

THE INCANDESCENT BULB ON THE SHABBAT:AN ANALYSIS OF THE HALACHA IN THE LIGHT OF MODERN SCIENCE

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In attempting to introduce some semblance of order, from the critical point of view of modern technology, into the current Polemics in the world of Halacha concerning the use of the incandescent bulb on the Shabbat, we must bear in mind, at the very outset, one important fact: that, at the present stage of the game we can come to no definitive conclusion. The entire problem is exceptionally delicate, because of the great stress laid in the Halacha on the laws of Shabbat and particularly on the laws concerning fire, and we must not forget that we are, figuratively as well as literally, playing with fire. Let no one be "moreh heter heter", act lightly, because of the conclusions of one Rabbi or one authority.

Let me briefly review for you the fundamentals of the laws of Shabbat as delineated by the Sages of the Mishna and the Talmud. The *melachot*, the types of "work" which are forbidden on Shabbat (and the term "work" is used here in a technical sense, not in the layman's sense, just as the term "work" has a special technical meaning for the physicist) are derived from the types of work needed for the building of the Mishkan, since both passages - relating to Shabbat and Mishkan - are *shimuk*, next to each other. The number of such categories of work is 39, the *melachot* 39. These 39 major categories are known as *melachot*, and each *melacha* is subdivided into minor categories known as *avot*, the requirement being that each *Toladah* be similar to its *Av* in some certain specified manner. Let us now single out four of these *Avot* which will be

of special interest to us. We have הכנת אש , making a fire, and הכנת אש , extinguishing a fire. On הכנת אש the Torah issued a special prohibition, aside from the general הכנת אש , in the sentence " אשר תבנה ביום שבת ", "Thou shalt not make a fire in any of thy dwelling places on the day of the Shabbat". Another Av Melachah is הכנת אש , which literally means "cooking", הכנת אש , as we shall see later, has certain other and more inclusive connotations. The fourth Av Melachah I wish to mention is הכנת אש , which literally means "striking with a hammer", but is to be understood as the completing of any utensil. Thus, for instance, if I attach a leg to a table which had only three legs, I am guilty of הכנת אש הכנת אש , since before it was not a table but, as a result of my action it has become a complete table.

This, then, is the general fabric into which we may or may not read a Biblical prohibition, an הכנת אש , on the lighting of the incandescent bulb on the Shabbat. Incidentally, it should be mentioned that even if one would conclude that there is no הכנת אש , prohibition by the Torah, involved, there is, at any rate, a very definite Rabbinic interdiction, an הכנת אש .

The principles underlying the operation of the incandescent bulb are, I am sure, well known to all of you; but, for the sake of clarity, let allow me to review it for you briefly.

The bulb contains the two poles connected by a thin and highly resistant filament, usually tungsten, which will heat to incandescence when a current is passed through it at the proper voltage. The older type of bulb was evacuated as much as possible to eliminate most of the oxygen. Modern bulbs are, instead, filled with an inert gas, such as nitrogen, which completely replaces the oxygen-containing air in the bulb. The nitrogen in the bulb is at reduced pressure; at room temperature, it is in the vicinity of 1/3 atmosphere. When

the circuit is closed and the filament is heated to incandescence, at the usual 110 volts, the pressure is raised to approximately one atmosphere. The radiation of heat and light by the filament is, as was said, a result of the resistance of the filament. There can be ~~no~~ no oxidation since oxygen is completely absent and nitrogen is inert under these conditions. Completing the biography of the incandescent bulb, the thin tungsten filament will, as a result of the heat, begin to vaporize until eventually the coil snaps at one point and the circuit is broken. The bulb is then respectfully thrown into the garbage receptacle

Now, before we begin to analyze the Halacha in consideration of the problem of the incandescent bulb and its relation to *Elc*, fire, we must postulate one basic dichotomy; there are two types of phenomenon which come under the general heading of *Elc* "fire". One is the common combustion, or oxidizing fire, in which we have heat, light and a chemical reaction - oxidation. The ordinary burning of wood or paper or other combustibles ~~comes~~ is included in this class. The second type is non-oxidizing fire, that is, a radiation of light and heat from a body which is chemically stable. The heating of a heavy metal or alloy such as steel till it glows, and the fire (i.e. the combination of heat and light) from the filament of the incandescent bulb, are examples of non-oxidizing fire.

Etymologically, the Biblical Hebrew word for burning, *העלה*, as in *והעלה אש עליו*, indicates complete destruction and, hence, in our terms - combustion, or oxidizing fire. We can bring sufficient proof for this. Consider, for instance, the passage in Mishpatim: *והעלה אש עליו*. Similarly, we have *והעלה אש עליו*. At times, the Torah even employs the term *העלה* to indicate destruction without the use of fire, such as *והעלה אש עליו*. In fact, the only place in the Torah where *העלה*, as burning, certainly does not imply destruction, the Torah

makes special mention of it:

הוא לא נחשב כחומר, אלא כחומר

However, all this is only indicative in a very general manner and we cannot base any ultimate Hla Halachic decision on etymologically derived evidence.

We find that the Rabbis of the Talmud also recognized this distinction between two types of fire. In discussing the problem of of tempering metals on the Shabbat, the Yerushalmi (Talmud of Jerusalem) tells us that a difference of opinion developed between R. Yehuda and the Chachomim as to whether $\text{לכ} \text{לכ} \text{לכ}$ or $\text{לכ} \text{לכ} \text{לכ}$. Rabbi Meier Simcha, author of " $\text{לכ} \text{לכ}$ " on the Rambam, interprets

$\text{לכ} \text{לכ}$ as equivalent to any other Toladah in Shabbat, remarking that the similarity here is, however, somewhat far fetched. If, however, we were to read our own analysis of the concept of fire into the words of the Yerushalmi, we will find that the Yerushalmi is more coherent and more logical. Toladah here is not the same Toladah as in the other M'lachot Shabbat, but rather indicates a second type of fire which we called the non-oxidizing fire. The problem in the Yerushalmi was, then, whether heating a metal to a red glow, i.e. creating a non-oxidizing fire, belongs in the same category with the usual לכ , oxidizing fire, in which case it is an Av M'lachah, or if $\text{לכ} \text{לכ} \text{לכ}$, that is, that non-oxidizing fire is not at all clasifiable as fire.

Let us now analyze the problem halachically by a search in the literature of the Rishonim. From the Yerushalmi I just quoted to you it is obvious that the problem of the glowing filament is most closely approximated, in the Halacha, by the act of לכ , the tempering of metals. In both, the metal body radiates heat and light without itself being consumed or oxidized. A systematic analysis must begin by determining the Av M'lachah to which we assign the process of Tzeruf.

Rashi (Shabbat, 41 b) attributed Tzeruf to the Av M'lachah of *עֲבוֹדַת הָאֵשׁ*. The Av of *עֲבוֹדַת הָאֵשׁ*, you will remember, is a final Constructive operation, or the completion of a utensil. Thus, when I heat the metal till it begins to soften and then put it in cold water, I accomplish the hardening or consolidation of the metal bar and, in this sense, I can be considered to have made a new metal bar with the present properties of hardness. If we now attempt to apply the law of Tzeruf, according to Rashi, to the incandescent filament, it at once becomes obvious that there is no reason to forbid its usage because of Tzeruf since no "completion" ever occurs. The filament is never, Heaven forbid, dipped into cold water while it is being heated electrically, and by merely turning the switch and breaking the circuit the filament returns to its previous hardness and consistency. There is, then, no problem of Tzeruf in the incandescent bulb, according to Rashi's assignment of Tzeruf to *עֲבוֹדַת הָאֵשׁ*.

Maimonides, the Rambam, writes in Mishne Torah (הלכות שבת):
 ז"ל ח"ו יחזיק אש או אש או אש, פי"ב (פ"ב) ש"ס. א"ל פ"ד מ"ד
 "He who heats metal (on Shabbat) in order to temper it in water is guilty of transgressing a Toladah of *ש"ס*". And in the next halacha (פ"ד) he writes: ז"ל ח"ו יחזיק אש או אש, פי"ב (פ"ב) ש"ס. א"ל פ"ד מ"ד
 that if he puts hot metal in cold water with the intention of tempering it he is guilty of transgressing a Toladah of *ש"ס*. In essence, then, Maimonides assigns Tzeruf to the Avot of *ש"ס* and *ש"ס*, one upon heating the metal and one upon cooling it.

Before continuing with Maimonides, let us quote the dictum of Shmuel in Tractate Shabbat (42 a): *א"ל ח"ו יחזיק אש או אש, פי"ב (פ"ב) ש"ס. א"ל פ"ד מ"ד*
א"ל ח"ו יחזיק אש או אש, פי"ב (פ"ב) ש"ס. א"ל פ"ד מ"ד. "It is permitted to put out a burning (or glowing) piece-of-ember of metal in a public place in order that no one should be hurt, but not a burning piece of wood (or coal ember)"

when there is specific intent for tempering, Tzeruf, is there a question of $\text{דבר} \text{ ו} \text{דבר}$ and דבר ; but when there is no intent for Tzeruf, there is no ~~no~~ guilt on account of these two. This is the first verdict quoted from Maimonides. The second passage, from דבר , complements the first by stating that where there is no intent for Tzeruf, but only to soften for purposes, let us say, of fitting it into a certain mold, he is guilty of a Toladah of דבר . This solution, which blends with the pattern of our analysis, is also mentioned by Rabbi Shlomo Gorontchek in an article printed in the Kislev, 5709, issue of the monthly "SINAI", published in Jerusalem under the auspices of the Ministry of Religion, and reprinted for Americans in the Tishrei, 5710, issue of "HAPARDES". Incidentally, Rabbi Gorontchek's conclusions that the lighting of the incandescent bulb on Shabbat is only an דבר and not an דבר , has brought on an avalanche of bitter criticism with even some veiled ^{at} high-dramatic consequences.

I mentioned the Av Melachah of דבר . The word literally means "cooking", and indeed the conventional form of cooking, the דבר , דבר , is the cooking of food. As for the Toladot of דבר , we read as follows in Tractate Shabbat (74 b): דבר . "He who melts tar (on Shabbat) is guilty because of (i.e. as a Toladah of) דבר ". The principle is thus firmly established that the Melachah of דבר is applicable not only to foods but to the heating of other materials as well. This principle is summarized very concisely by Maimonides (דבר): דבר . "The principle of the matter is that both the heating of a hard body in fire and or the hardening of a soft body through fire, leads to guilt because of דבר ". This is consistent with the statement of Maimonides previously quoted that the melting or heating-to-ember of metal, without intent to temper, is a

Toladah of *Sei N* .

Now, however, that we have disposed of the Avot ~~131~~ *M'lachot* of *ע'022 ד'N* , *ד'722* and *1120* as reasons for outlawing use of the incandescent bulb on the Shabbat, we are faced with the most cogent of all reasons to prohibit the lighting of the electric bulb *ל'N"71K9N* . Maimonides' verdict that heating a metal to an ember is a Toladah of *Sei N* , indicates that heating the filament of a bulb to incandescence would similarly be forbidden because of *Sei N* .

Rabbi Gorontchek, in the article mentioned, eliminates this difficulty in the following manner: *Sei N* , he says, is defined only as *71K9N 731N* , as coming as a result of fire, though indirectly. The incandescent filament, however, results not from fire, *ע'K* , but from the filament's resistance to the current, and the Av *M'lachah* of *Sei N* is therefore not applicable to the incandescent bulb.

We must, however, reject his contentions on the grounds that extension of his arguments lead us to perfectly ridiculous results. According to Rabbi Gorontchek, it would be perfectly permissible,

ל'N"71K9N , ~~on the Shabbat, the most elaborate chicken soup, xxxxx~~ to cook, on the Shabbat, the most elaborate chicken soup, as long as we use an electric stove. This is, of course, somewhat absurd, and is a hard pill to swallow. We must conclude that, on the contrary, any rise in temperature is *Sei N* regardless of the primary source of energy.

We remain, so far, with the thorny ~~lingering~~ fact that the lighting ~~is~~ of the incandescent bulb should be forbidden, even ~~לענין חילוקין~~ as a ~~דבר אסור~~. There is only one way left in which we can possibly find that the incandescence bulb is freed from the shackles of the culinary ~~דבר אסור~~.

~~דבר~~ was interpreted, according to Maimonides, as the causing of a perceptible elevation of temperature. When I heat the tar, as in the case mentioned in the Talmud, I apply the heat with the intention of raising the temperature which melts the tar so that I may use it for my purposes. Let me stress the fact that here I have special intention to raise the temperature of the tar, this temperature elevation being the necessary precursor to the melting process. With the incandescent bulb, however, the case is ~~entirely~~ entirely different, for here I have no interest at all in the temperature change of the filament, but rather my interest is centered solely on the radiation of light by the filament. Thus the two are different; for here my object is hot tar, and here the radiation of light. ^{And} ~~thus~~, since my intent is not to create heat, which is the reason for any possible ~~חילוקין~~ of ~~דבר~~ I am therefore not guilty of any ~~דבר אסור~~.

Of course, we are now faced with the problem which the ~~שאלה~~ raised on Maimonides concerning ~~הנזק~~ and ~~הנזק~~ which I promised to discuss and dispose of. The question was that Maimonides usually upholds the opinion of R. Yohudah that ~~הנזק~~ ~~הנזק~~ that if I accomplish a certain act involving ~~הנזק~~ A and B, and A is only accidental or incidental since my goal and purpose was the accomplishment of B, I am nevertheless guilty on both counts if A is a ~~הנזק~~ meaning that it is a necessary concomitant of B in the particular act I am accomplishing. Thus, heating a metal should be a ~~הנזק~~ of ~~הנזק~~ and ~~הנזק~~ even without intent of ~~הנזק~~ to temper; and similarly in our present case, although I do not intend to cause a ~~הנזק~~ rise in temperature, yet I should be guilty on the count of ~~דבר~~.

The difficulty can be overcome by the following reasoning: granted that the Ramban-Maimonides- will maintain that ע"פ חכמינו ז"ל with Rabbi Yehuda in the M'lechet Shabat as well as in other cases in the Perek other than Shabbat, where this principle is applicable. However, there is a limit to its application in the M'lechet of Shabbat. Those Telodot which in form bear very little resemblance to their Avot and whose sole relation to their Avot consists of a common ע"פ or intention to perform a certain constructive act, are entirely dissociated from their Avot when this common, mutual ע"פ is absent.

Thus, the ע"פ of the ז"ל on Maimonides' assignment of ע"פ to ע"פ and ע"פ is answered; as it is, the assignment of hot metal embers to ע"פ as a ע"פ is rather far-fetched, considering that one is an ^{oxidizing} ~~oxidative~~ and the other a non-oxidizing fire; and remembering the Yerushalmi which I mentioned at the very beginning, that it is doubtful whether at all a metal ember can be regarded as ע"פ. Yet we may say that Tzeruf is a Teladah of ע"פ and ע"פ—but only when the ע"פ or intent is expressly for Tzeruf; otherwise the similarity is too frail to be of any value.

The same will hold true of Maimonides' placement of ע"פ metal embers in the category of ע"פ. It is true that cooking food involves an elevation of temperature, and so does the heating of a metal, but the formal appearances of the two acts are vastly different, and we can regard the creation of a ע"פ as a ע"פ and the putting out of a ע"פ as a ע"פ, when and only when the ע"פ of the one who heats the metal is primarily to cause the temperature elevation. In the operation of the lighting of the incandescant bulb, however, my intent is to produce light and not to create heat. Since there is no common ground, and all logical as well as formal relations of my act to that of cooking ^{are} ~~is~~ absent, my action can no longer be regarded as ע"פ of ע"פ. Thus, there being no ע"פ on my action, we find that Maimonides' verdicts tally with the statement of ע"פ in Tractate Shabbat that ע"פ ע"פ ע"פ.

The only solution - the only acceptable solution - is that where the Toladah bears no, or very little, formal resemblance to its Av, the only similarity being a יין or intent to achieve one certain creative result, then when this intent is lacking, the Toladah loses its identity as such and is no longer forbidden because of relation to that particular Av. Since creating a permanent orifice or opening in an abcess is, as it is, rather distant in external form from ליגור סכין , from applying the last stroke of a hammer to a utensil, and is regarded as a Toladah of this ליגור סכין only because both involve a common intent of completion of a structure, then, when this common intent is lacking, since the intent is now only to force out the pus, he is not guilty of ליגור סכין .

This same principle we apply to the Toladot of דבר דבר , דבר and דבר , as was just shown. In fact, we can also extend this reasoning to cover the assignment of Tzeruf to ליגור סכין , which is Rashi's opinion. However, this is unnecessary.

I believe that a brief summary of what has been said so far is now in order.

The radiation of heat and light by the filament of the incandescent bulb was characterized as the equivalent of Tzeruf. Rashi's designation of Tzeruf as a Toladah of ליגור סכין is not applicable to the filament since nothing final has been accomplished as far as tempering of the filament is concerned. Maimonides' assignment of Tzeruf to דבר דבר and דבר is not applicable to the filament because there was no intent for Tzeruf. And though Maimonides usually does not require intent in M'lachot Shabbat to declare one guilty, yet, as was shown, without intent these particular cases are immune from the generalization. Rabenu Chananel's interpretation of Shmuel's dictum in the Talmud presented the only difficulty because, according to him, the creation of or extinguishing of a אש is a Toladah of דבר דבר and דבר regardless of intent.

Finally, we considered Maimonides' assignment of the producing and extinguishing of a אש או אור to העצם . Rabbi Gorontchek's contention that העצם is a result of fire only, not of electrically-caused heat, was discarded because of the consequences of such argument. Instead, we applied to העצם the same reasoning used on $\text{האש$ and האור , namely, that of lack of intent. These, then, are our fundamental considerations.

Now, for some self-criticism and evaluation. I believe that the conclusion that according to Rashi, who assigned Tzeruf to העצם the lighting of the bulb is not a מלאכה , is based on solid reasoning. Similarly, our treatment of Maimonides' opinion assigning Tzeruf to האש and האור seems correct in its analytic relation to the problem of the incandescent bulb. The only analysis than can be considered not too well fortified is that of Maimonides' opinion that Tzeruf is a Toladah of העצם . The main contention was that in such a case where the Toladah is, in external form, removed from the Av, then if we can demonstrate a lack of intent in the enactment of the Toladah, the Toladah is no longer forbidden on Shabbat. Now, while this argument was legitimate for our treatment of Maimonides on האש and האור , since Maimonides is there in complete agreement with the Talmud that basically it is permitted to produce or cool a metal ember, yet, with העצם the same reasoning is weak because our dismissal of any relation of a Toladah to its Av, in the absence of intent, where there is little formal relationship between the two, is not well fortified with distinct criteria. Who is to judge which Toladot are closely related, in external form, to their Avot, and which are entirely dissimilar? With האש this problem was obviated because of the Talmudic dictum that essentially there is no question of האש on metal embers, and Maimonides' emphasis on intent - ע"פ ה"א פ"ה - . With האש , while we could not use the same Talmudic dictum, since the Talmud there discusses האש and not העצם , yet we properly differentiated

between oxidizing and non-oxidizing fire which was supported by the Yerushalmi's analysis of לכד אש ביום , and the same differentiation was seen to account for the rationale of the Talmudic sanction of the extinguishing of metal embers on Shabbat. With שלשן , however, no such dichotomy is admissible, logically, and the Talmudic dictum concerning metal embers refers only to cooling them not producing them. We remain, with שלשן , only with our own impressions of what constitutes a weak formal relation between Toladah and Av. And while we may be justified (and we probably are) in an a priori evaluation of the Toladah-Av bond of שלשן as weak, and although the basic premise has been demonstrated by Maimonides' judgement on (כבודו ב' ב' נ) , puncturing of the abcess, nevertheless clear and indisputable criteria are lacking.

In conclusion, let me say that this entire discussion has been הלכות אש ביום , only theoretical and not intended as a final conclusion upon which we may base actual practice. I wish to repeat, that even if there should be general consent, which there is not, that there is no (אין אף ב' ב' נ) on the use of the incandescent bulb on the Shabbat, yet there remains a powerful בשרא ב' ב' נ fortified and strengthened by the force of לכד אש ביום , of tradition, practiced and sanctified in Jewish communities all over the world.