty-

five plates each, in photographic and photovisual wave lengths taken with the 100-inch telescope were measured for magnitudes of selected variables and of those non-variable stars which border the variable star gap. The magnitude system was that used in the previous photometric study of this cluster.¹

The planimetry of the derived light curves, reduced to intensity ratios, yielded mean magnitudes and colors which were the basic data for this investigation. The probable error of an individual measurement was ± 0.025 in m_{pv} and ± 0.027 in m_{pg} . The probable error of the mean magnitude of a given variable is ± 0.01 .

The resulting color-magnitude diagram shows that all the cluster-type variables measured in M 3 fall in a discrete region unoccupied by non-variable stars. There is a sharp delineation between variable stars and non-variable stars. The inclusive region of variability extends from C.I. 0.00 to $+0.23$ with a mean m_{pv} of 15.68. The scatter in magnitude for all save five of the variables is ± 0.03 . These same five stars deviate in relations involving period and amplitude discussed below.

Three stars previously believed to be non-variables fell inside the region occupied by the RR Lyrae stars. These three stars proved to be variables of small amplitude. One star fell on the blue edge of the gap with a period of $0^d.28719$ and an amplitude in m_{pg} of 0.16. The other two stars fell on the red side of the gap with periods $0^d.9170$ and $0^d.9987$ and amplitudes 0.14 and 0.15 mag., respectively.

These three stars are consistent with the general color index-amplitude relation found to hold for all cluster-type variables studied. This relation shows that the amplitude of variation is small at each edge of the variable star region and rises to a maximum of 1.6 in m_{pg} at C.I. = 0.07 mag.

The mean magnitude and color index data have been used to test the pulsation criterion $P\sqrt{\rho} = \text{constant}$. In the observed quantities, this criterion reduces to

$$\log P + .3 m_{pv} = .73 \text{ (C.I.)} \\ - .5 \log (M/M_{\odot}) - 6.28$$

using a pulsation constant of 0.041 days computed by I. Epstein.² A plot of $\log P + .3 m_{pv}$ vs. C.I. gives a linear correlation with slope of .73 for Bailey type *a* and *b* variables as required by theory.

The type *c* variables define a second linear relation with the same slope but with a displacement in period of $P_{a,b}/P_c = 1.48$. This same slope indicates that the type *c* variables satisfy the pulsation criterion. Their displacement in period could indicate pulsation in a different mode from that of the *a* and *b* stars, as suggested by Schwarzschild.³

The period-luminosity relation obtained from this investigation indicates a variation of 0.3 mag. in m_{pg} for a period range of $0^d.3$ to $0^d.7$. Unlike the classical Cepheids, these RR Lyrae stars are brighter at shorter periods and fainter at the long periods. In m_{pv} there is no significant change of magnitude with period.

1. *A. J.* 58, 61, 1953.

2. *Ap. J.* 112, 6, 1950.

3. *Circ. Harv. Coll. Obs.* No. 437, 1940.

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Rush, J. H. and Dorothy E. Trotter. Evidence of the 23-year solar cycle in recurrent magnetic storms.

Magnetic storms recurring at 27-day intervals were more than twice as numerous before the sunspot minima of 1913 and 1933 as they were before the intervening minima of 1923 and 1944. For these two sets of minima we found totals of 113 and 49 individual storms, respectively, counting storms in dubious sequences at half-weight. A conventional statistical criterion applied to these data yields a probability of about 0.14 that the observed difference is due to chance.¹

This evidence suggests that recurrent storm activity regularly alternates between high and low values in successive spot cycles. On this supposition, the incidence of recurrent storms during the current minimum should be high. To date, 45 such storms have occurred, on the same basis of weighting as was applied to the earlier sets. This figure exceeds the mean for the preceding four minima; and recurrent storm sequences have not yet ceased.

In terms of Wolf numbers, sunspot activity during the four cycles ending 1913-1944 has alternated between relatively high and low values, but in opposite phase to the recurrent storm activity. This fact might suggest that the alternation in numbers of recurrent storms results from an inverse dependence of M-region activity on spot numbers; but spot numbers during the